Perinatal and Maternal Mortality Review Committee

He matenga ohorere, he wairua uiui, wairua mutungakore

Health Quality & Safety Commission New Zealand
Kupu Taurangi Hauora o Aotearoa

Fourteenth Annual Report of the Perinatal and Maternal Mortality Review Committee | Te Pūrongo ā-Tau Tekau mā Whā o te Komiti Arotake Mate Pēpi, Mate Whaea Hoki

Reporting mortality and morbidity 2018 | Te tuku pūrongo mō te mate me te whakamate 2018

February 2021 | Hui-tanguru 2021

PMMRC. 2021. *Fourteenth Annual Report of the Perinatal and Maternal Mortality Review Committee | Te Pūrongo ā-Tau Tekau mā Whā o te Komiti Arotake Mate Pēpi, Mate Whaea Hoki: Reporting mortality and morbidity 2018 | Te tuku pūrongo mō te mate me te whakamate 2018.* Wellington: Health Quality & Safety Commission.

Published in February 2021 by the Perinatal and Maternal Mortality Review Committee, PO Box 25496, Wellington 6146, New Zealand

ISBN 978-1-98-859932-8 (Online)

The document is available online at: www.hqsc.govt.nz/our-programmes/mrc/pmmrc

Acknowledgements | He mihi

The Perinatal and Maternal Mortality Review Committee (PMMRC) is grateful to the following groups and individuals for their help in producing this report:

- the lead maternity carers and district health board (DHB) clinicians throughout New Zealand and the local coordinators[1] within each DHB who helped to collect data in this report
- the University of Otago's Mortality Review Data Group – particularly Joseph Hii, Kasia Szymanska, Nick Wolfe, Rachael Lawrence Lodge, and Stephen Chalmers, who established and maintain the perinatal and maternal mortality and morbidity websites and collated the data and produced the tables and figures in this report – and the epidemiology team of Dr Gabrielle McDonald, Glenda Oben, Associate Professor Sue Crengle (Kāi Tahu, Kāti Māmoe, Waitaha) and Dr Helen Paterson, who designed the analysis and prepared this report
- the PMMRC secretariat of the Health Quality & Safety Commission, which includes:
  - Kirsty Mitchell, the national coordinator of the PMMRC, who made the data set as complete and accurate as possible, and helped prepare this report
  - Sarah McQuillan Smith, who provided administrative support to the PMMRC and drafted the maternal morbidity appendix to this report
  - Jo Sorasio, who contributed to many aspects of report production
- the members of the PMMRC, who provided advice and guidance for the analysis
- the Maternal Mortality Review Working Group, who worked on the maternal mortality chapter
- the Neonatal Encephalopathy Working Group, who worked on the neonatal encephalopathy chapter
- Associate Professor Elana Curtis (Ngāti Rongomai, Ngāti Pikiao, Te Arawa), Public Health Physician and senior lecturer medical at Te Kupenga Hauora Māori, University of Auckland), Ms Deborah Pittman (Director of Midwifery, Auckland District Health Board) and Dr Vicki Culling (Perinatal & Infant Loss Educator), who peer reviewed an earlier version of the report – this final report does not necessarily reflect their views
- the staff at Analytical Services, Ministry of Health, who provided the denominator data.

Perinatal and Maternal Mortality Review Committee

The PMMRC members in 2020 are:

- Mr John Tait (Chair), obstetrician and gynaecologist, Chief Medical Officer, Capital & Coast DHB
- Associate Professor Max Berry, neonatologist, University of Otago, Wellington
- Dr Donna Cormack (Kāti Māmoe, Kāi Tahu), senior researcher and lecturer with joint positions at Te Kupenga Hauora Māori, Faculty of Medical and Health Sciences, University of Auckland and Te Rōpū Rangahau Hauora a Eru Pōmare, Department of Public Health, University of Otago, Wellington and Ngā Pou Arawhenua, Māori Caucus member
- Dr Robin Cronin, midwifery research and education, Auckland
- Dr Rose Elder (Deputy Chair), obstetrician and gynaecologist, Capital & Coast DHB
- Ms Louise Kuraia (Ngāpuhi, Ngāti Manu, Kōhatu Taka, Te Whakatōhea me Ngāi Tai ki Tōrere), Chief Advisor, Māori Crown Relations, Ministry of Health and Ngā Pou Arawhenua, Māori Caucus member
- Ms Claire MacDonald, midwifery advisor, New Zealand College of Midwives, midwife, Christchurch
- Ms Lisa Paraku (Ngāti Tamaterā, Ngāti Porou), Friends of Sands, Wellington Hutt Valley and hapori/community member; Kaiohu Matua Māori – Chief Advisor Māori Health, Whānau Āwhina Plunket; Sleep on Side project member; Whetūrangitia project member and Ngā Pou Arawhenua, Māori Caucus member
- Dr Sarah Tout, obstetrician and gynaecologist, Clinical Director Women's Health, Counties Manukau Health.

[1] For a list of the local coordinators, go to: www.hqsc.govt.nz/our-programmes/mrc/pmmrc/about-us/local-coordinators

Maternal Mortality Review Working Group

The Maternal Mortality Review Working Group members in 2020 are:

- Dr Sarah Wadsworth (Chair), obstetrician, Counties Manukau Health
- Dr Eileen Bass, physician, Hutt Valley DHB
- Dr Sue Belgrave, obstetrician and gynaecologist, Auckland DHB
- Dr Rose Elder, Deputy Chair, PMMRC
- Dr Anne Hart, anaesthetist, Counties Manukau Health
- Ms Beatrice Leatham (Ngāti Porou), midwife at Hauora Tairāwhiti; and lecturer at Auckland University of Technology
- Ms Jo McMullan, charge midwife manager, Capital & Coast DHB
- Dr Amy Spark, forensic pathologist, Palmerston North DHB
- Mr John Tait, Chair, PMMRC
- Dr Rexson Tse, forensic pathologist, Auckland DHB
- Dr Susan Tutty, general practitioner (GP) and GP liaison women's health, Counties Manukau Health
- Dr Lindsay Twiss, psychiatrist, Counties Manukau Health
- Ms Karen Whiterod, clinical nurse specialist, Mental Health and Addiction Service, MidCentral Health
- Ms Brigid Beehan, midwifery liaison New Zealand College of Midwives, midwifery clinical educator, Auckland University of Technology.

Neonatal Encephalopathy Working Group

The Neonatal Encephalopathy Working Group members in 2020 are:

- Dr Jutta van den Boom (Chair), neonatal paediatrician, Waikato DHB
- Dr Malcolm Battin (expert advisor), neonatal paediatrician, Auckland DHB
- Dr Kitty Bach, neonatal paediatrician, Auckland DHB
- Dr David Bailey, obstetrician and gynaecologist, Northland DHB
- Ms Karen Bennington, neonatal nurse practitioner, Capital & Coast DHB
- Dr Robin Cronin, midwifery research and education, Auckland DHB
- Ms Julie Richards, midwife, Nelson Marlborough DHB and Ara Institute of Canterbury
- Mr John Tait, Chair, PMMRC
- Dr Kristy Wolff, obstetrician and gynaecologist, Northland DHB.

Past members of Maternal Mortality Review and Neonatal Encephalopathy working groups

The PMMRC would also like to acknowledge the following individuals who had been a working group member during the production of this report.

Past Maternal Mortality Review Working Group members

- Dr Lesley Dixon, midwifery adviser, New Zealand College of Midwives, Christchurch
- Dr Liz MacDonald, perinatal psychiatrist, Canterbury DHB
- Dr Catherine Marnoch, obstetric physician, Waitematā DHB

Past Neonatal Encephalopathy Working Group members

- Ms Anne Jackson, neonatal nurse practitioner, Canterbury DHB
- Dr Suzanne Miller, principal lecturer, School of Midwifery, Otago Polytechnic and midwife, Wellington.

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Chair's introduction – Mr John Tait | Te kupu whakataki a te manukura – ko John Tait

Firstly, and most importantly, I would like to recognise the mothers and babies whose lives have been lost, and the families and whānau who bear the grief of losing their loved ones.

It is therefore with the upmost respect and recognition to those mothers and babies that I present the 14th annual report of the Perinatal and Maternal Mortality Review Committee (the PMMRC). The information presented in this report does not begin to demonstrate the lifelong heartache experienced following each one of the deaths included.

It is the aim and belief of the PMMRC that the production of this report will highlight and direct necessary, and urgent, service and system-level changes to reduce these deaths in Aotearoa/New Zealand.

I would like to thank the members of the PMMRC and working groups for their ongoing valuable contribution and commitment to improving the outcomes of all mothers and babies here in Aotearoa/New Zealand. Equally, I would like to acknowledge the significant work of local coordinators both in collecting information on these deaths and supporting the families and whānau through this extrordinarily difficult time. Without the generous contribution of your time and expertise it would not have been possible to produce this report.

I would also like to acknowledge that 2020 was International Year of the Midwife. It is also significant that August 2020 marks the 30th anniversary of the Nurses Amendment Act 1990, which reintroduced autonomous midwifery practice in Aotearoa/New Zealand. We acknowledge the commitment of midwives who are so deeply involved in supporting women, families and whānau through the loss of a child, while navigating their own professional and personal experience.

Each year, the PMMRC report investigates the epidemiology of perinatal mortality, maternal mortality and neonatal encephalopathy, and this year also includes a supplementary document on maternal morbidity (Appendix A). This year's report shows there has been a significant reduction in deaths overall (perinatal related deaths) in Aotearoa/New Zealand since 2007, as well as a significant reduction in fetal and early neonatal deaths. However, we must not be complacent.

While this report shows a decrease in these deaths, it is unacceptable that, yet again, it is babies of Māori, Pacific and Indian women who are over-represented within the data in this report. Also, it is of great concern to the PMMRC that this inequity could further increase as a result of barriers to accessing care during the response to the COVID-19 pandemic.

Wāhine Māori have statistically significant higher rates of maternal mortality than New Zealand European women. While there were no deaths by suicide in 2018, this remains the single largest cause of maternal death in Aotearoa/New Zealand, with suicide accounting for 44 percent of direct causes of maternal death since 2006.

Therefore, this year we challenge, and call to action, all of us working within the health system, health organisations and health practitioners, to prioritise and implement the recommendations of the PMMRC to ensure quality and equitable maternal and perinatal care is provided. This is desperately needed.

We can and must do better.

John Tait
Chair, Perinatal and Maternal Mortality Review Committee

Parents, whānau, families and communities Ngā mātua, ngā whānau me ngā hapori

E kī ana te kōrero, ahakoa he iti te matakahi, ka pakaru i a ia te tōtara, tihei mauri ora! - A little effort can achieve great things, I exhort the breath of life.

E aku nui, e aku rahi tēnā koutou katoa – special greetings to you all.

Ko wai au? I te taha o tōku māmā, he uri au no Aerana, County Antrim, Ballymena. I te taha o tōku pāpā, he uri au no Pare Hauraki ahau. Ko Pania (Lisa) Paraku tōku ingoa. Kia ora.

Once again, I am humbled to stand on behalf of bereaved whānau and families as a member of the Perinatal and Maternal Mortality Review Committee (the PMMRC). My role is to offer whānau and family voice to spaces that are typically clinical and data driven. This is no small feat.

My beautiful Jasmine Lee was born perfect and still in 2006, and she, along with her five siblings who did not enter the world of light, bring me to this mahi. My own experience has been heavy and varied within our health system and it is important that I stand with our PMMRC rōpū in pursuit of zero preventable deaths or harm for our pēpi and our māmā.

To my fellow bereaved parents, whānau and families, can I offer the following mihi to you: Ko te tūmanako ka nui te aroha ki a koe, ki a kōrua, ki a koutou me ōu whānau hoki, my love to you and to your family.

Ki ngā pēpi kua ngaro ki te pō, moe mai koutou. To our precious ones who have disappeared into the night, rest in peace. I acknowledge our precious babies, our grief and our journey.

I acknowledge those that stand with me in this mahi. My whānau whānui, my whānau at Sands, our Māori māmā rōpū, and Dr Vicky Culling who remains fearless in the collective pursuit of national bereavement care which offers equitable outcomes for our community – ngā mihi nui ki a koutou.

As a proud wāhine Māori standing with three mana wāhine, together with our ngākau Māori who make up the PMMRC, **our wero, our challenge,** has become louder, and more urgent. We can no longer ignore the fact that evidence-based recommendations of the PMMRC are not being prioritised and implemented, year after year after year.

On behalf, I ask – Why? Is this kaupapa not important enough, the health and wellbeing of our precious babies, their mothers? Why are our babies and mothers dying, when in some cases this is preventable? Why are my people the ones most affected, when we hold the right to equitable outcomes under Te Tiriti? Why are our cousins in the Pacific, our young mothers and our friends from India also those most affected?

I then ask – How? How can we engender a collective response that recognises shared space and shared value in order to implement the recommendations of the PMMRC, and where possible, ensure our most precious taonga, our babies and their mothers, can be in the world of light?

How do we dismantel and decolonise our system, standing strong in anti-racism and begin to heal the mamae of historical trauma? The answers have been gifted to us, within the *Hauora Report,*[2] within the Health and Disability System Review, in particular the alternate view,[3] and within our humble recommendations from the PMMRC.

[2] Wai 2575 Tribunal Report 2019. *HAUORA: Report on Stage One of the Health Services and Outcomes Kaupapa Inquiry*. URL: https://forms.justice.govt.nz/search/Documents/WT/wt_DOC_152801817/Hauora%20W.pdf

[3] See pp 173–6: https://systemreview.health.govt.nz/assets/Uploads/hdsr/health-disability-system-review-final-report.pdf

My elders have asked me... ‘If not you, then who?’ And now I ask the same of you. I share this whakataukī or proverb – *Ma pango, ma whero ka oti te mahi – collectively the work will be done.*

E hoa mā, he kaupapa nui tēnei. My friends, this is such an important kaupapa for us all.

To my fellow PMMRC whānau, e mihi maioha ki a koutou, many thanks for what you do. This is heavy mahi that must be done to achieve equitable outcomes, prevent our babies and mothers dying where we can, and to create a gentle path when our loved ones do die. You do this mahi with grace – I acknowledge you and on behalf, I thank you.

To my fellow bereaved parents, whānau and families we stand with and for you. Our wero and our recommendations inform the system of how to be better. We can do this, and we must, in honour of our precious babies and mothers who have gone before and in service to us all.

Ahakoa he mihi poto tēnei, he mihi aroha.

Nō reira, tēnā koutou, tēnā koutou, tēnā tātou katoa. Although this greeting is short, it is from the heart with love. Therefore, greetings to you all, greetings to us all.

Nāku iti noa, nā,

Lisa Paraku

Key findings for the maternity sector from the PMMRC's 14th annual report

Ngā kitenga matua e pā ana ki te rāngai whakawhānau i te pūrongo ā-tau 14 o te PMMRC

Perinatal and Maternal Mortality Review Committee
He matenga ohorere, he wairua uiui, wairua mutungakore

Our Vision

Te mahi tahi puta noa i te pūnaha kia kore rawa ai e mate, e whara ngā māmā me ā rātau pēpi, whānau hoki mai i ngā mate, wharanga rānei ka taea te ārai.

Working together across the system towards zero preventable deaths or harm for all mothers and babies, families and whānau.

Perinatal death prevention

Congenital abnormalities are the leading cause of death in babies.

Sadly, in 2018

604

babies died

from 20 weeks of pregnancy until 27 days of age

The PMMRC continues to ask for bread and flour to be supplemented with **folic acid**, as this has been shown to reduce the number of neural tube defects (a type of congential anomaly).

District health boards (DHBs) and primary care providers to provide active navigational support for women to find and register with their lead maternity carer with minimal delay.[1]

Routine early antenatal care should meet clinical and cultural needs and should include attention to modifiable risk factors such as supporting whānau to become smokefree and screening for other health conditions such as diabetes, sexually transmitted infections and urinary tract infections.

After-death care

Around 30% of precious babies who died had a full post-mortem (autopsy) examination afterwards, which is the investigation that provides the fullest possible information for whānau/family about why their baby died.

No woman who chose a full post-mortem examination regretted her decision. 10% of women who declined later regretted the loss of opportunity to understand more about their baby's death.[2]

Neonatal encephalopathy

Around three-quarters of babies with neonatal encephalopathy are cooled to help reduce brain damage. To be most effective, **cooling should start with 6 hours of birth** – this only happened for 80% of babies who received cooling.

Recognise
the baby who will benefit

Communicate
with a tertiary centre

Cool
promptly when appropriate

To address the social and cultural determinants of health, the PMMRC supports:

- cultural safety education for clinicians, which is essential
- the recommendations of *He Mana Kōmihana Whakae Tino Rangatiratanga Pou Tarawhao | Māori Commissioning – An alternate view of the New Zealand Health and Disability System Review* final report[3]
- the recommendations of the Welfare Expert Advisory Group report, *Whakamana Tāngata*.[4]

The PMMRC insists that:

- Government should fund the provision of specific maternal mental health services
- the Ministry of Health should resource the co-design of a national perinatal bereavement pathway.

Maternal death

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Tragically, on average nearly 10 women die each year either during pregnancy, or soon after the baby is born. Post-mortem helps us to understand how we can improve care in the future.

The PMMRC recommends that a Maternal and Infant Mental Health Network is funded by the Ministry of Health and includes these areas of priority:

- **a stocktake of current mental health services** available across Aotearoa New Zealand for pregnant and recently pregnant women to identify both the strengths of services and gaps or inequity in current services and skills in the workforce
- **a national pathway for accessing maternal mental health services**, including:
  - culturally safe services, including access to kaupapa Māori mental health and maternity services and the provision of appropriate screening
  - care for wāhine/women who are or have been in the mental health system
  - communication and coordination.

1. Makowharemahihi C, Lawton BA, Cram F, et al. 2014. Initiation of maternity care for young Maori women under 20 years of age. *NZMJ* 127(1393): 52–61.
2. Cronin RS, Li M, Wise M, et al. 2018. Late stillbirth post mortem examination in New Zealand: Maternal decision-making. ANZJOG 58(6): 667–73. URL: https://obgyn.onlinelibrary.wiley.com/doi/10.1111/ajo.12790.
3. See pp 173–6 of https://systemreview.health.govt.nz/assets/Uploads/hdsr/health-disability-system-review-final-report.pdf.
4. Welfare Expert Advisory Group Report. 2019. *Whakamana Tāngata: Restoring dignity to social security in New Zealand.* Wellington: Welfare Expert Advisory Group Report. URL: www.weag.govt.nz/weag-report.

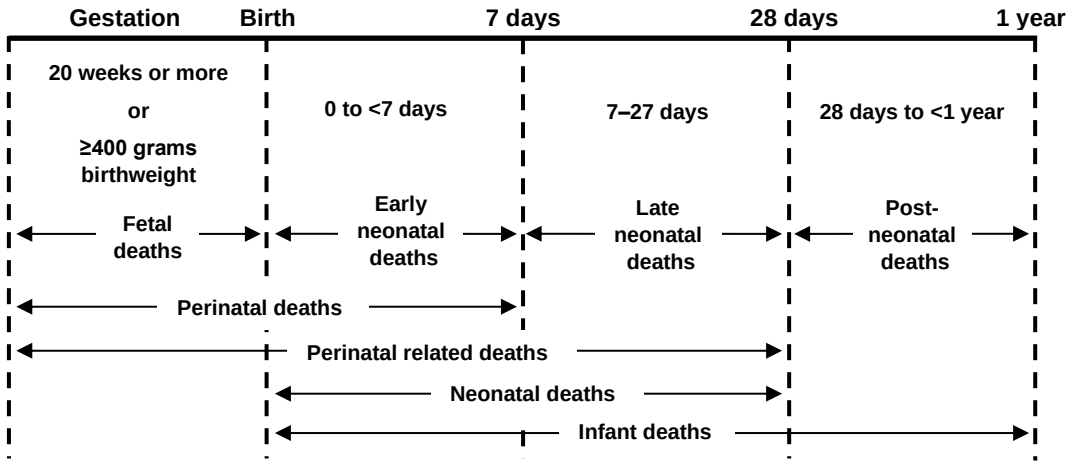
Health Quality & Safety Commission New Zealand
Kupu Taurangi Hauora o Aotearoa

New Zealand Government

Executive summary | Whakarāpopototanga matua

This monitoring report outlines some of the trends in mortality in babies and mothers, and serious morbidity from neonatal encephalopathy. Deaths are usually multifactorial in nature – usually a death has more than one cause. The aim of this work is to monitor trends and look at systems issues that could be modified to prevent future deaths.

Definitions used by the PMMRC – perinatal related and infant deaths



Source: Adapted from New Zealand Health Information Service (2007) and Ministry of Health (2010).[4]

Perinatal mortality

Since 2007, when the Perinatal and Maternal Mortality Review Committee (PMMRC) began collecting data, deaths overall (perinatal related deaths) have reduced significantly. Perinatal mortalities (fetal and early neonatal deaths) decreased significantly among babies of New Zealand European mothers, but not for any other ethnic group.

The decrease in the rate of stillbirths was largely driven by a reduction in stillbirths in babies of New Zealand European women. There was also a statistically significant decrease in stillbirths for babies of Middle Eastern, Latin American, or African (MELAA) women, but no significant change occurred in any other ethnic group.

The rates of terminations of pregnancy and rates of neonatal mortality overall showed no statistically significant changes.

Deaths due to congenital anomalies remain the leading cause of death overall. The rates of perinatal-related mortality in the peripartum period due to hypoxia have decreased significantly since 2007.

Our results show that certain groups are at higher risk of serious adverse outcomes. These include babies of Māori, Pacific and Indian mothers; and babies of mothers aged less than 20 years. Mortality also increased somewhat for babies of mothers aged 40 years and over.

Mortality rates varied significantly by the level of socioeconomic deprivation in the areas where mothers lived, as measured by the New Zealand Index of Deprivation 2013 (NZDep2013). Those mothers living in the most deprived areas (quintile 5) were statistically significantly more likely to lose a baby from stillbirth, neonatal death and perinatal related death overall, compared with those living in any other quintile. This variation in mortality rates by deprivation was most marked for deaths due to spontaneous preterm labour or rupture of membranes.

[4] New Zealand Health Information Service. 2007. *Fetal and Infant Deaths 2003 & 2004*.Wellington: Ministry of Health.
Ministry of Health. 2010. *Fetal and Infant Deaths 2006*. Wellington: Ministry of Health.

Our data suggest that the National Maternity Collection (MAT) data set[5] underestimates maternal body mass index (BMI). However, regardless of whether we use MAT or PMMRC data, the mortality rates from stillbirth, neonatal death and perinatal related death overall increase with increasing maternal BMI.

Rates of mortality from stillbirth, neonatal death and perinatal related death overall were higher for babies of women who were smoking at the time of registration with a lead maternity carer (LMC) compared with those who were not. Smoking is a significant and modifiable risk factor of perinatal loss. When women are appropriately supported to quit, outcomes clearly improve in relation to some risk factors for mortality, such as spontaneous preterm birth and small for gestational age. Effective smoking cessation programmes do exist, and investment in appropriate programmes designed to reduce this modifiable risk factor should be supported.

Mortality rates were higher for small for gestational age babies than those who were appropriate or large for gestational age. In particular, babies with a birthweight in the 5th customised centile group or below have substantially higher mortality rates than the other centile groups.

Overall, around 41% of babies who died had optimal investigation into the cause(s) of their death, meaning that their death was investigated through post-mortem, karyotype confirming chromosomal abnormality or clinical examination or investigation confirming the diagnosis. Around half of terminations of pregnancy had 'optimal' investigation, whereas under 40% of stillbirths and neonatal deaths did. There were some variations between prioritised ethnic groups in both the rate of offering of post-mortem and the rate of uptake if offered.

Local review of cases showed that a number of deaths had potentially avoidable aspects. Review findings indicated contributory factors were present in just under one quarter of perinatal related deaths. Barriers to access and/or barriers to engagement with care were the most common type of contributory factor; others that the reviews considered were organisational and/or management factors, and personnel factors.

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.[6]

The rate of NE cases per 1,000 term births fluctuated from year to year, with a high of 1.38 per 1,000 live births in 2012 and a low of 1.00 in 2014. Between the years 2010 and 2018, the rate has not shown a statistically significant trend up or down.

Babies of primiparous women had the highest rates of NE, and those rates were statistically significantly higher than for babies of multiparous women regardless of parity. The rates of NE varied by gestational age at birth, with higher rates for those at the extreme ends of term pregnancies. Babies with lower birthweight had higher rates of NE; those under 2,500g had the highest rate.

Overall, 77% of babies had cooling therapy, with the proportion slightly higher for babies with moderate NE. The rates of cooling were the same for babies of Māori mothers as for those with New Zealand European mothers.

Mortality was much higher in babies with severe NE, among whom 60% died, compared with 2% of babies with moderate NE.

[5] The MAT data set is the primary source of information for publicly funded maternity care in Aotearoa/New Zealand.

[6] Nelson KB, Leviton A. 1991. How much of neonatal encephalopathy is due to birth asphyxia? *American Journal of Diseases of Children* 145(11): 1325–31.

Maternal mortality

Maternal death is the death of a woman while pregnant or within 42 days of termination of pregnancy (miscarriage, termination[7] 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.

The PMMRC collected information on a total of 126 maternal deaths during pregnancy or within 42 days postpartum over the period 2006–2018, as well as on another 28 coincidental maternal deaths. The number of maternal deaths has fluctuated substantially over this time. Although the trend is not statistically significant, the total number of maternal deaths followed a general downward pattern over the study period.

The incidence of maternal death increased with age, with the highest rates among those aged 40 years and over (39.2 per 100,000 maternities). In our analysis of the incidence of maternal deaths by prioritised ethnic group, wāhine Māori had statistically significantly higher rates than New Zealand European women. There was a general pattern of increasing mortality with increasing deprivation, when measured by NZDep2013. However, this pattern was not statistically significant (p=0.11).

There were 68 direct[8] and 50 indirect[9] maternal deaths[10] over the study period 2006–2018 inclusive. The single largest cause of maternal death in Aotearoa/New Zealand was suicide, which accounted for 30 deaths during this time (44% of direct causes). The next leading cause was amniotic fluid embolism (AFE), which caused 14 deaths (11.1%).

Suicide continues to be the leading cause of maternal death in Aotearoa/New Zealand and particularly affects wāhine Māori. PMMRC strongly recommends making targeted investment in maternal mental health a key priority for funding by the Ministry of Health. Maternal wellbeing, the development of culturally appropriate maternal screening tools and treatment for women and their babies continue to be areas in urgent need of investment, alongside addressing the wider societal drivers of suicide. Investment should prioritise populations who would benefit the most, such as ngā māma Māori, and be informed by research findings about when women most need that support.

The COVID-19 outbreak in 2020 has impacted on maternity care in a number of ways. Supply of contraceptives has been and continues to be unreliable.[11] Whānau were not able to attend hospital births and the maternity sector was challenged with the need to care for people giving birth while following recommendations to stay out of hospital as much as possible. We will take these conditions into account when examining 2020 data and reporting on them in 2022.

[7] Termination of pregnancy is the interruption of an ongoing pregnancy (whether the baby was stillborn or live born). This report includes only termination of pregnancy from 20 weeks' gestation in the perinatal section. For maternal mortality, a maternal death following termination of pregnancy at any gestational age is included.

[8] Direct maternal deaths are those that result from obstetric complications of the pregnant state (pregnancy, labour or puerperium) from interventions, omissions or incorrect treatment or from a chain of events resulting from the above.

[9] Indirect maternal deaths are those that result 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.

[10] For another eight maternal deaths, the cause is as yet unknown.

[11] PHARMAC. 2020. Oral contraceptives: Supply updates. Wellington: PHARMAC Te Pātaka Whaioranga. URL: https://www.pharmac.govt.nz/information-for/enquiries/oral-contraceptives-supply-updates/ (accessed 18 August 2020).

1 Challenge | Wero

Year after year, the Perinatal and Maternal Mortality Review Committee (PMMRC) reports show inequity continues and no significant progress is being made to reduce mortality and morbidity for whānau Māori, Pasifika families, Indian families and those living in areas of high deprivation. Now the COVID-19 pandemic and its response are likely to amplify those shortcomings.

While PMMRC acknowledges the hard work and determination of the sector and its contribution to a significant reduction in perinatal death overall, the inequities that remain are significant and unacceptable.

Therefore, this year, our wero, our challenge to you – the decision-makers and leaders of the health system, and all health organisations and practitioners – is to give priority to implementing the recommendations of the PMMRC.

Implementation of the PMMRC recommendations remains critical to achieving high-quality, equitable maternal and perinatal care and outcomes.

Achieving such care and outcomes will require you to:

- **meaningfully honour the health sector's responsibilities to Te Tiriti o Waitangi**
- **strengthen your focus and prioritisation to accelerate the implementation of PMMRC recommendations, with the aim of achieving equitable outcomes for Māori mothers and babies.**

Urgent action, centred in equity, is required to help reduce the loss and grief that families and whānau are experiencing as a result of preventable death in Aotearoa/New Zealand.

Since 2007, the PMMRC has made numerous recommendations to drive service- and system-level change. Yet, despite the health sector's commitment to it, the data show that this change has only benefited some groups and remains elusive for many who have greater need.

We all have a responsibility to the women and their babies, families and whānau whose lives and deaths are represented in the PMMRC data to promptly implement recommendations to reduce the perinatal and maternal deaths that are preventable and avoidable. In 2018 alone, reviews identified preventable contributory factors that impacted on 79 perinatal related deaths.

We absolutely should be better supporting these parents and whānau, as they are bearing the grief of the death of their baby […] ~ Dr Vicki Culling, perinatal and infant loss educator

Strengthening your focus and prioritisation

Of utmost concern to the PMMRC are the frequent barriers to accessing care, differential quality of maternity of care, stagnant rates of perinatal death and alarmingly higher rates of maternal suicide that Māori whānau are experiencing. We ask and challenge you all to prioritise recommendations that create a Tiriti-compliant system where it is safe for Māori women to give birth in Aotearoa/New Zealand.

Monitoring by ethnicity for improvement analysis

To meet this challenge, district health boards (DHBs) must invest resource into monitoring key maternity indicators for Māori and other ethnic groups to identify variations between them, and then identify areas for quality improvement based on this analysis. Quality improvement projects must be co-developed so that models of care meet the needs of these populations.

National consensus in the care of preterm births

It is important that DHBs follow the national consensus statement specifically on the care of mother and baby(ies) at periviable gestations[12] published in 2019.

Preterm birth continues to be the leading cause of neonatal death, and Māori babies are over-represented in these deaths. Care for these babies needs to occur in one of Aotearoa/New Zealand's six tertiary neonatal centres, meaning more than one third of families will need to access care away from home. The sector must support whānau and families to access this care, including with transport and accommodation for whānau from outside the tertiary neonatal centres.

Cultural safety in practice

All health organisations must require staff to practise cultural safety standards. Action is needed to address the lack of consideration of cultures and religions outside of western and Christian norms.

Calling on the Ministry of Health

The Ministry of Health plays a critical role in making resources available to support health practitioners, health organisations and district health boards to implement these recommendations.

In upholding its responsibilities under Te Tiriti o Waitangi, the Ministry of Health needs to ensure that Māori have an equal voice in decision-making and the development of health policy, process and practice in order to achieve equitable health outcomes. The Ministry also has a significant role to play in working with, and influencing, other government agencies to do the same, and in this way accelerate progress across the wider determinants of health.

It would be misleading to conclude that failures in the health system are the reason for all the disparities. Sub-standard housing, poor education, unemployment, low incomes, cultural alienation, alienation from land, and frank discrimination have all contributed to the problem. In that respect, a whole-of-society remedy must be sought ~ Sir Mason Durie

The PMMRC calls on the Ministry of Health to prioritise:

- the need for investment in maternal and infant mental health
- the development of a high-quality, appropriate and equitable national perinatal bereavement pathway
- aligning ethnicity data collected and included in all data sets with the *Health Information Standards Organisation (HISO) Ethnicity Data Protocols* (Ministry of Health 2017).[13]

[12] New Zealand Child and Youth Clinical Networks. 2019. *National Consensus Statement on the care of mother and baby(ies) at periviable gestations*. URL: https://www.starship.org.nz/guidelines/new-zealand-consensus-statement-on-the-care-of-mother-and-baby-ies-at/ (accessed 24 November 2020).

[13] Ministry of Health. 2017. *HISO 10001:2017 Ethnicity Data Protocols*. Wellington: Ministry of Health.

Working together to make change

To support the implementation of the recommendations of the PMMRC, Appendices B–F list recommendations that are yet to be fully implemented.

Approximately half of the recommendations made over the past 13 years are yet to be fully implemented. Much work remains to be done.

The recommendations have been grouped into five key areas: health practitioners, DHBs, colleges and regulatory bodies, government and research recommendations. Our aim in taking this approach is to make it easier for you to understand where you can make an impact.

We hope that this information also enables you to support the work of your colleagues and organisations and that, in owning these responsibilities together, we can make the greatest and most valuable impact towards changing the outcomes of women and their babies, families and whānau.

Ngā mihi nui ki a koutou katoa.

Mr John Tait
Chair, Perinatal and Maternal Mortality Review Committee

2 Methods | Ngā tikanga mahi

See *Methods and definitions for Perinatal and Maternal Mortality Review Committee (PMMRC) reporting* document, available at: www.hqsc.govt.nz/our-programmes/mrc/pmmrc/publications-and-resources/publication/4210.

Definitions used by the PMMRC

Fetal death is the death of a fetus at 20 weeks' gestation or beyond (≥20 weeks) or weighing at least 400g if gestation is unknown. Fetal death includes stillbirth and 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.

Neonatal death is the death of any baby showing signs of life at 20 weeks' gestation or beyond or weighing at least 400g 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 on the sixth day of life. **Late neonatal death** is a death that occurs between the seventh day and midnight of the 27th day of life.

Perinatal mortality is fetal and early neonatal death from 20 weeks' gestation (or weighing at least 400g if gestation is unknown) until midnight of the sixth day of life.

Perinatal related mortality is fetal deaths (including terminations of pregnancy and stillbirths) and neonatal deaths (up to midnight of the 27th day of life) per 1,000 total babies born at 20 weeks' gestation or beyond, and weighing at least 400g if gestation was unknown.

A **maternal death** is the death of a woman while pregnant or within 42 days of termination 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. It does not include accidental or incidental causes of death of a pregnant woman (coincidental deaths).

Maternities are all live births and all fetal deaths at 20 weeks' gestation or beyond or weighing at least 400g if gestation is unknown. The maternal mortality ratio is calculated per 100,000 maternities.

Neonatal encephalopathy (NE) is a clinically defined syndrome of disturbed neurological function within the first week of life, manifested by difficulty in initiating and maintaining respiration, depression of tone and reflexes, subnormal level of consciousness and often seizures.

Ethnic comparisons

Throughout the report, we make comparisons between prioritised ethnic groups. At times, we compare outcomes for babies of Māori women with outcomes for babies of New Zealand European women. Te Tiriti o Waitangi underlies the health sector's obligations to Māori, and upholds Māori rights to monitor the Crown to ensure that it meets these responsibilities and that Māori have equitable outcomes in the health sector. Adding to the Tiriti-based Māori rights are the broader rights of women and children to equitable outcomes regardless of their ethnicity. In presenting comparisons between different ethnic groups, we are not commenting on the deficits of any particular ethnic group, but rather are highlighting the deficits of a society that creates, maintains and tolerates these differences.

Comparison between mother and baby ethnicity

The ethnicity of both mother and baby is important for reporting on mortality. As many of the determinants of health for a baby relate to their mother, in many instances it is appropriate to examine maternal ethnicity so that we can explore areas for improvement and intervention. In addition, to understand the burden of mortality for different ethnic groups, we need to examine mortality by baby ethnicity, which may differ from maternal ethnicity.

Table 2.1 and Table 2.2 show how the numbers in individual ethnic groups can differ depending on the data sources. 'PMMRC' data are those that the PMMRC collects directly through our Rapid Reporting Forms, following the death of a baby so they relate only to babies who have died (numerator). 'MAT' data are those data that are in the National Maternity Collection, which contains data on pregnancy, delivery and babies. This source includes data on most babies born in Aotearoa/New Zealand (denominator population). Table 2.1 shows that for maternal ethnicity, there are no substantial differences between the two data sources. In contrast, Table 2.2 shows that for baby ethnicity, substantial amounts of data are missing from MAT, with the overall effect of producing a large proportion (51%) of missing cases. This unfortunately makes the baby ethnicity data in MAT too unreliable to use.

Table 2.1: Prioritised maternal ethnic group by PMMRC and MAT data sources for perinatal related deaths 2007–2018

2007–2018	PMMRC	MAT
Prioritised maternal ethnic group		
Māori	2,056	2,059
Pacific peoples	1,037	1,072
Indian	479	409
Other Asian	599	566
MELAA	150	173
NZ European	3,012	2,648
Other European	466	605
Other	<3	-
Unknown	<3	6
Total	**7,802**	**7,538**

MELAA = Middle Eastern, Latin American, or African.

Sources: Numerator: PMMRC's perinatal data extract 2007–2018; Denominator: MAT data 2007–2018.

Table 2.2: Prioritised baby ethnic group by PMMRC and MAT data sources for perinatal related deaths 2007–2018

2007–2018	PMMRC	MAT
Prioritised baby ethnic group		
Māori	2,444	1,084
Pacific peoples	1,058	531
Indian	494	256
Other Asian	592	282
MELAA	155	80
NZ European	2,799	1,306
Other European	251	218
Other	-	-
Unknown	9	3,781
Total	**7,802**	**7,538**

MELAA = Middle Eastern, Latin American, or African.

Sources: Numerator: PMMRC's perinatal data extract 2007–2018; Denominator: MAT data 2007–2018.

National Maternity Collection (MAT)

MAT is based on two sources:

- primary maternity services provided under section 88 of the New Zealand Public Health and Disability Act 2000, which is sourced from lead maternity carer (LMC) claims for payment
- the National Minimum Dataset (NMDS), which contains information on inpatient and day patient health events during pregnancy, birth and the postnatal period for the mother and baby.

While MAT should have a record of most births that occur in New Zealand, either through the NMDS for those who give birth in hospital or through LMC claims, antenatal data have not routinely been uploaded for women who are receiving care from providers other than LMC midwives, general practitioners (GPs) or

obstetricians. In particular, women who receive antenatal care through their DHB may not have their antenatal data entered into MAT. Some DHBs, such as Counties Manukau, routinely provide antenatal care. Due to a technical issue, antenatal data from DHBs may not be uploaded into MAT, even when the DHB provides them. The Ministry has developed the Health Information Organisation (HISO) Maternity Care Summary Standard in conjunction with stakeholders for the purpose of gaining consistent information from maternity service providers. These providers include DHBs, which have been advised to update unsupported maternity software as a matter of urgency in order to improve the consistency and availability of these data. In our 13th report, we presented an approximation of the effect of this approach on data reported: using the examples of smoking status and body mass index, we showed substantial differences between those women whose antenatal records are in MAT and those whose records are not.[14]

Perinatal Society of Australia and New Zealand death classifications

All perinatal deaths are classified in accordance with either the Perinatal Society of Australia and New Zealand (PSANZ) Perinatal Death Classification (PDC) or the PSANZ Neonatal Death Classification (NDC). In 2017, PSANZ revised these death classification systems to include new subcategories,[15] which were subsequently implemented in New Zealand in 2018.

We have classified the deaths presented in this report using the revised 2017 version of PSANZ death classification systems. This includes deaths from 1 January 2018. Deaths prior to 2018, which were originally classified using the 2007 version, have been reclassified according to the 2017 revision.

[14] PMMRC. 2019. *Te Pūrongo ā-Tau Tekau mā Toru o te Komiti Arotake Mate Pēpi, Mate Whaea Hoki | Thirteenth Annual Report of the Perinatal and Maternal Mortality Review Committee: Te tuku pūrongo mō te mate me te whakamate 2017 | Reporting mortality and morbidity 2017*. Wellington: Health Quality & Safety Commission. URL: https://www.hqsc.govt.nz/assets/PMMRC/Publications/13thPMMRCreport/13thPMMRCAnnualReportWebFINAL.pdf (accessed 18 September 2020). p 16.

[15] For a comparison of the PSANZ death classification systems, see the Stillbirth and Neonatal Death Alliance (PSANZ-SANDA) website. URL: https://sanda.psanz.com.au/assets/Uploads/Appendix-U-Changes-in-this-version-of-the-classifications.pdf (accessed 13 May 2020).

3 Perinatal mortality | Te mate pēpi

Aotearoa/New Zealand overview and key findings

Since 2007, when the PMMRC started collecting data, there is some evidence of a statistically significant decrease in deaths overall (perinatal related mortality), and in the rates of perinatal (fetal and early neonatal) mortalities. Overall, there has been a statistically significant decrease in the rate of stillbirths[16] but no reduction in neonatal mortality (Figure 3.1). Table 3.1 presents the rates of perinatal death for the period 2009–2018.

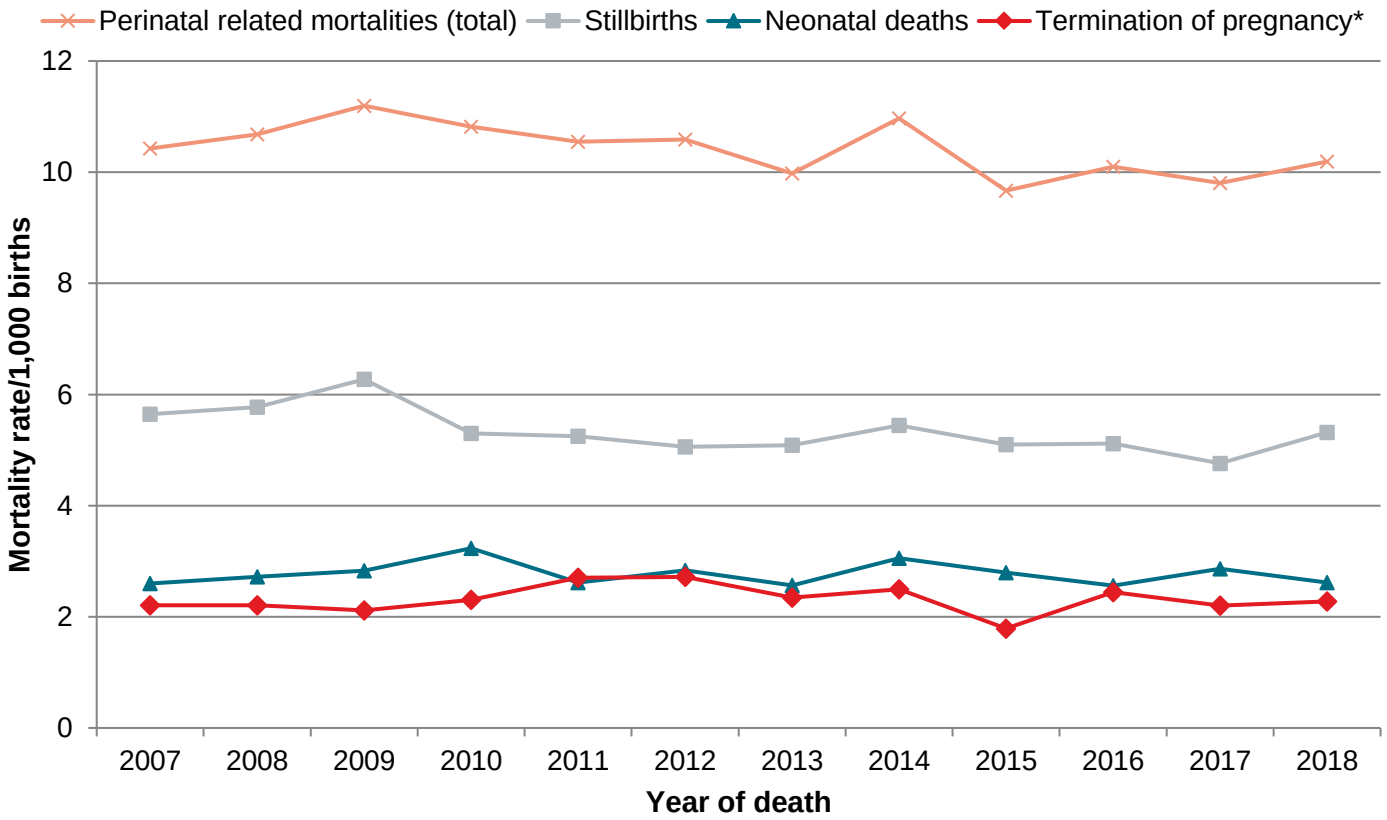
To examine the population groups that benefited from the improvements that occurred, we undertook further analyses by prioritised ethnic group. The main reason why perinatal related mortalities and perinatal mortalities fell over the period 2007–2018 was that mortality in babies of New Zealand European mothers fell by a statistically significant rate. Other ethnic groups had no statistically significant change in rates of perinatal related mortalities and in perinatal mortalities.

Over the period 2007–2018, stillbirths in babies of both New Zealand European and Middle Eastern, Latin American, or African (MELAA) mothers decreased by a statistically significant rate, but the rate of stillbirths did not change in other groups. Similarly, there was a statistically significant decrease in fetal deaths for New Zealand European mothers, but not for any other ethnic groups.

Between the years 2007 and 2018, there were no significant changes in terminations of pregnancy or in neonatal deaths for any of the ethnic groups.

The mortality rates for babies of women of Māori, Pacific, Indian or Other European groups did not change to a statistically significant level in any of the above categories.

Figure 3.1: Perinatal related mortality rates (per 1,000 births) using New Zealand definitions by year 2007–2018



* In this report, 'Termination of pregnancy' refers to the interruption of an ongoing pregnancy from 20 weeks' gestation onwards.
Sources: Numerator: PMMRC's perinatal data extract 2007–2018; Denominator: MAT births 2007–2018.

[16] Chi-squared test for trend p=0.002

Table 3.1: Summary of New Zealand perinatal related mortality rates using New Zealand definition (≥20 weeks or ≥400g if gestation is unknown) by year 2009–2018

	n									
	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Total births	65,203	65,449	63,243	63,286	60,137	60,080	59,783	60,606	60,478	59,258
Fetal deaths (terminations of pregnancy and stillbirths)*	547	498	503	492	447	477	412	458	421	450
Terminations of pregnancy	138	151	171	172	141	150	107	148	133	135
Stillbirths	409	347	332	320	306	327	305	310	288	315
Early neonatal deaths <7 days	137	165	139	142	122	150	131	123	137	116
Late neonatal deaths 7–27 days	46	45	25	36	31	32	35	31	35	38
Neonatal deaths <28 days#	183	210	164	178	153	182	166	154	172	154
Perinatal mortalities+	684	663	642	634	569	627	543	581	558	566
Perinatal related mortalities^	730	708	667	670	600	659	578	612	593	604
Perinatal mortalities excluding lethal and terminated fetal abnormalities•	513	463	443	440	414	447	397	413	404	414
Perinatal related mortalities excluding lethal and terminated fetal abnormalities•	544	494	459	462	432	466	415	434	429	440
	Rate									
	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Total births										
Fetal deaths (terminations of pregnancy and stillbirths)*	8.39	7.61	7.95	7.77	7.43	7.94	6.89	7.56	6.96	7.59
Terminations of pregnancy	2.12	2.31	2.70	2.72	2.34	2.50	1.79	2.44	2.20	2.28
Stillbirths	6.27	5.30	5.25	5.06	5.09	5.44	5.10	5.12	4.76	5.32
Early neonatal deaths <7 days										
Late neonatal deaths 7–27 days										
Neonatal deaths <28 days#	2.83	3.23	2.61	2.83	2.56	3.05	2.80	2.56	2.86	2.62
Perinatal mortalities+	10.49	10.13	10.15	10.02	9.46	10.44	9.08	9.59	9.23	9.55
Perinatal related mortalities^	11.20	10.82	10.55	10.59	9.98	10.97	9.67	10.10	9.81	10.19
Perinatal mortalities excluding lethal and terminated fetal abnormalities•	7.87	7.07	7.00	6.95	6.88	7.44	6.64	6.81	6.68	6.99
Perinatal related mortalities excluding lethal and terminated fetal abnormalities•	8.34	7.55	7.26	7.30	7.18	7.76	6.94	7.16	7.09	7.43

* Fetal death rate per 1,000 babies born (includes terminations and stillbirths).

\# Neonatal death rate per 1,000 live born babies.

\+ Fetal deaths and early neonatal deaths per 1,000 babies born.

^ Fetal deaths and early and late neonatal deaths per 1,000 babies born.

• Lethal and terminated fetal abnormalities are all perinatal related deaths with Perinatal Society of Australia and New Zealand Perinatal Death Classification (PSANZ-PDC) of congenital anomaly, and neonatal deaths with PSANZ Neonatal Death Classification (PSANZ-NDC) of congenital anomaly.

Sources: Numerator: PMMRC's perinatal data extract 2009–2018; Denominator: MAT births 2009–2018.

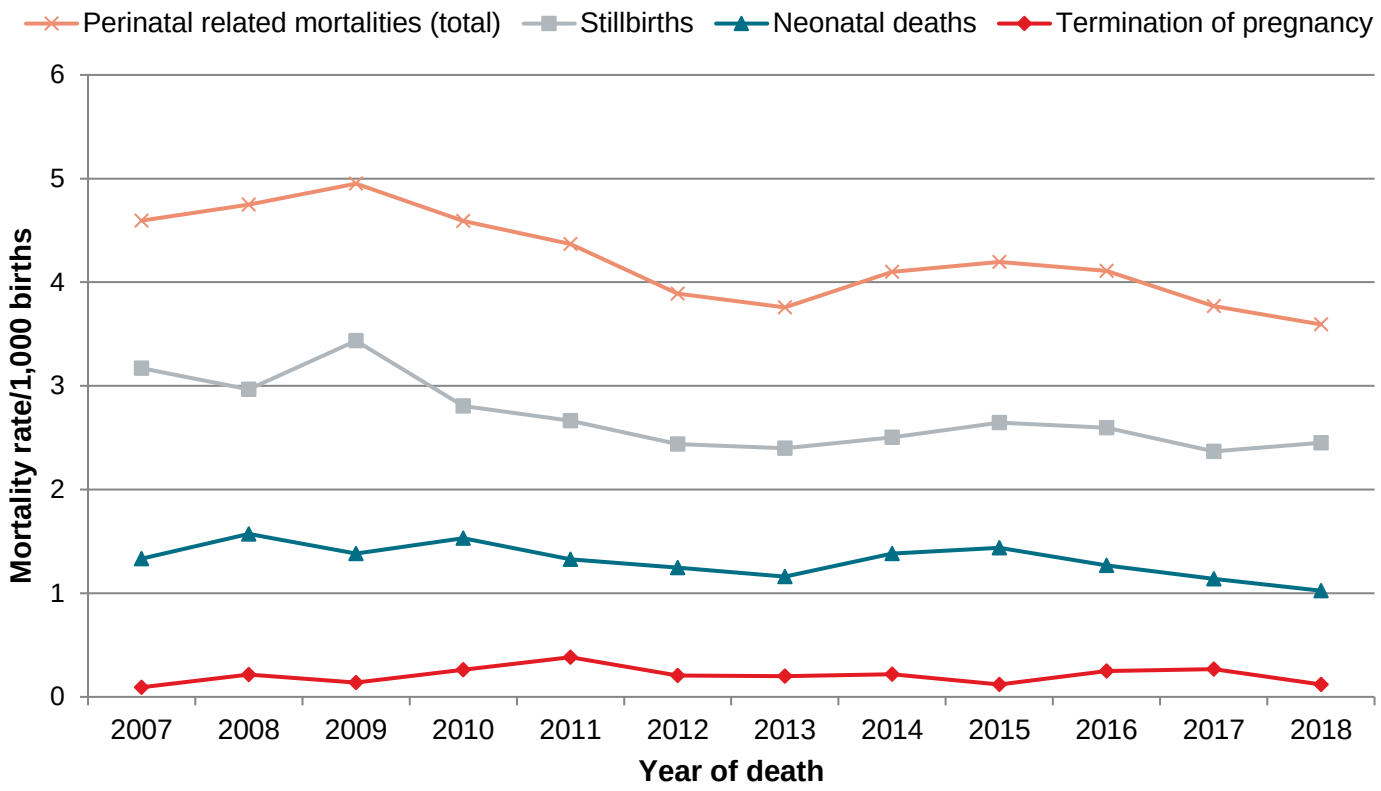
Using international definitions, there is strong evidence of a statistically significant decrease in fetal deaths, stillbirths, perinatal mortalities and perinatal related mortalities over the period 2007–2018 (Figure 3.2). Table 3.2 presents the mortality rates using international definitions for the period 2009–2018.

Table 3.2: New Zealand perinatal related mortality rates (per 1,000 births) using the international definition (≥1,000g or ≥28 weeks if birthweight unknown) by year 2009–2018

	n									
	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Total births	64,630	64,886	62,695	62,723	59,604	59,514	59,322	60,094	59,951	58,726
Fetal deaths (terminations of pregnancy and stillbirths)*	231	199	191	166	155	162	164	171	158	151
Terminations of pregnancy	9	17	24	13	12	13	7	15	16	7
Stillbirths	222	182	167	153	143	149	157	156	142	144
Early neonatal deaths <7 days	59	68	65	54	45	59	57	53	46	40
Late neonatal deaths 7–27 days	30	31	18	24	24	23	28	23	22	20
Neonatal deaths <28 days#	89	99	83	78	69	82	85	76	68	60
Perinatal mortalities+	290	267	256	220	200	221	221	224	204	191
Perinatal related mortalities^	320	298	274	244	224	244	249	247	226	211
Perinatal mortalities excluding lethal and terminated fetal abnormalities•	237	202	179	166	156	167	174	167	156	149
Perinatal related mortalities excluding lethal and terminated fetal abnormalities•	253	219	188	176	167	177	185	180	169	157
	Rate									
	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Total births										
Fetal deaths (terminations of pregnancy and stillbirths)*	3.57	3.07	3.05	2.65	2.60	2.72	2.76	2.85	2.64	2.57
Terminations of pregnancy	0.14	0.26	0.38	0.21	0.20	0.22	0.12	0.25	0.27	0.12
Stillbirths	3.43	2.80	2.66	2.44	2.40	2.50	2.65	2.60	2.37	2.45
Early neonatal deaths <7 days										
Late neonatal deaths 7–27 days										
Neonatal deaths <28 days#	1.38	1.53	1.33	1.25	1.16	1.38	1.44	1.27	1.14	1.02
Perinatal mortalities+	4.49	4.11	4.08	3.51	3.36	3.71	3.73	3.73	3.40	3.25
Perinatal related mortalities^	4.95	4.59	4.37	3.89	3.76	4.10	4.20	4.11	3.77	3.59
Perinatal mortalities excluding lethal and terminated fetal abnormalities•	3.67	3.11	2.86	2.65	2.62	2.81	2.93	2.78	2.60	2.54
Perinatal related mortalities excluding lethal and terminated fetal abnormalities•	3.91	3.38	3.00	2.81	2.80	2.97	3.12	3.00	2.82	2.67

* Fetal death rate per 1,000 babies born (includes terminations and stillbirths).
# Neonatal death rate per 1,000 live born babies.
+ Fetal deaths and early neonatal deaths per 1,000 babies born.
^ Fetal deaths and early and late neonatal deaths per 1,000 babies born.
• Lethal and terminated fetal abnormalities are all perinatal related deaths with PSANZ-PDC of congenital anomaly, and neonatal deaths with PSANZ-NDC of congenital anomaly.
Sources: Numerator: PMMRC's perinatal data extract using the international definition (≥1,000g or ≥28 weeks if birthweight unknown) 2009–2018; Denominator: MAT births using the international definition (≥1,000g or ≥28 weeks if birthweight unknown) 2009–2018.

Figure 3.2: Perinatal related mortality annual rates (per 1,000 births) using international definitions* by year 2007–2018



* Rates of fetal death, neonatal death, perinatal mortality and perinatal related mortality of babies weighing ≥1,000g, or ≥28 weeks if birthweight is unknown, per 1,000 total births of babies weighing ≥1,000g, or ≥28 weeks if birthweight is unknown. Babies without birthweight or gestation are included if they have been registered.

Sources: Numerator: PMMRC's perinatal data extract using the international definition (≥1,000g or ≥28 weeks if birthweight unknown) 2007–2018; Denominator: MAT births using the international definition (≥1,000g or ≥28 weeks if birthweight unknown) 2007–2018.

All perinatal deaths are classified in accordance with either the Perinatal Society of Australia and New Zealand (PSANZ) Perinatal Death Classification (PDC) or the PSANZ Neonatal Death Classification (NDC). We classified the deaths presented here using the 2017 revision of these death classification systems.[17]

In 2018, from 20 weeks' gestation onwards, 70% of terminations of pregnancy were classified as PSANZ-PDC congenital anomaly, with 8.1% classified as PSANZ-PDC for maternal conditions. Nearly a quarter of stillbirths were classified as PSANZ-PDC unexplained antepartum fetal death (for unknown reasons). The rates of unexplained stillbirth between Māori and New Zealand European women showed statistically significant differences: rates for Māori were 1.6 times[18] higher than those for New Zealand European women over the period 2007–2018 (data not shown).

Of the known causes in 2018, 16% of stillbirths were due to placental dysfunction or causative placental pathology, and 12% due to spontaneous preterm labour or rupture of membranes. The leading PSANZ-PDC category of neonatal death was spontaneous preterm birth (33.8%), followed by congenital anomaly (22.1%) and antepartum haemorrhage (15.6%) (Table 3.3).

[17] For a comparison of the PSANZ death classification systems, go to the Stillbirth and Neonatal Death Alliance (PSANZ-SANDA) website. URL: https://sanda.psanz.com.au/assets/Uploads/Appendix-U-Changes-in-this-version-of-the-classifications.pdf (accessed 13 May 2020).

[18] Rate ratio: 1.62 (95% CI 1.31–1.99).

Table 3.3: Perinatal related deaths by perinatal death classification (PSANZ-PDC) 2018

Perinatal death classification (PSANZ-PDC)	Fetal deaths				Neonatal deaths		Perinatal related deaths (total)	
	Termination of pregnancy		Stillbirths					
	n	%	n	%	n	%	n	%
Congenital anomaly	94	69.6	34	10.8	34	22.1	162	26.8
Perinatal infection	<3	x	12	3.8	9	5.8	22	3.6
Hypertension	6	4.4	10	3.2	3	1.9	19	3.1
Antepartum haemorrhage	6	4.4	29	9.2	24	15.6	59	9.8
Maternal conditions	11	8.1	23	7.3	8	5.2	42	7.0
Complications of multiple pregnancy	3	2.2	23	7.3	5	3.2	31	5.1
Specific perinatal conditions	4	3.0	18	5.7	6	3.9	28	4.6
Hypoxic peripartum death	-	-	<3	x	5	3.2	6	1.0
Placental dysfunction or causative placental pathology	<3	x	49	15.6	6	3.9	56	9.3
Spontaneous preterm labour or rupture of membranes (<37 weeks' gestation)	9	6.7	39	12.4	52	33.8	100	16.6
Unexplained antepartum fetal death	-	-	77	24.4	-	-	77	12.7
Neonatal death without obstetric antecedent	-	-	-	-	<3	x	<3	x

'x' indicates percentage suppressed due to small numbers.

Source: PMMRC's perinatal data extract 2018.

During the period 2007–2018, congenital anomalies were the most frequent cause of death. Table 3.4 presents the causes of perinatal death for the period 2009–2018.

Our data show strong evidence that perinatal deaths due to hypoxic peripartum death have statistically significantly reduced over the period 2007–2018 ($p<0.001$). The main reason for this decline was a statistically significant reduction in hypoxic peripartum deaths among babies of New Zealand European mothers.

There is some evidence of a reduction in the rate of death from maternal hypertension, maternal conditions and neonatal death without obstetric antecedent (data not shown).

Table 3.4: Perinatal death classification (PSANZ-PDC) specific perinatal related mortality rates (per 1,000 births) using New Zealand definition by year 2009–2018

Perinatal death classification (PSANZ-PDC)	2009		2010		2011		2012		2013		2014		2015		2016		2017		2018	
	N=65,203		N=65,449		N=63,243		N=63,286		N=60,137		N=60,080		N=59,783		N=60,606		N=60,478		N=59,258	
	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate
Congenital anomaly	184	2.82	214	3.27	206	3.26	206	3.26	164	2.73	191	3.18	163	2.73	177	2.92	163	2.70	162	2.73
Perinatal infection	25	0.38	28	0.43	21	0.33	19	0.30	20	0.33	24	0.40	22	0.37	26	0.43	28	0.46	22	0.37
Hypertension	29	0.44	27	0.41	21	0.33	19	0.30	13	0.22	13	0.22	21	0.35	9	0.15	13	0.21	19	0.32
Antepartum haemorrhage	79	1.21	78	1.19	78	1.23	60	0.95	75	1.25	69	1.15	79	1.32	72	1.19	78	1.29	59	1.00
Maternal conditions	38	0.58	32	0.49	26	0.41	36	0.57	34	0.57	39	0.65	29	0.49	37	0.61	29	0.48	42	0.71
Complications of multiple pregnancy	32	0.49	22	0.34	23	0.36	25	0.40	26	0.43	25	0.42	10	0.17	21	0.35	21	0.35	31	0.52
Specific perinatal conditions	33	0.51	37	0.57	38	0.60	27	0.43	25	0.42	27	0.45	33	0.55	32	0.53	31	0.51	28	0.47
Hypoxic peripartum death	29	0.44	20	0.31	20	0.32	21	0.33	11	0.18	17	0.28	17	0.28	13	0.21	13	0.21	6	0.10
Placental dysfunction or causative placental pathology	54	0.83	50	0.76	56	0.89	57	0.90	57	0.95	45	0.75	43	0.72	53	0.87	54	0.89	56	0.95
Spontaneous preterm labour or rupture of membranes (<37 weeks' gestation)	119	1.83	120	1.83	94	1.49	115	1.82	88	1.46	122	2.03	77	1.29	87	1.44	84	1.39	100	1.69
Unexplained antepartum fetal death	101	1.55	70	1.07	80	1.26	76	1.20	81	1.35	80	1.33	77	1.29	79	1.30	71	1.17	77	1.30
Neonatal death without obstetric antecedent	7	0.11	10	0.15	4	0.06	9	0.14	6	0.10	7	0.12	7	0.12	6	0.10	8	0.13	<3	s

's' indicates rate suppressed due to small numbers.

Sources: Numerator: PMMRC's perinatal data extract 2009–2018; Denominator: MAT births 2009–2018.

Using the international definition for perinatal related mortality of birthweight greater than or equal to 1,000g or gestational age 28 weeks or greater (Table 3.5), we found some evidence of a statistically significant reduction in deaths due to antepartum haemorrhage, unexplained antepartum fetal death and neonatal death without obstetric antecedent during the study period 2007–2018.[19] There was strong evidence of a statistically significant decrease in the rate of deaths due to hypoxic peripartum death.[20]

[19] Chi-squared tests for trend p=0.035, 0.043 and 0.027 respectively.

[20] Chi-squared test for trend p<0.0001.

Table 3.5: Perinatal death classification (PSANZ-PDC) specific perinatal related mortality rates (per 1,000 births) using international definition (≥1,000g or ≥28 weeks if birthweight unknown) by year 2009–2018

Perinatal death classification (PSANZ-PDC)	2009		2010		2011		2012		2013		2014		2015		2016		2017		2018	
	N=64,630		N=64,886		N=62,695		N=62,723		N=59,604		N=59,514		N=59,322		N=60,094		N=59,951		N=58,726	
	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate
Congenital anomaly	65	1.01	79	1.22	86	1.37	67	1.07	54	0.91	65	1.09	64	1.08	66	1.10	56	0.93	52	0.89
Perinatal infection	15	0.23	13	0.20	12	0.19	9	0.14	9	0.15	12	0.20	12	0.20	17	0.28	16	0.27	14	0.24
Hypertension	14	0.22	11	0.17	9	0.14	3	0.05	5	0.08	6	0.10	10	0.17	6	0.10	6	0.10	6	0.10
Antepartum haemorrhage	24	0.37	23	0.35	17	0.27	13	0.21	18	0.30	11	0.18	17	0.29	12	0.20	19	0.32	15	0.26
Maternal conditions	20	0.31	19	0.29	7	0.11	17	0.27	22	0.37	14	0.24	15	0.25	16	0.27	8	0.13	17	0.29
Complications of multiple pregnancy	8	0.12	<3	s	3	0.05	3	0.05	5	0.08	4	0.07	3	0.05	<3	s	3	0.05	4	0.07
Specific perinatal conditions	23	0.36	27	0.42	28	0.45	15	0.24	16	0.27	20	0.34	26	0.44	22	0.37	18	0.30	19	0.32
Hypoxic peripartum death	29	0.45	20	0.31	20	0.32	21	0.33	11	0.18	17	0.29	17	0.29	13	0.22	13	0.22	6	0.10
Placental dysfunction or causative placental pathology	33	0.51	31	0.48	29	0.46	32	0.51	22	0.37	30	0.50	24	0.40	24	0.40	19	0.32	34	0.58
Spontaneous preterm labour or rupture of membranes (<37 weeks' gestation)	10	0.15	19	0.29	9	0.14	10	0.16	5	0.08	9	0.15	14	0.24	8	0.13	9	0.15	3	0.05
Unexplained antepartum fetal death	72	1.11	45	0.69	50	0.80	45	0.72	51	0.86	49	0.82	40	0.67	55	0.92	51	0.85	39	0.66
Neonatal death without obstetric antecedent	7	0.11	10	0.15	4	0.06	9	0.14	6	0.10	7	0.12	7	0.12	6	0.10	8	0.13	<3	s

's' indicates rate suppressed due to small numbers.

Sources: Numerator: PMMRC's perinatal data extract using the international definition (≥1,000g or ≥28 weeks if birthweight unknown) 2009–2018; Denominator: MAT births using the international definition (≥1,000g or ≥28 weeks if birthweight unknown) 2009–2018.

For stillbirths, there was strong evidence of a statistically significant reduction in hypoxic peripartum deaths between the years 2007 and 2018.[21] There was some evidence of a reduction in the rate of stillbirths due to spontaneous preterm labour or rupture of membranes[22] and antepartum haemorrhage.[23] For this period, the largest category of death for stillbirth was unexplained antepartum fetal death (Table 3.6).

[21] Chi-squared test for trend p<0.0001.

[22] Chi-squared test for trend p=0.023.

[23] Chi-squared test for trend p=0.046.

Table 3.6: Perinatal death classification (PSANZ-PDC) specific stillbirth rates (per 1,000 births) by year 2009–2018

Perinatal death classification (PSANZ-PDC)	2009		2010		2011		2012		2013		2014		2015		2016		2017		2018	
	N=65,203		N=65,449		N=63,243		N=63,286		N=60,137		N=60,080		N=59,783		N=60,606		N=60,478		N=59,258	
	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate
Congenital anomaly	32	0.49	39	0.60	28	0.44	38	0.60	24	0.40	35	0.58	30	0.50	31	0.51	29	0.48	34	0.57
Perinatal infection	16	0.25	17	0.26	10	0.16	9	0.14	10	0.17	12	0.20	12	0.20	10	0.17	17	0.28	12	0.20
Hypertension	24	0.37	18	0.28	12	0.19	9	0.14	8	0.13	9	0.15	16	0.27	8	0.13	10	0.17	10	0.17
Antepartum haemorrhage	53	0.81	46	0.70	48	0.76	31	0.49	44	0.73	33	0.55	46	0.77	38	0.63	37	0.61	29	0.49
Maternal conditions	26	0.40	23	0.35	13	0.21	19	0.30	22	0.37	21	0.35	22	0.37	17	0.28	12	0.20	23	0.39
Complications of multiple pregnancy	22	0.34	11	0.17	16	0.25	15	0.24	21	0.35	12	0.20	7	0.12	18	0.30	16	0.26	23	0.39
Specific perinatal conditions	28	0.43	31	0.47	31	0.49	21	0.33	12	0.20	23	0.38	25	0.42	29	0.48	25	0.41	18	0.30
Hypoxic peripartum death	11	0.17	7	0.11	9	0.14	11	0.17	3	0.05	7	0.12	9	0.15	4	0.07	4	0.07	<3	s
Placental dysfunction or causative placental pathology	46	0.71	43	0.66	51	0.81	54	0.85	53	0.88	44	0.73	39	0.65	47	0.78	48	0.79	49	0.83
Spontaneous preterm labour or rupture of membranes (<37 weeks' gestation)	50	0.77	44	0.67	36	0.57	40	0.63	28	0.47	52	0.87	24	0.40	31	0.51	21	0.35	39	0.66
Unexplained antepartum fetal death	101	1.55	68	1.04	78	1.23	73	1.15	81	1.35	79	1.31	75	1.25	77	1.27	69	1.14	77	1.30
Neonatal death without obstetric antecedent	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

s' indicates rate suppressed due to small numbers.

Sources: Numerator: PMMRC's perinatal data extract, stillbirths only, 2009–2018; Denominator: MAT births 2009–2018.

Neonatal death

For babies aged 20–27 weeks' gestation, extreme prematurity was the leading cause of neonatal death during the period 2007–2018.

For babies aged 28 weeks' gestation and over, congenital anomalies were the leading cause of neonatal death, followed by neurological conditions. For this gestational group, neonatal deaths from neurological conditions decreased by a statistically significant rate over the study period 2007–2018 (data not shown). Table 3.7 presents the causes of neonatal death for the period 2009–2018.

Table 3.7: Neonatal death classification (PSANZ-NDC) specific neonatal death rates (per 1,000 live births) by year 2009–2018

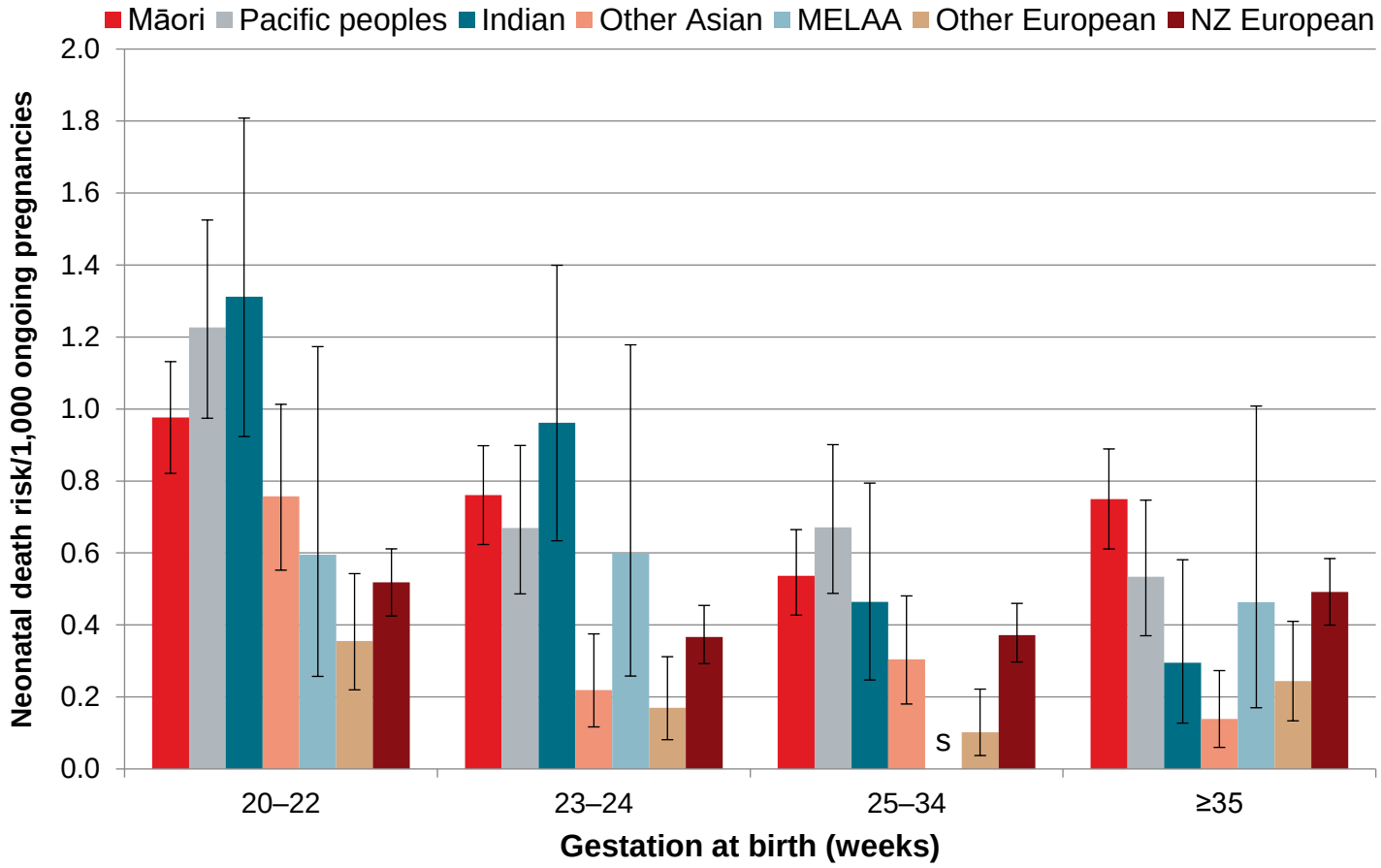
Neonatal death classification (PSANZ-NDC)	2009		2010		2011		2012		2013		2014		2015		2016		2017		2018	
	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate
Gestation <28 weeks	**N=286**		**N=291**		**N=242**		**N=256**		**N=257**		**N=274**		**N=255**		**N=251**		**N=282**		**N=238**	
Congenital anomaly	<3	s	-	-	<3	s	<3	s	<3	s	<3	s	3	11.76	<3	s	4	14.18	<3	s
Extreme prematurity	57	199.30	84	288.66	54	223.14	67	261.72	63	245.14	69	251.82	51	200.00	55	219.12	70	248.23	63	264.71
Cardio-respiratory disorders	11	38.46	16	54.98	7	28.93	10	39.06	5	19.46	12	43.80	10	39.22	6	23.90	9	31.91	10	42.02
Infection	5	17.48	7	24.05	7	28.93	10	39.06	5	19.46	7	25.55	<3	s	4	15.94	8	28.37	7	29.41
Neurological	11	38.46	<3	s	8	33.06	6	23.44	8	31.13	12	43.80	11	43.14	8	31.87	8	28.37	3	12.61
Gastrointestinal	5	17.48	4	13.75	<3	s	<3	s	<3	s	<3	s	<3	s	3	11.95	4	14.18	6	25.21
Other	3	10.49	-	-	-	-	<3	s	<3	s	<3	s	4	15.69	<3	s	<3	s	-	-
Gestation ≥28 weeks	**N=63,787**		**N=64,109**		**N=61,997**		**N=61,625**		**N=59,106**		**N=58,945**		**N=58,748**		**N=59,489**		**N=59,269**		**N=57,196**	
Congenital anomaly	41	0.64	46	0.72	48	0.77	36	0.58	31	0.52	43	0.73	42	0.71	33	0.55	28	0.47	34	0.59
Extreme prematurity	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cardio-respiratory disorders	-	-	<3	s	4	0.06	4	0.06	<3	s	4	0.07	6	0.10	5	0.08	7	0.12	4	0.07
Infection	7	0.11	12	0.19	8	0.13	7	0.11	7	0.12	8	0.14	5	0.09	10	0.17	7	0.12	5	0.09
Neurological	30	0.47	26	0.41	15	0.24	19	0.31	17	0.29	12	0.20	20	0.34	16	0.27	14	0.24	13	0.23
Gastrointestinal	3	0.05	<3	s	-	-	<3	s	-	-	<3	s	<3	s	<3	s	-	-	3	0.05
Other	8	0.13	10	0.16	9	0.15	13	0.21	13	0.22	9	0.15	10	0.17	8	0.13	12	0.20	4	0.07

's' indicates rate suppressed due to small numbers.

Sources: Numerator: PMMRC's perinatal data extract, neonatal deaths only, 2009–2018; Denominator: MAT births excluding fetal deaths 2009–2018.

Figure 3.3 presents the neonatal mortality rate by prioritised ethnic group (excluding congenital anomalies). This shows that the burden of mortality for all ethnic groups is in babies born before they reach 25 weeks' gestation. By prioritised ethnic group, neonatal mortality rates are statistically significantly higher in babies born to mothers of Indian, Pacific and Māori ethnicities, compared with babies with New Zealand European mothers.

Figure 3.3: Neonatal death risk (per 1,000 ongoing pregnancies) by gestational age at birth and maternal ethnicity excluding death with congenital anomalies 2009–2018*



* Unknown/Other ethnicity not represented.

MELAA = Middle Eastern, Latin American, or African.

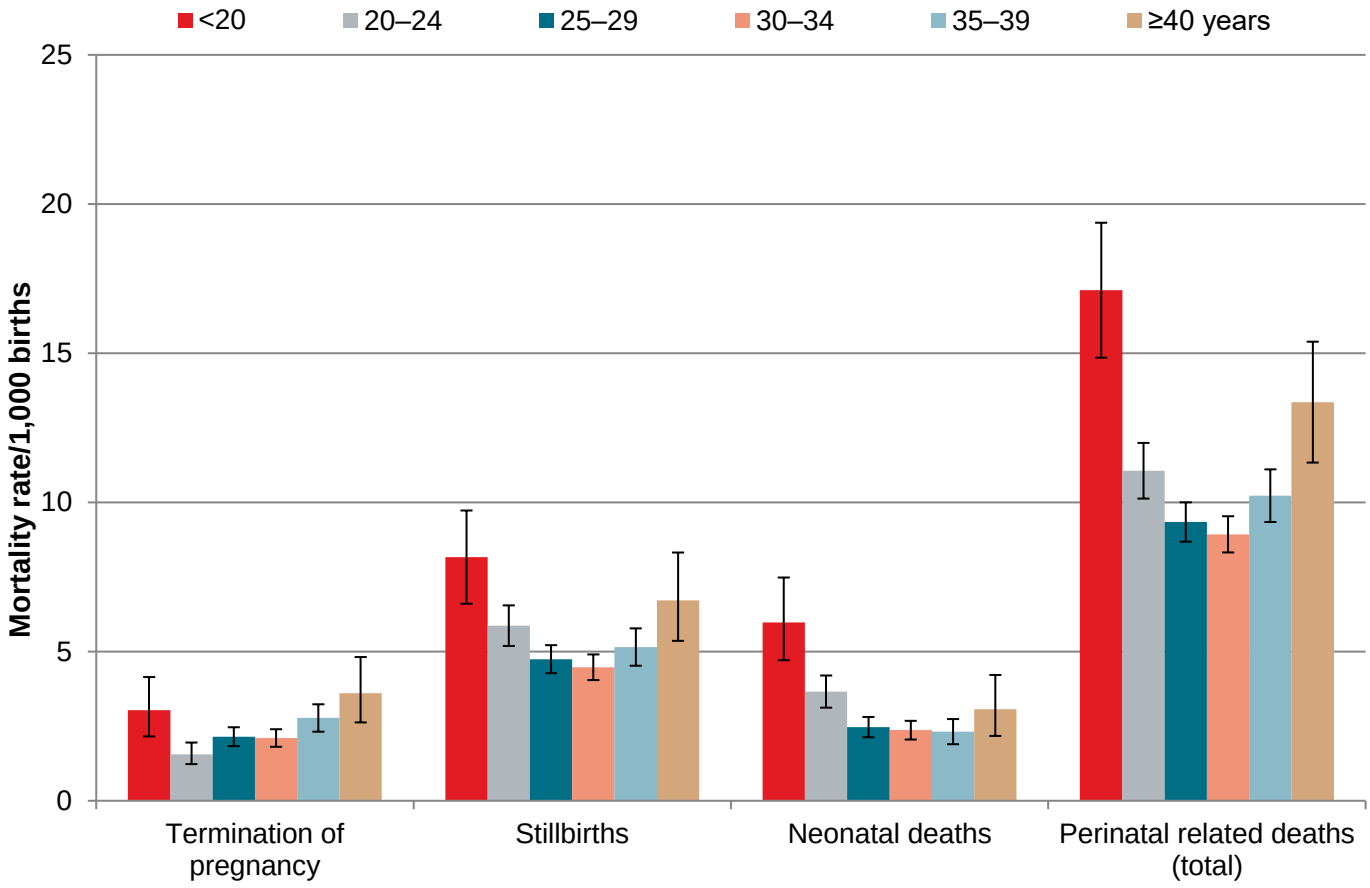
's' indicates rate suppressed due to small numbers.

Sources: Numerator: PMMRC's perinatal data extract excluding congenital anomalies 2009–2018; Denominator: MAT live births 2009–2018.

Maternal age

Perinatal related mortality rates have a U-shaped trend by maternal age, with the highest rates at the extremes of childbearing age. This is particularly evident for stillbirths, where rates are highest for mothers aged under 20 years and aged 40 years and over. Neonatal deaths were highest in babies of mothers who were under 20 years of age (Figure 3.4 and Table 3.8).

Figure 3.4: Perinatal related mortality rates (per 1,000 births, with 95% confidence intervals (CIs)) by maternal age 2014–2018



Sources: Numerator: PMMRC's perinatal data extract 2014–2018; Denominator: MAT births 2014–2018.

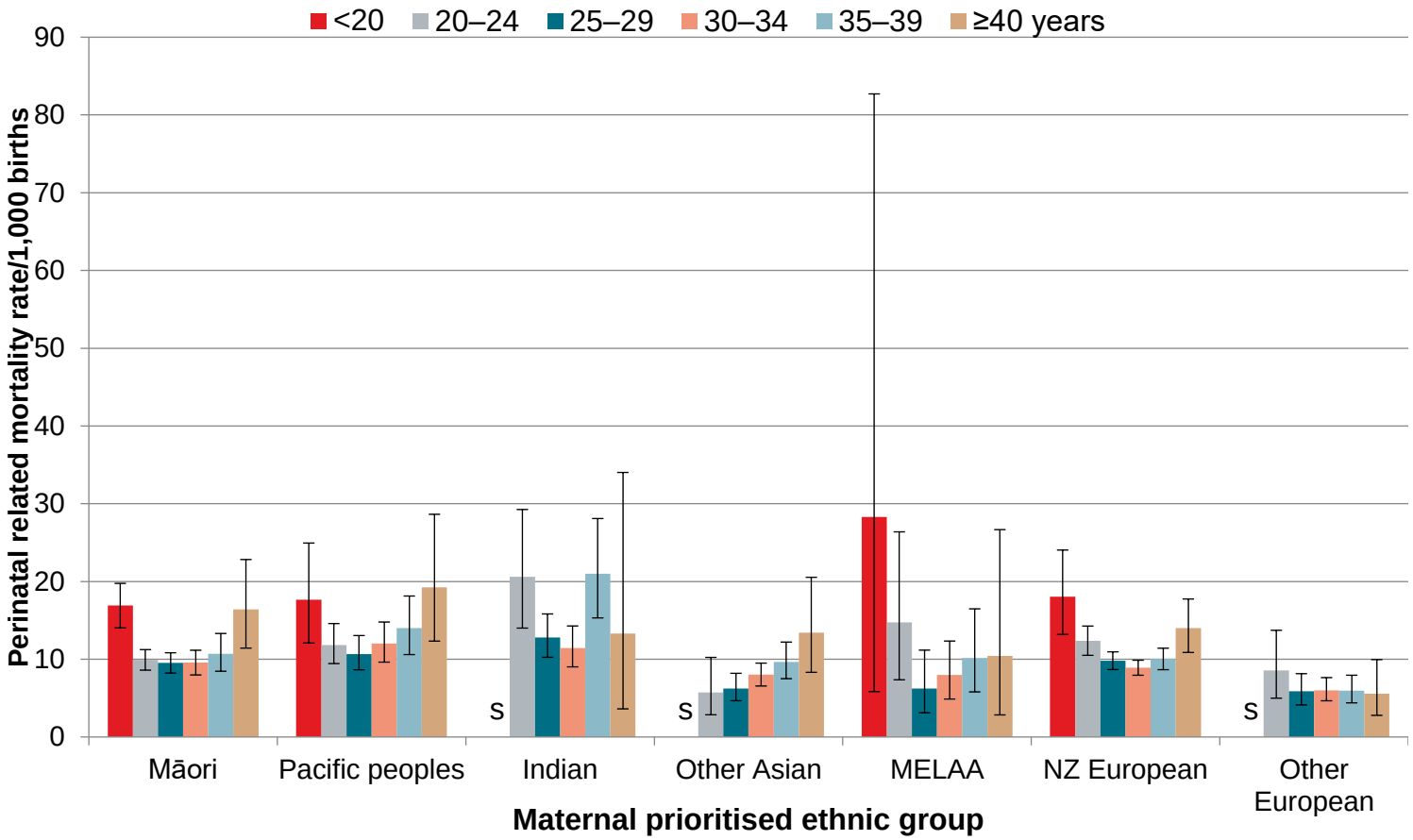
Table 3.8: Perinatal related mortality rates (per 1,000 births) by maternal age 2014–2018

Maternal age (years)	Total births		Fetal deaths						Neonatal deaths			Perinatal related deaths (total)		
			Termination of pregnancy			Stillbirths								
	N=300,205		n=673			n=1,545			n=828			n=3,046		
	N	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
<20	12,856	4.3	39	5.8	3.03	105	6.8	8.17	76	9.2	5.98	220	7.2	17.11
20–24	48,728	16.2	76	11.3	1.56	286	18.5	5.87	177	21.4	3.66	539	17.7	11.06
25–29	82,405	27.4	177	26.3	2.15	391	25.3	4.74	202	24.4	2.47	770	25.3	9.34
30–34	93,168	31.0	196	29.1	2.10	417	27.0	4.48	219	26.4	2.37	832	27.3	8.93
35–39	50,461	16.8	140	20.8	2.77	260	16.8	5.15	116	14.0	2.32	516	16.9	10.23
≥40	12,499	4.2	45	6.7	3.60	84	5.4	6.72	38	4.6	3.07	167	5.5	13.36
Unknown	88	0.0	-	-	-	<3	x	-	-	-	-	<3	x	-

'x' indicates percentage suppressed due to small numbers.

Sources: Numerator: PMMRC's perinatal data extract 2014–2018; Denominator: MAT births 2014–2018.

Figure 3.5: Perinatal related mortality rates (per 1,000 births, with 95% CIs) by maternal age and prioritised ethnic group 2014–2018



MELAA = Middle Eastern, Latin American, or African.

's' indicates rate not calculated due to small numbers.

Sources: Numerator: PMMRC's perinatal data extract 2014–2018; Denominator: MAT births 2014–2018.

The study period 2007–2018 saw little change in perinatal related mortality rates by maternal age group. Some evidence indicates an increase in deaths of babies born to mothers younger than 20 years, but no evidence suggests any substantial change in any other age group (data not shown). Table 3.9 presents the rates of perinatal related deaths by maternal age for the period 2009–2018.

Figure 3.5 shows the perinatal related mortality rates by maternal age for each prioritised ethnic group. The U-shaped trend by maternal age was evident for babies of Māori, Pacific and New Zealand European mothers.

Table 3.9: Perinatal related mortality rates (per 1,000 births) by maternal age and year 2009–2018

Maternal age (years)	2009		2010		2011		2012		2013		2014		2015		2016		2017		2018	
	n	N	n	N	n	N	n	N	n	N	n	N	n	N	n	N	n	N	n	N
<20	80	4,910	57	4,625	65	4,128	63	3,967	65	3,382	51	3,047	45	2,828	54	2,491	32	2,328	38	2,162
20–24	142	12,085	164	12,259	116	11,940	126	11,697	115	11,011	116	10,477	86	10,139	125	9,779	104	9,497	108	8,836
25–29	169	16,005	162	16,307	147	15,866	149	16,267	139	15,598	165	16,016	150	15,992	143	16,893	153	16,946	159	16,558
30–34	169	17,840	149	18,104	160	17,608	163	17,855	147	17,129	175	17,983	158	18,296	169	18,746	174	19,038	156	19,105
35–39	138	11,765	136	11,395	145	11,028	119	10,676	89	10,318	111	9,940	107	9,977	90	10,202	100	10,103	108	10,239
≥40	32	2,569	40	2,731	34	2,648	50	2,805	45	2,678	40	2,596	32	2,531	30	2,481	30	2,546	35	2,345
Unknown	-	29	-	28	-	25	-	19	-	21	<3	21	-	20	<3	14	-	20	-	13

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
	Rate	Rate	Rate	Rate	Rate	Rate	Rate	Rate	Rate	Rate
<20	16.3	12.3	15.7	15.9	19.2	16.7	15.9	21.7	13.7	17.6
20–24	11.8	13.4	9.7	10.8	10.4	11.1	8.5	12.8	11.0	12.2
25–29	10.6	9.9	9.3	9.2	8.9	10.3	9.4	8.5	9.0	9.6
30–34	9.5	8.2	9.1	9.1	8.6	9.7	8.6	9.0	9.1	8.2
35–39	11.7	11.9	13.1	11.1	8.6	11.2	10.7	8.8	9.9	10.5
≥40	12.5	14.6	12.8	17.8	16.8	15.4	12.6	12.1	11.8	14.9
Unknown	-	-	-	-	-	-	-	-	-	-

Sources: Numerator: PMMRC's perinatal data extract 2009–2018; Denominator: MAT births 2009–2018.

The leading cause of perinatal related death for all maternal age groups was spontaneous preterm labour or rupture of membranes (ROM). The highest rate of mortality due to spontaneous preterm labour/ROM was seen in babies born to mothers under 20 years of age. The relationship between spontaneous preterm labour/ROM and the demographic characteristics of the mother (such as maternal age, ethnicity and/or deprivation) should be the subject of future research.

For women aged 20–24 years, antepartum haemorrhage and unexplained antepartum fetal death were the next most frequent causes after spontaneous preterm labour/ROM. In mothers aged 25–34 years, spontaneous preterm labour/ROM and unexplained antepartum death accounted for nearly 40% of perinatal related deaths. However, the rates for both categories were lower than the rates for women aged 24 years and younger, reflecting the overall lower perinatal related mortality rate in the age group of 25–34 years. Maternal conditions and placental dysfunction or causative placental pathology particularly affected mothers under 20 years of age, whereas hypertension was an uncommon cause of perinatal related death in this age group.

The rate of placental dysfunction or causative placental pathology was highest in mothers under 20 years of age, and reduced with age until 40 years and over. Deaths due to hypertension or to specific perinatal conditions tended to increase with age (Table 3.10 and Figure 3.6). See Table 3.11 for further information on women under 20 years of age who were pregnant, and Table 3.12 for information about perinatal related deaths in this age group.

Table 3.10: Perinatal death classification (PSANZ-PDC) specific perinatal related mortality rates (excluding congenital anomalies) by maternal age* 2014–2018

Perinatal death classification (PSANZ-PDC)	Maternal age (years)														
	<20			20–24			25–34			35–39			≥40		
	N=12,856			N=48,728			N=175,573			N=50,461			N=12,499		
	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Perinatal infection	14	8.2	1.09	28	6.6	0.57	66	5.7	0.38	13	3.8	0.26	<3	x	s
Hypertension	<3	x	s	16	3.8	0.33	43	3.7	0.24	10	2.9	0.20	5	5.6	0.40
Antepartum haemorrhage	26	15.2	2.02	69	16.2	1.42	201	17.4	1.14	45	13.3	0.89	16	17.8	1.28
Maternal conditions	22	12.9	1.71	34	8.0	0.70	82	7.1	0.47	21	6.2	0.42	11	12.2	0.88
Complications of multiple pregnancy	<3	x	s	19	4.5	0.39	57	4.9	0.32	23	6.8	0.46	7	7.8	0.56
Specific perinatal conditions	4	2.3	0.31	28	6.6	0.57	82	7.1	0.47	29	8.6	0.57	8	8.9	0.64
Hypoxic peripartum death	4	2.3	0.31	11	2.6	0.23	35	3.0	0.20	14	4.1	0.28	<3	x	s
Placental dysfunction or causative placental pathology	22	12.9	1.71	54	12.7	1.11	127	11.0	0.72	41	12.1	0.81	7	7.8	0.56
Spontaneous preterm labour or rupture of membranes (<37 weeks' gestation)	53	31.0	4.12	93	21.9	1.91	229	19.8	1.30	77	22.7	1.53	17	18.9	1.36
Unexplained antepartum fetal death	21	12.3	1.63	64	15.1	1.31	220	19.0	1.25	63	18.6	1.25	15	16.7	1.20
Neonatal death without obstetric antecedent	<3	x	s	9	2.1	0.18	15	1.3	0.09	3	0.9	0.06	<3	x	s

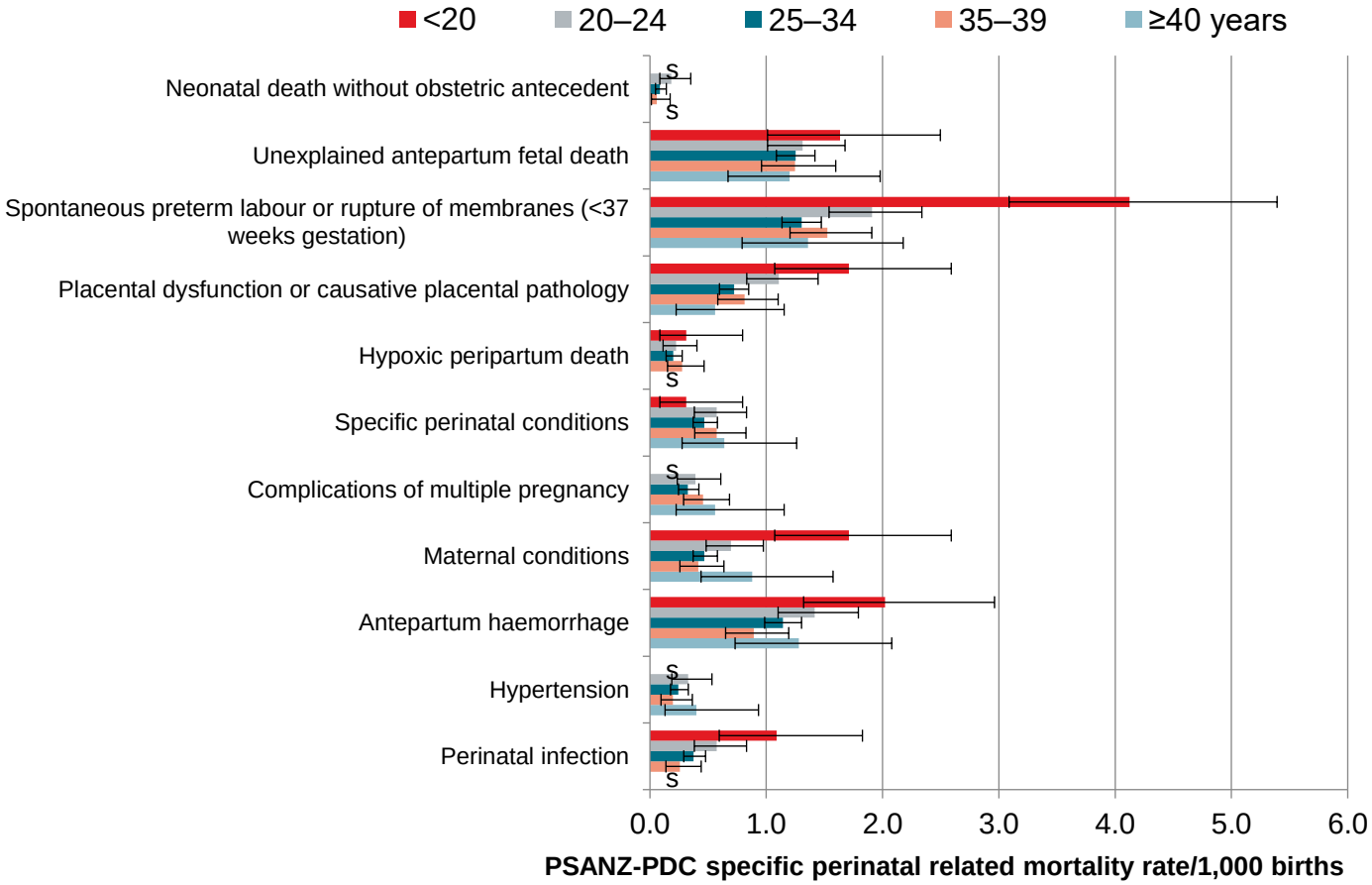
* Excludes two babies where maternal age was unknown.

'x' indicates percentage not calculated due to small numbers.

's' indicates rate not calculated due to small numbers.

Sources: Numerator: PMMRC's perinatal data extract (excluding congenital anomalies) 2014–2018; Denominator: MAT births 2014–2018.

Figure 3.6: Perinatal death classification (PSANZ-PDC) specific perinatal related mortality rates (excluding congenital anomalies, with 95% CIs) by maternal age 2014–2018



's' indicates rate suppressed due to small numbers.

Sources: Numerator: PMMRC's perinatal data extract (excluding congenital anomalies) 2014–2018; Denominator: MAT births 2014–2018.

Mothers under 20 years of age

Of mothers under 20 years of age who experienced a perinatal related death, over 40% were 19 years of age. Relatively few women in this age group were living in the least deprived areas; the highest proportion lived in quintile 5 on the New Zealand Index of Deprivation 2013 (NZDep2013) (Table 3.11).

Of mothers under 20 years of age who experienced a perinatal related death, 59% were Māori, and overall 65% did not smoke. Half of the mothers had a body mass index (BMI) in the normal range. Ninety-nine percent of the mothers registered with an LMC during their pregnancy. Of the mothers under 20 years of age who were recorded as having registered with an LMC during their pregnancy (between 2009 and 2018), 47% did so in their first trimester. However, because the data set is limited to mothers who registered with a midwife, obstetrician or GP LMC, the actual percentage of women who registered within their first trimester may be lower than this (Table 3.11).

Table 3.11: Demographic and other characteristics of all mothers under 20 years of age by time period (2009–2013 and 2014–2018)

Mothers aged under 20 years	2009–2013 N=21,012		2014–2018 N=12,856		2009–2018 (Total) N=33,868	
	N	%	N	%	N	%
Age (years)						
<16	653	3.1	436	3.4	1,089	3.2
16	1,767	8.4	980	7.6	2,747	8.1
17	3,736	17.8	2,069	16.1	5,805	17.1
18	6,124	29.1	3,696	28.7	9,820	29.0
19	8,732	41.6	5,675	44.1	14,407	42.5
Deprivation quintile						
1 (least deprived)	1,096	5.2	587	4.6	1,683	5.0
2	1,668	7.9	1,002	7.8	2,670	7.9
3	2,948	14.0	1,526	11.9	4,474	13.2
4	5,301	25.2	3,026	23.5	8,327	24.6
5 (most deprived)	9,769	46.5	6,612	51.4	16,381	48.4
Missing	230	1.1	103	0.8	333	1.0
Prioritised ethnic group						
Māori	12,143	57.8	7,930	61.7	20,073	59.3
Pacific peoples	2,809	13.4	1,811	14.1	4,620	13.6
Asian	321	1.5	191	1.5	512	1.5
Indian	96	0.5	54	0.4	150	0.4
Other Asian	225	1.1	137	1.1	362	1.1
MELAA	163	0.8	106	0.8	269	0.8
European	5,567	26.5	2,817	21.9	8,384	24.8
NZ European	5,037	24.0	2,552	19.9	7,589	22.4
Other European	530	2.5	265	2.1	795	2.3
Unknown	9	0.0	<3	x	10	0.0
Limited to LMC*	**N=16,982**		**N=11,416**		**N=28,398**	
Smoking at registration with LMC						
Yes	6,129	36.1	3,868	33.9	9,997	35.2
No	10,853	63.9	7,548	66.1	18,401	64.8
Missing	-	-	-	-	-	-
BMI at registration						
<18.5	687	4.0	399	3.5	1,086	3.8
18.5–24.9	8,824	52.0	5,253	46.0	14,077	49.6
25.0–29.9	4,625	27.2	3,236	28.3	7,861	27.7
30.0–34.9	1,961	11.5	1,654	14.5	3,615	12.7
35.0–39.9	610	3.6	622	5.4	1,232	4.3
≥40.0	228	1.3	235	2.1	463	1.6
Unknown	47	0.3	17	0.1	64	0.2
First registration with LMC						
First	7,292	42.9	5,954	52.2	13,246	46.6
Second	8,314	49.0	4,594	40.2	12,908	45.5
Third	1,284	7.6	768	6.7	2,052	7.2
Postpartum	91	0.5	100	0.9	191	0.7
Missing	<3	x	-	-	<3	x

* All data limited to mothers who were registered for care with an LMC (a midwife, obstetrician or GP) claiming from the Section 88 Primary Maternity Services Notice.

MELAA = Middle Eastern, Latin American, or African.

LMC = lead maternity carer.

BMI = body mass index.

'x' indicates percentage not calculated due to small numbers.

Source: MAT births of babies of mothers <20 years of age 2009–2018.

The stillbirth rate for babies of mothers under 20 years of age (7.15 per 1,000 births) was approximately 1.5 times higher than for mothers aged 20 years and over (4.93 per 1,000 births), and the neonatal mortality rate was two times higher (5.46 per 1,000 births compared with 2.61 per 1,000 live births). The rate for termination of pregnancy was similar between the two groups (Table 3.12). In our 13th report, we highlighted that it is important for cohesive primary maternity services to be responsive to and appropriate for mothers aged under 20 years.[24]

Table 3.12: Perinatal death classification (PSANZ-PDC) among babies of mothers <20 years of age and those ≥20 years of age 2009–2018

Perinatal death classification (PSANZ-PDC)	2009–2018			
	Women <20 years		Women ≥20 years	
	N=33,868		N=583,445	
	n	Rate	n	Rate
Termination of pregnancy (per 1,000 births)	97	2.86	1,296	2.22
Stillbirth (per 1,000 births)	242	7.15	2,874	4.93
Neonatal death (per 1,000 live births)	183	5.46	1,511	2.61
Perinatal death classification (PSANZ-PDC)				
Congenital anomaly	124	3.66	1,661	2.85
Perinatal infection	26	0.77	201	0.34
Hypertension	<3	s	179	0.31
Antepartum haemorrhage	62	1.83	645	1.11
Maternal conditions	34	1.00	267	0.46
Specific perinatal conditions	15	0.44	217	0.37
Hypoxic peripartum death	14	0.41	293	0.50
Fetal growth restriction	12	0.35	151	0.26
Spontaneous preterm birth	42	1.24	469	0.80
Unexplained antepartum death	126	3.72	844	1.45
No obstetric antecedent	55	1.62	701	1.20

's' indicates rate suppressed due to small numbers.

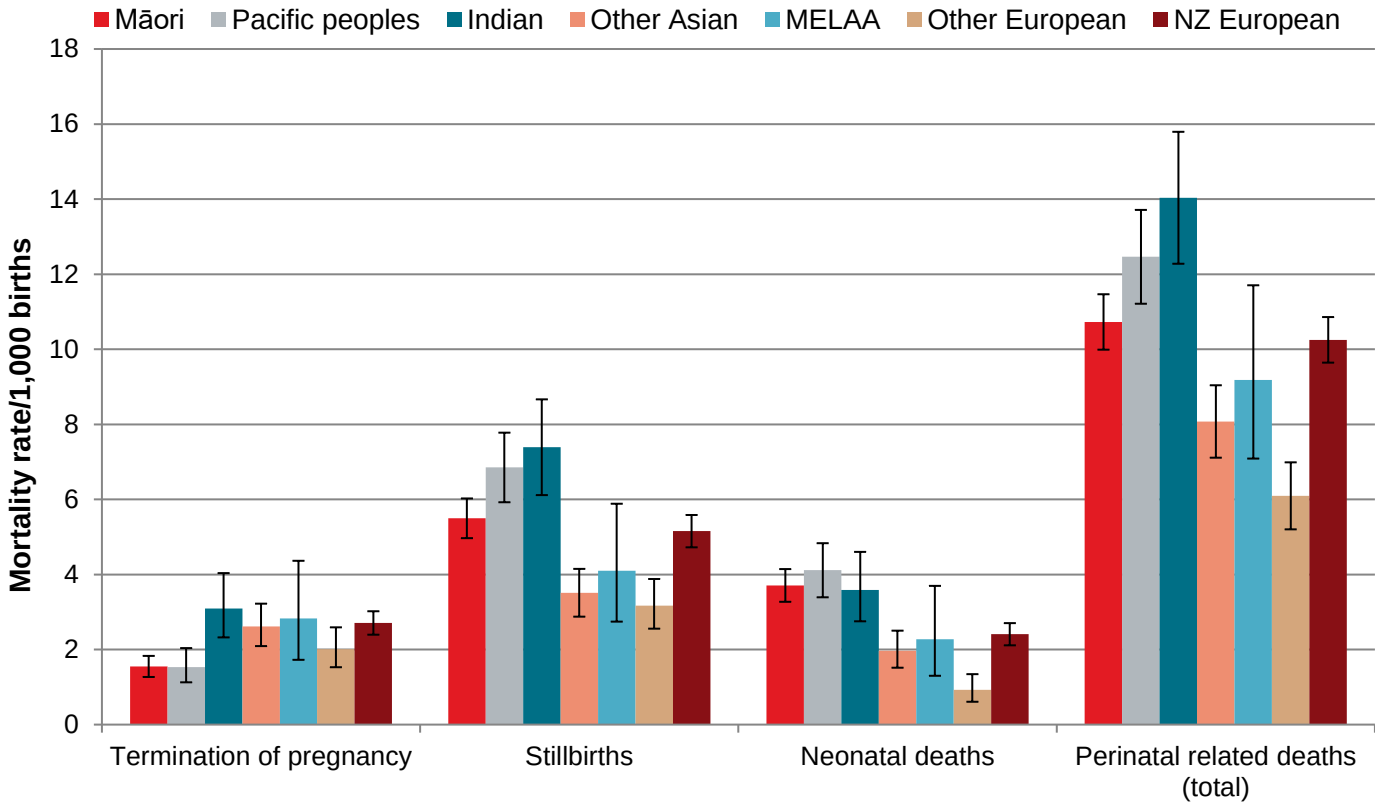
Sources: Numerator: PMMRC's perinatal data extract, where matched to MAT data 2009–2018; Denominator: MAT births 2009-2018.

[24] PMMRC. 2019. *Te Pūrongo ā-Tau Tekau mā Toru o te Komiti Arotake Mate Pēpi, Mate Whaea Hoki | Thirteenth Annual Report of the Perinatal and Maternal Mortality Review Committee: Te tuku pūrongo mō te mate me te whakamate 2017 | Reporting mortality and morbidity 2017.* Wellington: Health Quality & Safety Commission. URL: https://www.hqsc.govt.nz/assets/PMMRC/Publications/13thPMMRCreport/13thPMMRCAnnualReportWebFINAL.pdf (accessed 6 May 2020).

Perinatal related mortality by prioritised ethnic group

There were significant differences in perinatal related mortality by prioritised ethnic group of both mother (Figure 3.7 and Table 3.13) and baby (Figure 3.8 and Table 3.14). These patterns were the same, regardless of whether our analysis used the mother's or baby's prioritised ethnic group.

Figure 3.7: Perinatal related mortality rates (per 1,000 births, with 95% CIs) by maternal prioritised ethnic group 2014–2018



MELAA = Middle Eastern, Latin American, or African.

Sources: Numerator: PMMRC's perinatal data extract 2014–2018; Denominator: MAT births 2014–2018.

Table 3.13: Perinatal related mortality rates (per 1,000 births) by maternal prioritised ethnic group 2014–2018

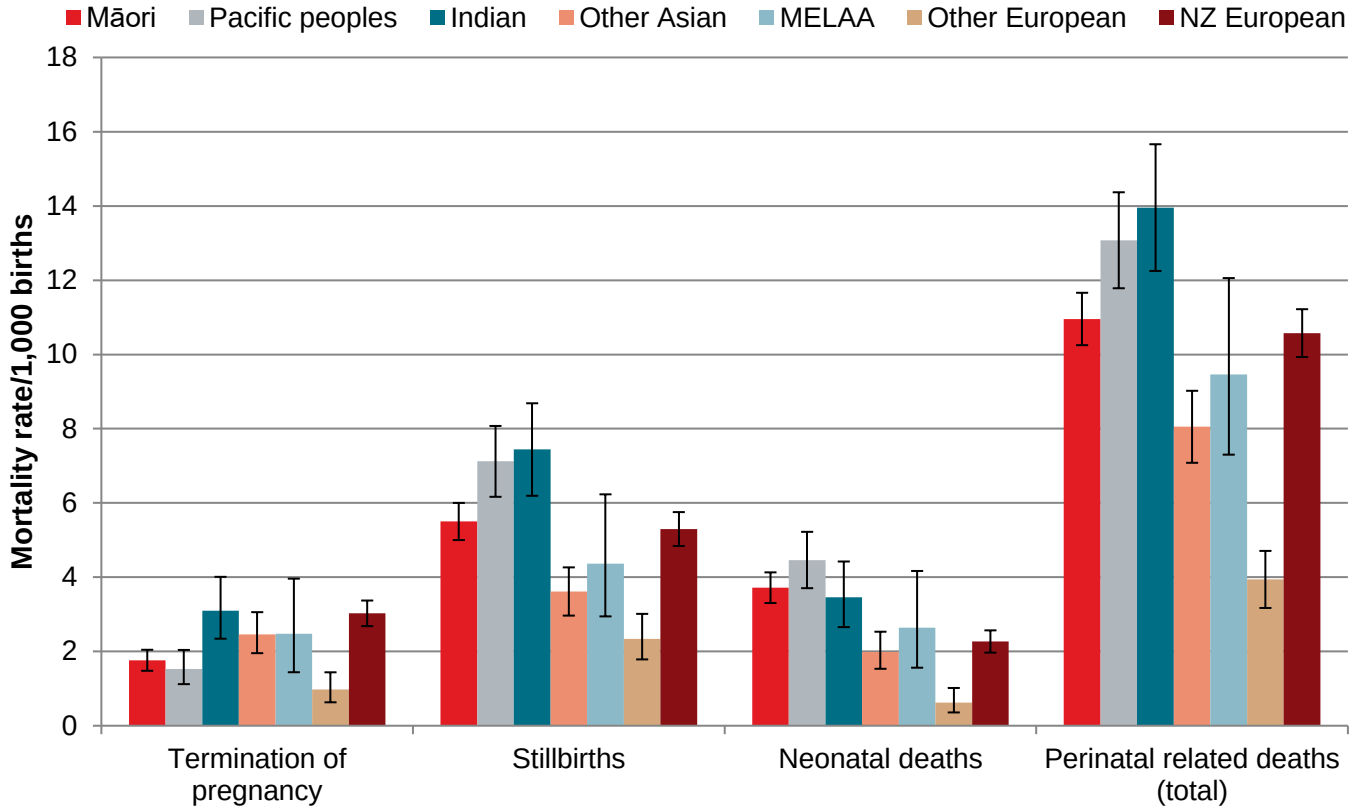
Prioritised ethnic group (mother)	Total births		Fetal deaths						Neonatal deaths			Perinatal related deaths (total)		
			Termination of pregnancy			Stillbirths								
	N=300,205*		n=673			n=1,545			n=828			n=3,046		
	N	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Māori	75,506	25.2	117	17.4	1.55	415	26.9	5.50	278	33.6	3.71	810	26.6	10.73
Pacific peoples	30,651	10.2	47	7.0	1.53	210	13.6	6.85	125	15.1	4.11	382	12.5	12.46
Asian	50,763	16.9	141	21.0	2.78	246	15.9	4.85	127	15.3	2.52	514	16.9	10.13
Indian	17,455	5.8	54	8.0	3.09	129	8.3	7.39	62	7.5	3.59	245	8.0	14.04
Other Asian	33,308	11.1	87	12.9	2.61	117	7.6	3.51	65	7.9	1.96	269	8.8	8.08
MELAA	7,078	2.4	20	3.0	2.83	29	1.9	4.10	16	1.9	2.28	65	2.1	9.18
European	136,089	45.3	348	51.7	2.56	643	41.6	4.72	282	34.1	2.09	1,273	41.8	9.35
NZ European	106,721	35.5	289	42.9	2.71	550	35.6	5.15	255	30.8	2.41	1,094	35.9	10.25
Other European	29,368	9.8	59	8.8	2.01	93	6.0	3.17	27	3.3	0.92	179	5.9	6.10

* Includes 118 unknown maternal ethnicity among total births and 2 unknown maternal ethnicity perinatal related deaths (total).

MELAA = Middle Eastern, Latin American, or African.

Sources: Numerator: PMMRC's perinatal data extract 2014–2018; Denominator: MAT births 2014–2018.

Figure 3.8: Perinatal related mortality rates (per 1,000 births, with 95% CIs) by baby's prioritised ethnic group 2014–2018



MELAA = Middle Eastern, Latin American, or African.

Sources: Numerator: PMMRC's perinatal data extract 2014–2018; Denominator: MAT births 2014–2018.

Table 3.14: Perinatal related mortality rates (per 1,000 births) by baby's prioritised ethnic group 2014–2018

Prioritised ethnic group (baby)	Total births		Fetal deaths						Neonatal deaths			Perinatal related deaths (total)		
			Termination of pregnancy			Stillbirths								
	N=300,205*		n=673			n=1,545			n=828			n=3,046		
	N	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Māori	84,523	28.2	149	22.1	1.76	465	30.1	5.50	312	37.7	3.72	926	30.4	10.96
Pacific peoples	30,055	10.0	46	6.8	1.53	214	13.9	7.12	133	16.1	4.46	393	12.9	13.08
Asian	51,327	17.1	138	20.5	2.69	256	16.6	4.99	128	15.5	2.51	522	17.1	10.17
Indian	18,415	6.1	57	8.5	3.10	137	8.9	7.44	63	7.6	3.46	257	8.4	13.96
Other Asian	32,912	11.0	81	12.0	2.46	119	7.7	3.62	65	7.9	1.99	265	8.7	8.05
MELAA	6,871	2.3	17	2.5	2.47	30	1.9	4.37	18	2.2	2.64	65	2.1	9.46
European	123,408	41.1	321	47.7	2.60	578	37.4	4.68	236	28.5	1.93	1,135	37.3	9.20
NZ European	97,776	32.6	296	44.0	3.03	518	33.5	5.30	220	26.6	2.27	1,034	33.9	10.58
Other European	25,632	8.5	25	3.7	0.98	60	3.9	2.34	16	1.9	0.63	101	3.3	3.94

* Includes 4,021 unknown baby's ethnicity total births and 5 unknown baby's ethnicity perinatal related deaths (total).

MELAA = Middle Eastern, Latin American, or African.

Sources: Numerator: PMMRC's perinatal data extract 2014–2018; Denominator: MAT births 2014–2018.

There was significant variation in the classification of perinatal related mortality by prioritised ethnic group (Figure 3.9). For deaths due to spontaneous preterm delivery, mortality rates were statistically significantly higher in Indian, Pacific and Māori women, compared with 'All others' ('Other Asian', MELAA and all European groups). For antepartum haemorrhage, rates were statistically significantly higher in babies of Indian and Pacific mothers than those of 'All other' mothers. Deaths due to placental dysfunction were statistically significantly higher in babies of Indian women than babies of 'All other' mothers. Deaths due to maternal conditions and perinatal infection were statistically significantly higher in babies of Pacific and Māori mothers than babies of 'All other' mothers. For babies of Māori mothers, rates for specific perinatal

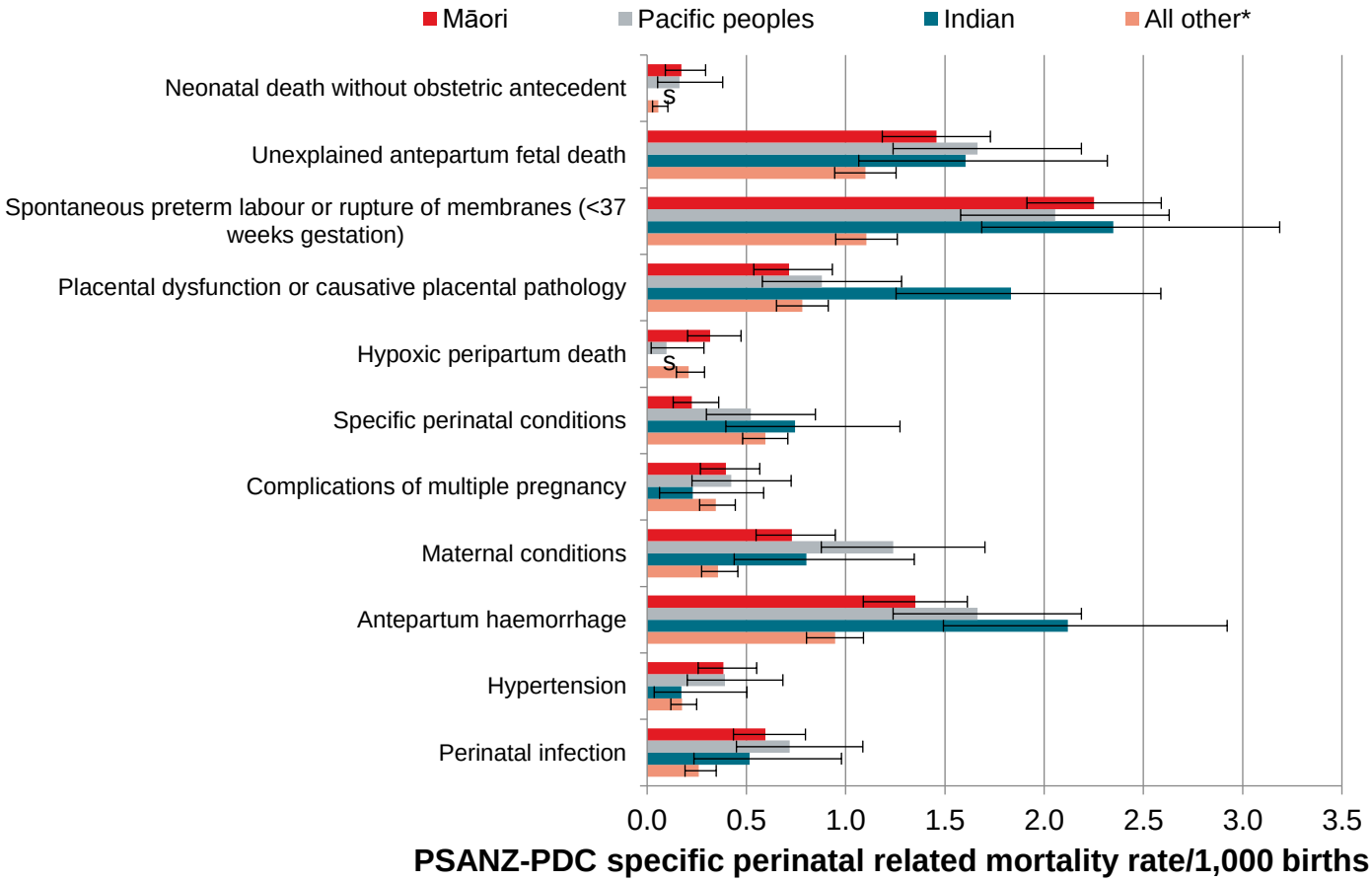
conditions were statistically significantly lower than for 'All other' mothers, and statistically significantly higher for hypertension.

No significant differences in mortality rates by prioritised ethnic category were evident for deaths due to hypoxic peripartum death, complications of multiple pregnancy, unexplained antepartum death, and deaths where no obstetric antecedent was identified (Figure 3.9).

While the rate of perinatal related mortality varies from year to year, few changes have occurred for most ethnic groups over the study period 2007–2018. There was some evidence that mortality rates have decreased in babies of New Zealand European mothers. However, the rates did not change for other ethnic groups. Table 3.15 presents the rates of perinatal related mortality by maternal ethnicity over time for the period 2009–2018.

Mortality rates alone do not provide a complete picture of the burden of mortality in specific communities. For communities with high fertility rates, such as Pacific and Māori communities,[25] the burden of perinatal deaths is greater than in communities with lower fertility rates. Therefore, these deaths have a greater impact in the community.

Figure 3.9: Perinatal death classification (PSANZ-PDC) specific perinatal related mortality rates (per 1,000 births, with 95% CIs) (excluding congenital anomalies) by maternal prioritised ethnic category 2014–2018



* 'All other' includes Other Asian, Middle Eastern, Latin American, or African (MELAA), Other European, New Zealand European, Unknown/Other.

's' indicates rate suppressed due to small numbers.

Sources: Numerator: PMMRC's perinatal data extract (excluding congenital anomalies) 2014–2018; Denominator: MAT births 2014–2018.

[25] Statistics New Zealand. 2016. National ethnic population projections. URL: http://archive.stats.govt.nz/browse_for_stats/population/estimates_and_projections/projections-overview/nat-ethnic-pop-proj.aspx. (accessed 26 November 2020).

Table 3.15: Perinatal related mortality rates (per 1,000 births) by maternal prioritised ethnic group* and year 2009–2018

Maternal prioritised ethnic group	2009		2010		2011		2012		2013		2014		2015		2016		2017		2018	
	n	N	n	N	n	N	n	N	n	N	n	N	n	N	n	N	n	N	n	N
Māori	209	17,224	193	17,102	176	16,518	163	16,391	156	15,241	166	14,881	143	15,116	182	15,367	153	15,244	166	14,898
Pacific peoples	106	7,563	107	7,651	79	7,276	94	7,087	84	6,539	83	6,304	71	6,186	73	5,973	82	6,098	73	6,090
Asian	75	6,416	90	7,030	86	7,244	100	8,586	83	8,229	95	9,344	96	9,324	107	10,667	121	10,702	95	10,726
Indian	33	1,931	36	2,081	35	2,153	38	2,368	37	2,445	45	2,760	43	3,116	53	3,500	58	3,862	46	4,217
Other Asian	42	4,485	54	4,949	51	5,091	62	6,218	46	5,784	50	6,584	53	6,208	54	7,167	63	6,840	49	6,509
MELAA	12	1,216	5	1,322	13	1,313	16	1,274	10	1,319	15	1,311	15	1,361	8	1,401	17	1,567	10	1,438
European	328	32,739	312	32,301	313	30,838	297	29,906	267	28,771	299	28,199	253	27,772	241	27,175	220	26,850	260	26,093
NZ European	292	26,541	271	26,105	263	24,820	250	24,040	230	22,895	262	22,304	224	21,900	207	21,379	183	20,929	218	20,209
Other European	36	6,198	41	6,196	50	6,018	47	5,866	37	5,876	37	5,895	29	5,872	34	5,796	37	5,921	42	5,884

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
	Rate	Rate	Rate	Rate	Rate	Rate	Rate	Rate	Rate	Rate
Māori	12.13	11.29	10.66	9.94	10.24	11.16	9.46	11.84	10.04	11.14
Pacific peoples	14.02	13.99	10.86	13.26	12.85	13.17	11.48	12.22	13.45	11.99
Asian	11.69	12.80	11.87	11.65	10.09	10.17	10.30	10.03	11.31	8.86
Indian	17.09	17.30	16.26	16.05	15.13	16.30	13.80	15.14	15.02	10.91
Other Asian	9.36	10.91	10.02	9.97	7.95	7.59	8.54	7.53	9.21	7.53
MELAA	9.87	3.78	9.90	12.56	7.58	11.44	11.02	5.71	10.85	6.95
European	10.02	9.66	10.15	9.93	9.28	10.60	9.11	8.87	8.19	9.96
NZ European	11.00	10.38	10.60	10.40	10.05	11.75	10.23	9.68	8.74	10.79
Other European	5.81	6.62	8.31	8.01	6.30	6.28	4.94	5.87	6.25	7.14

* Excludes 430 unknown maternal ethnicity total births and 2 unknown maternal ethnicity perinatal related deaths (total).

MELAA = Middle Eastern, Latin American, or African.

Sources: Numerator: PMMRC's perinatal data extract 2009–2018; Denominator: MAT births 2009–2018.

Spontaneous preterm labour or rupture of membranes was the leading classification of death for babies of Māori, Pacific, Indian and New Zealand European mothers. However, other leading causes varied by ethnic group. Unexplained antepartum death was a leading classification of death for babies of mothers in the Other Asian and Other European prioritised ethnic groups. For babies of Indian and Other Asian mothers, antepartum haemorrhage was a frequent cause of death. For babies of mothers in the MELAA prioritised ethnic group, antepartum haemorrhage was a leading cause of death (Table 3.16).

Table 3.16: Perinatal death classification (PSANZ-PDC) specific perinatal related mortality rates (excluding congenital anomalies) by maternal prioritised ethnic group* 2014–2018

Perinatal death classification (PSANZ-PDC)	Māori			Pacific peoples			Asian								
							Indian			Other Asian			Total Asian		
	N=75,506			N=30,651			N=17,455			N=33,308			N=50,763		
	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Perinatal infection	45	6.9	0.60	22	7.3	0.72	9	4.9	0.52	8	4.9	0.24	17	4.9	0.33
Hypertension	29	4.5	0.38	12	4.0	0.39	3	1.6	0.17	5	3.0	0.15	8	2.3	0.16
Antepartum haemorrhage	102	15.7	1.35	51	16.9	1.66	37	20.0	2.12	35	21.3	1.05	72	20.6	1.42
Maternal conditions	55	8.5	0.73	38	12.6	1.24	14	7.6	0.80	9	5.5	0.27	23	6.6	0.45
Complications of multiple pregnancy	30	4.6	0.40	13	4.3	0.42	4	2.2	0.23	10	6.1	0.30	14	4.0	0.28
Specific perinatal conditions	17	2.6	0.23	16	5.3	0.52	13	7.0	0.74	10	6.1	0.30	23	6.6	0.45
Hypoxic peripartum death	24	3.7	0.32	3	1.0	0.10	<3	x	s	<3	x	s	4	1.1	0.08
Placental dysfunction or causative placental pathology	54	8.3	0.72	27	9.0	0.88	32	17.3	1.83	20	12.2	0.60	52	14.9	1.02
Spontaneous preterm labour or rupture of membranes (<37 weeks' gestation)	170	26.2	2.25	63	20.9	2.06	41	22.2	2.35	25	15.2	0.75	66	18.9	1.30
Unexplained antepartum fetal death	110	16.9	1.46	51	16.9	1.66	28	15.1	1.60	37	22.6	1.11	65	18.6	1.28
Neonatal death without obstetric antecedent	13	2.0	0.17	5	1.7	0.16	<3	x	s	3	1.8	0.09	5	1.4	0.10

	MELAA			European								
				NZ European			Other European			Total European		
	N=7,078			N=106,721			N=29,368			N=136,089		
	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Perinatal infection	<3	x	s	30	4.1	0.28	6	5.8	0.20	36	4.3	0.26
Hypertension	<3	x	s	21	2.8	0.20	3	2.9	0.10	24	2.8	0.18
Antepartum haemorrhage	7	17.5	0.99	111	15.0	1.04	14	13.5	0.48	125	14.8	0.92
Maternal conditions	3	7.5	0.42	45	6.1	0.42	6	5.8	0.20	51	6.0	0.37
Complications of multiple pregnancy	<3	x	s	44	6.0	0.41	6	5.8	0.20	50	5.9	0.37
Specific perinatal conditions	<3	x	s	74	10.0	0.69	10	9.6	0.34	84	10.0	0.62
Hypoxic peripartum death	<3	x	s	32	4.3	0.30	<3	x	s	33	3.9	0.24
Placental dysfunction or causative placental pathology	<3	x	s	105	14.2	0.98	12	11.5	0.41	117	13.9	0.86
Spontaneous preterm labour or rupture of membranes (<37 weeks' gestation)	6	15.0	0.85	145	19.6	1.36	19	18.3	0.65	164	19.5	1.21
Unexplained antepartum fetal death	5	12.5	0.71	125	16.9	1.17	27	26.0	0.92	152	18.0	1.12
Neonatal death without obstetric antecedent	-	-	-	7	0.9	0.07	-	-	-	7	0.8	0.05

* Excludes 134 unknown maternal ethnicity among total births (denominator) and 2 unknown maternal ethnicity perinatal related deaths (total) (numerator).

'x' indicates percentage suppressed due to small numbers.

's' indicates rate suppressed due to small numbers.

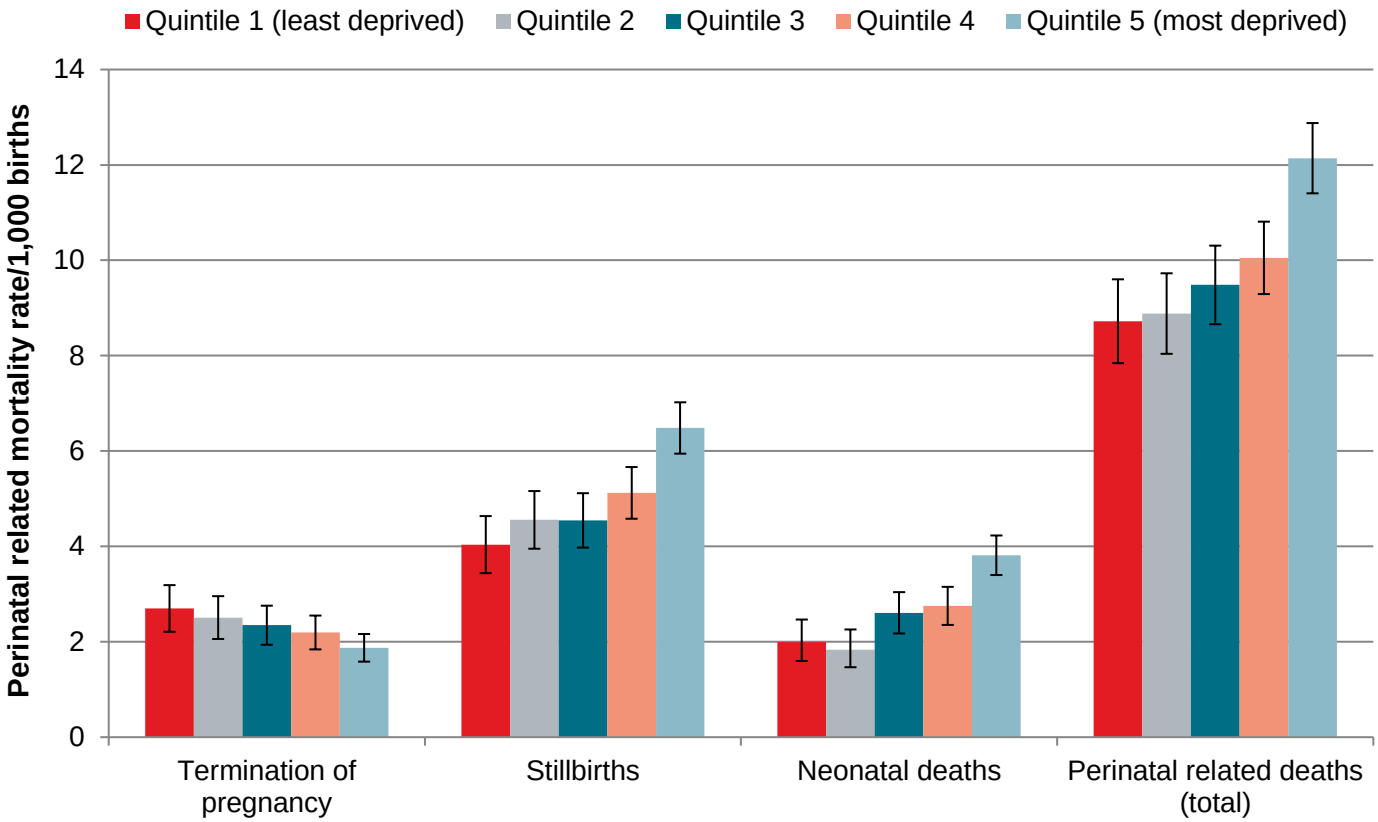
MELAA = Middle Eastern, Latin American, or African.

Sources: Numerator: PMMRC's perinatal data extract (excluding congenital anomalies) 2014–2018; Denominator: MAT births 2014–2018.

Socioeconomic deprivation

Perinatal related mortality varied significantly by NZDep2013 quintile. Babies of mothers living in quintile 5 (most deprived areas) had statistically significantly higher mortality rates than those in all other quintiles for all types of perinatal related mortality except termination of pregnancy (Figure 3.10 and Table 3.17). Although women living in NZDep2013 quintile 5 had a statistically significantly lower rate of termination of pregnancy than those in quintile 1, their rates for both stillbirth and neonatal death were significantly higher.

Figure 3.10: Perinatal related mortality rates (per 1,000 births, with 95% CIs) by NZDep2013 quintile 2014–2018



Sources: Numerator: PMMRC's perinatal data extract 2014–2018; Denominator: MAT births 2014–2018.

Table 3.17: Perinatal related mortality rates (per 1,000 births) by NZDep2013 quintile 2014–2018

Deprivation quintile	Total births		Fetal deaths						Neonatal deaths			Perinatal related deaths (total)		
			Termination of pregnancy			Stillbirths								
	N=300,205		n=673			n=1,545			n=828			n=3,046		
	N	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
1 (least deprived)	43,338	14.4	117	17.4	2.70	175	11.3	4.04	86	10.4	2.00	378	12.4	8.72
2	47,844	15.9	120	17.8	2.51	218	14.1	4.56	87	10.5	1.83	425	14.0	8.88
3	53,671	17.9	126	18.7	2.35	244	15.8	4.55	139	16.8	2.61	509	16.7	9.48
4	66,956	22.3	147	21.8	2.20	343	22.2	5.12	183	22.1	2.75	673	22.1	10.05
5 (most deprived)	85,907	28.6	161	23.9	1.87	557	36.1	6.48	325	39.3	3.82	1,043	34.2	12.14
Unknown	2,489	0.8	<3	x	s	8	0.5	-	8	1.0	-	18	0.6	-

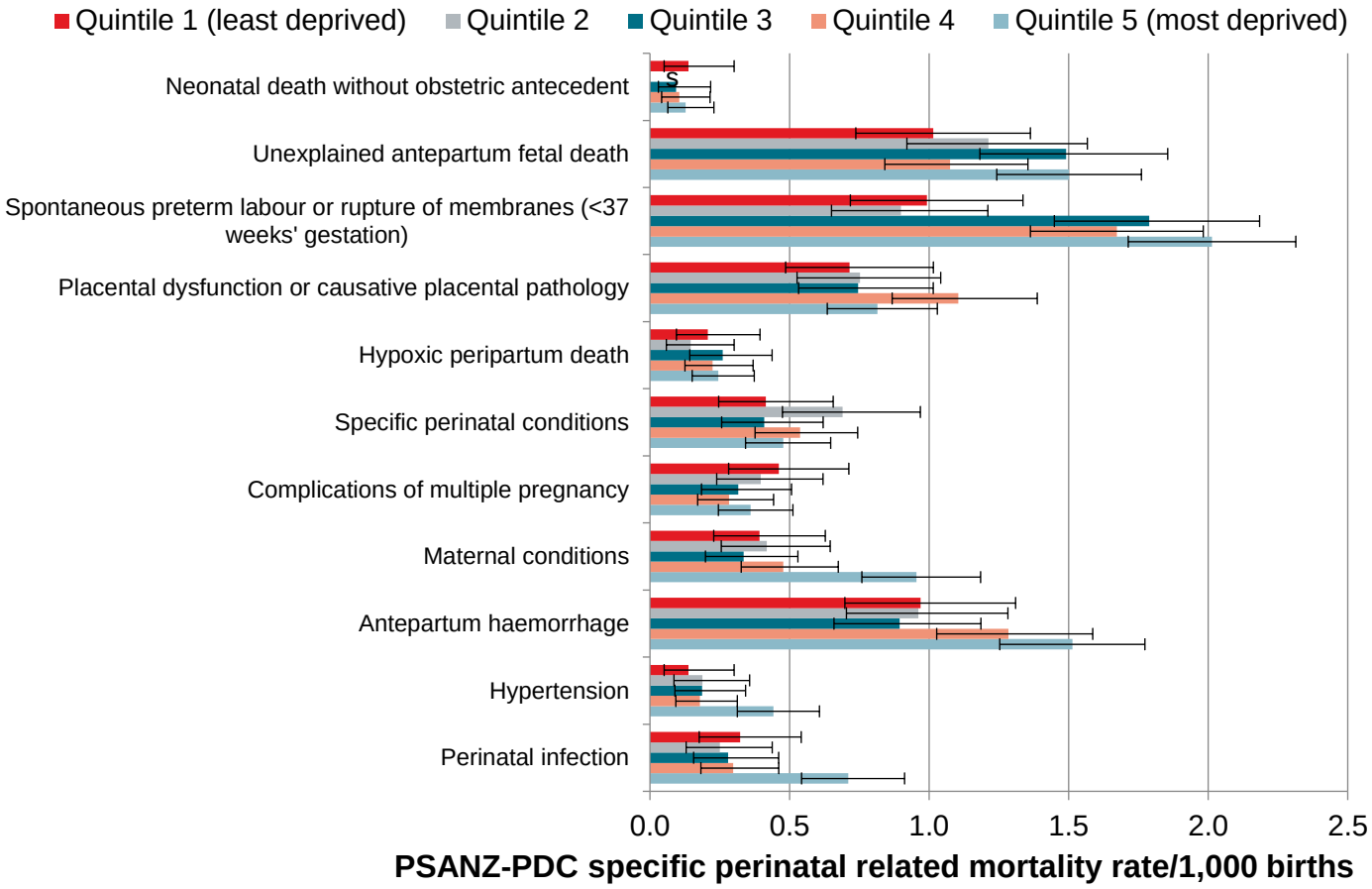
'x' indicates percentage not calculated due to small numbers.

's' indicates rate suppressed due to small numbers.

Sources: Numerator: PMMRC's perinatal data extract 2014–2018; Denominator: MAT births 2014–2018.

This variation in mortality rates by deprivation was most marked for deaths due to spontaneous preterm delivery, for which mortality rates generally increased with increasing deprivation. Other causes of death had little significant variation by deprivation (Figure 3.11 and Table 3.18). This pattern has been stable over time, with no significant changes in mortality rates by deprivation over the period 2007–2018. Table 3.19 presents the rates of perinatal related death by deprivation over time for the period 2009–2018.

Figure 3.11: Perinatal death classification (PSANZ-PDC) specific perinatal related mortality rates (per 1,000 births, with 95% CIs) (excluding congenital anomalies) by NZDep2013 quintile* 2014–2018



* Excludes 13 babies with unknown NZDep2013 quintile.

‘s’ indicates rate suppressed due to small numbers.

Sources: Numerator: PMMRC’s perinatal data extract (excluding congenital anomalies) 2014–2018; Denominator: MAT births 2014–2018.

Table 3.18: Perinatal death classification (PSANZ-PDC) specific perinatal related mortality rates (per 1,000 births) (excluding congenital anomalies) by NZDep2013 quintile* 2014–2018

Perinatal death classification (PSANZ-PDC)	Quintile 1 (least deprived)			Quintile 2			Quintile 3			Quintile 4			Quintile 5 (most deprived)		
	N=43,338			N=47,844			N=53,671			N=66,956			N=85,907		
	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Perinatal infection	14	5.6	0.32	12	4.2	0.25	15	4.1	0.28	20	4.1	0.30	61	7.8	0.71
Hypertension	6	2.4	0.14	9	3.2	0.19	10	2.7	0.19	12	2.5	0.18	38	4.8	0.44
Antepartum haemorrhage	42	16.8	0.97	46	16.2	0.96	48	13.2	0.89	86	17.7	1.28	130	16.5	1.51
Maternal conditions	17	6.8	0.39	20	7.0	0.42	18	4.9	0.34	32	6.6	0.48	82	10.4	0.95
Complications of multiple pregnancy	20	8.0	0.46	19	6.7	0.40	17	4.7	0.32	19	3.9	0.28	31	3.9	0.36
Specific perinatal conditions	18	7.2	0.42	33	11.6	0.69	22	6.0	0.41	36	7.4	0.54	41	5.2	0.48
Hypoxic peripartum death	9	3.6	0.21	7	2.5	0.15	14	3.8	0.26	15	3.1	0.22	21	2.7	0.24
Placental dysfunction or causative placental pathology	31	12.4	0.72	36	12.7	0.75	40	11.0	0.75	74	15.3	1.11	70	8.9	0.81
Spontaneous preterm labour or rupture of membranes (<37 weeks' gestation)	43	17.2	0.99	43	15.1	0.90	96	26.3	1.79	112	23.1	1.67	173	22.0	2.01
Unexplained antepartum fetal death	44	17.6	1.02	58	20.4	1.21	80	21.9	1.49	72	14.8	1.08	129	16.4	1.50
Neonatal death without obstetric antecedent	6	2.4	0.14	<3	x	s	5	1.4	0.09	7	1.4	0.10	11	1.4	0.13

* Excludes 13 babies with unknown NZDep2013 quintile.

'x' indicates percentage suppressed due to small numbers.

's' indicates rate suppressed due to small numbers.

Sources: Numerator: PMMRC's perinatal data extract (excluding congenital anomalies) 2014–2018; Denominator: MAT births 2014–2018.

Table 3.19: Perinatal related mortality rates (per 1,000 births) by NZDep quintile and year 2009–2018

Deprivation quintile	2009		2010		2011		2012		2013		2014		2015		2016		2017		2018	
	n	N	n	N	n	N	n	N	n	N	n	N	n	N	n	N	n	N	n	N
1 (least deprived)	76	9,103	80	9,028	103	8,828	80	8,969	59	8,316	93	8,602	74	8,373	69	8,816	70	8,922	72	8,625
2	106	9,539	104	9,782	99	9,551	89	9,545	78	9,378	77	9,321	83	9,478	91	9,797	93	9,763	81	9,485
3	120	12,101	117	12,161	116	11,684	106	11,772	126	10,791	118	10,703	90	10,732	99	10,857	104	10,874	98	10,505
4	178	15,189	155	15,206	152	14,788	140	14,715	114	13,566	138	13,469	138	13,436	127	13,471	118	13,364	152	13,216
5 (most deprived)	249	18,586	251	18,638	195	17,774	254	17,750	220	17,571	229	17,435	189	17,252	224	17,177	205	17,112	196	16,931
Unknown	<3	685	<3	634	<3	618	<3	535	3	515	4	550	4	512	<3	488	3	443	5	496

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
	Rate	Rate	Rate	Rate	Rate	Rate	Rate	Rate	Rate	Rate
1 (least deprived)	8.35	8.86	11.67	8.92	7.09	10.81	8.84	7.83	7.85	8.35
2	11.11	10.63	10.37	9.32	8.32	8.26	8.76	9.29	9.53	8.54
3	9.92	9.62	9.93	9.00	11.68	11.02	8.39	9.12	9.56	9.33
4	11.72	10.19	10.28	9.51	8.40	10.25	10.27	9.43	8.83	11.50
5 (most deprived)	13.40	13.47	10.97	14.31	12.52	13.13	10.96	13.04	11.98	11.58
Unknown	-	-	-	-	-	-	-	-	-	-

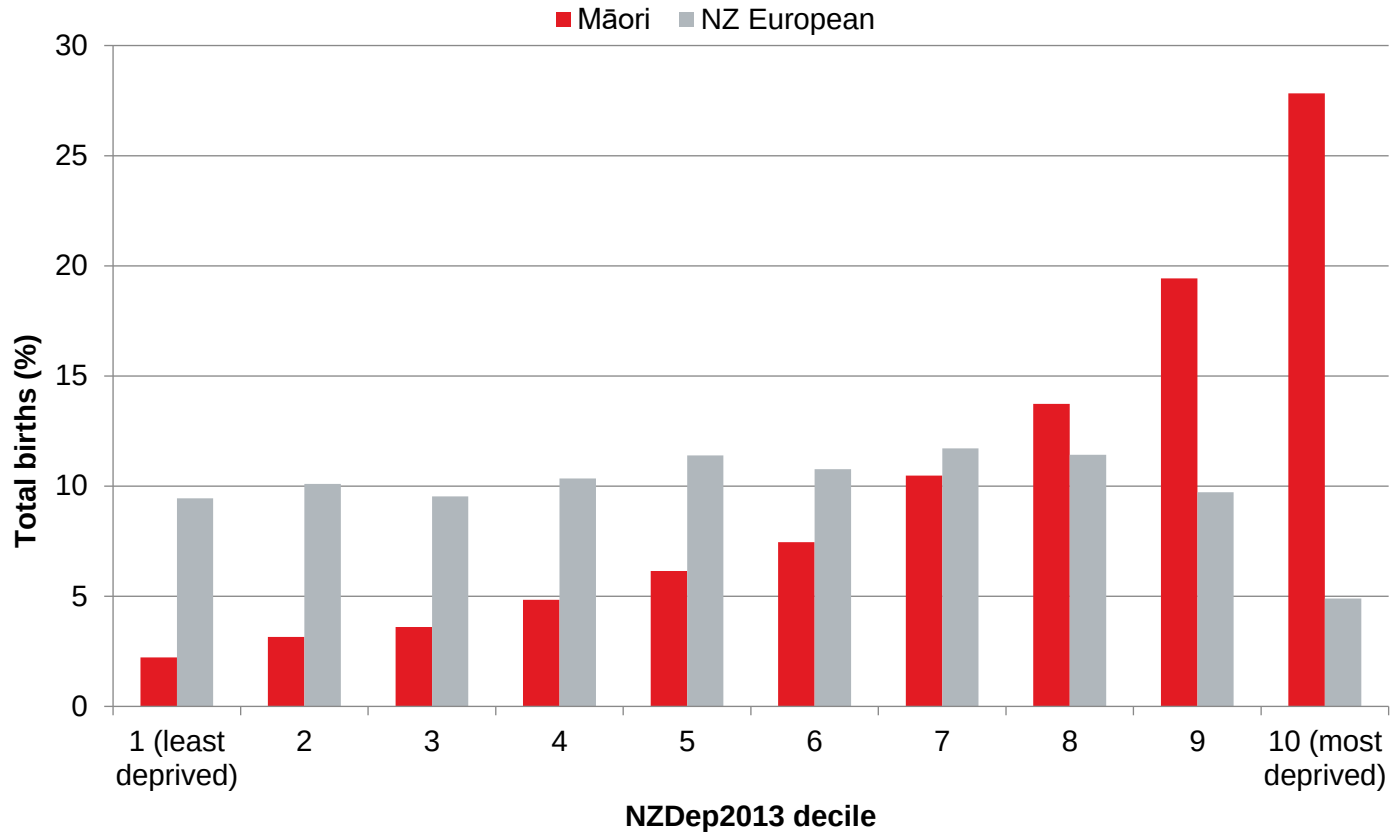
Sources: Numerator: PMMRC's perinatal data extract 2009–2018; Denominator: MAT births 2009–2018.

When examining the effect of deprivation on Māori and New Zealand Europeans, it is important to consider how deprivation levels are distributed in these two groups. Figure 3.12 shows the distribution of all infants born in Aotearoa/New Zealand by residential NZDep2013 decile over the period 2009–2018. Deprivation deciles, as the name implies, divide the population of Aotearoa/New Zealand into 10 groups (deciles), with 10% of the population in each one. For babies of New Zealand European mothers, approximately 10% of the population lives in each decile, with the exception of decile 10, in which 5% of this group lives. In contrast, very few Māori babies are born into NZDep2013 deciles 1 to 5, while nearly half (47%) are born into deciles 9 and 10, compared with 15% of babies born to New Zealand European mothers for these two deciles combined. Clearly the distribution of deprivation between babies of Māori and New Zealand European mothers is unequal.

In this context, Figure 3.13 shows the perinatal related mortality rate by NZDep2013 decile. Overall, mortality rates increase with increasing deprivation for babies of both Māori and New Zealand European mothers. Those in decile 10 have the highest mortality rates.

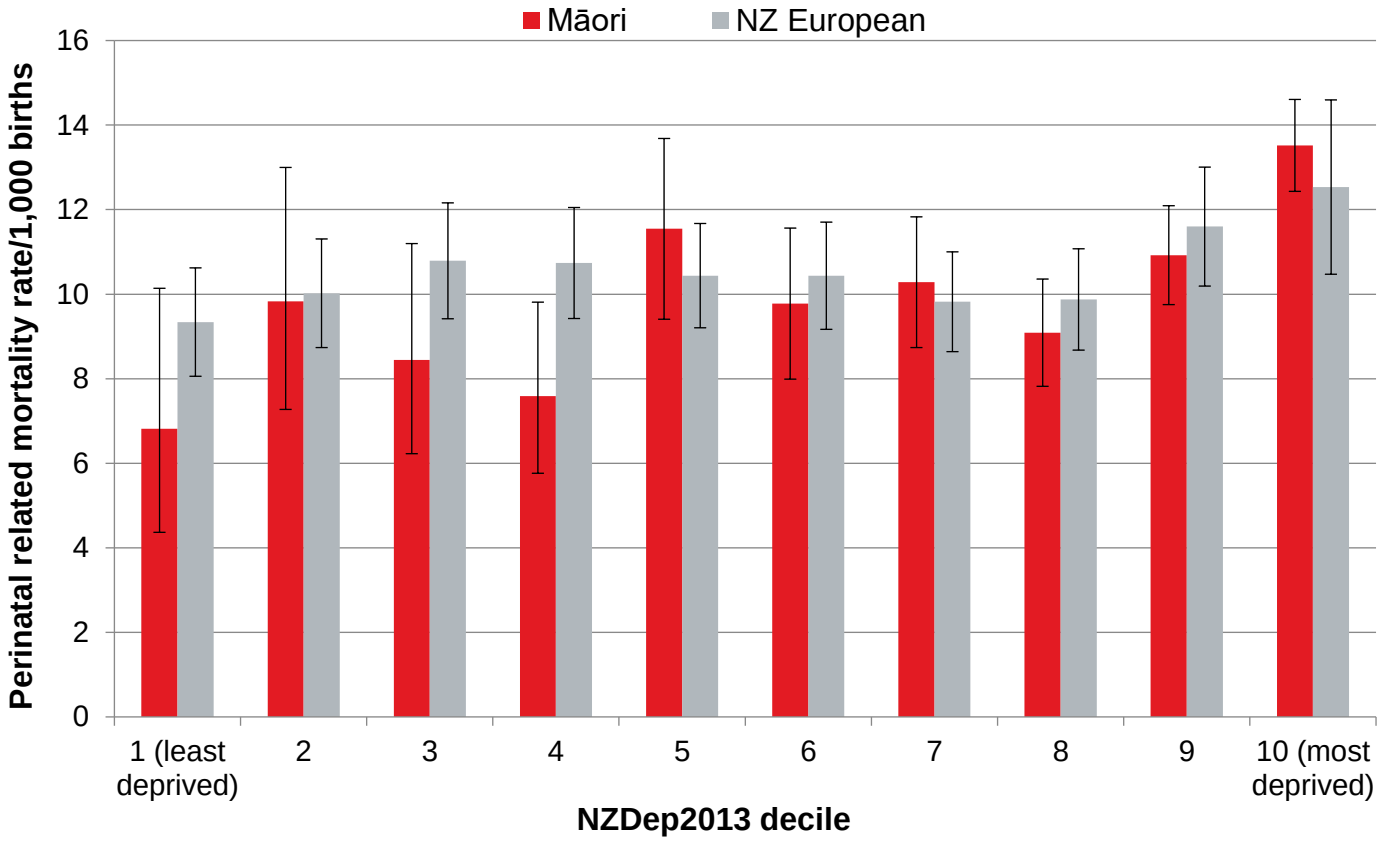
Because Māori mortality rates are highest in babies in decile 10 areas, and the proportion of Māori babies born into decile 10 areas is high, Māori are disproportionately affected by perinatal related mortality. Figure 3.14 presents the number of deaths by NZDep2013 decile, and shows that Māori communities living in decile 10 areas experience the burden of perinatal related mortality, with nearly twice as many deaths in this group as in any other.

Figure 3.12: All births by NZDep decile, Māori and New Zealand European 2009–2018



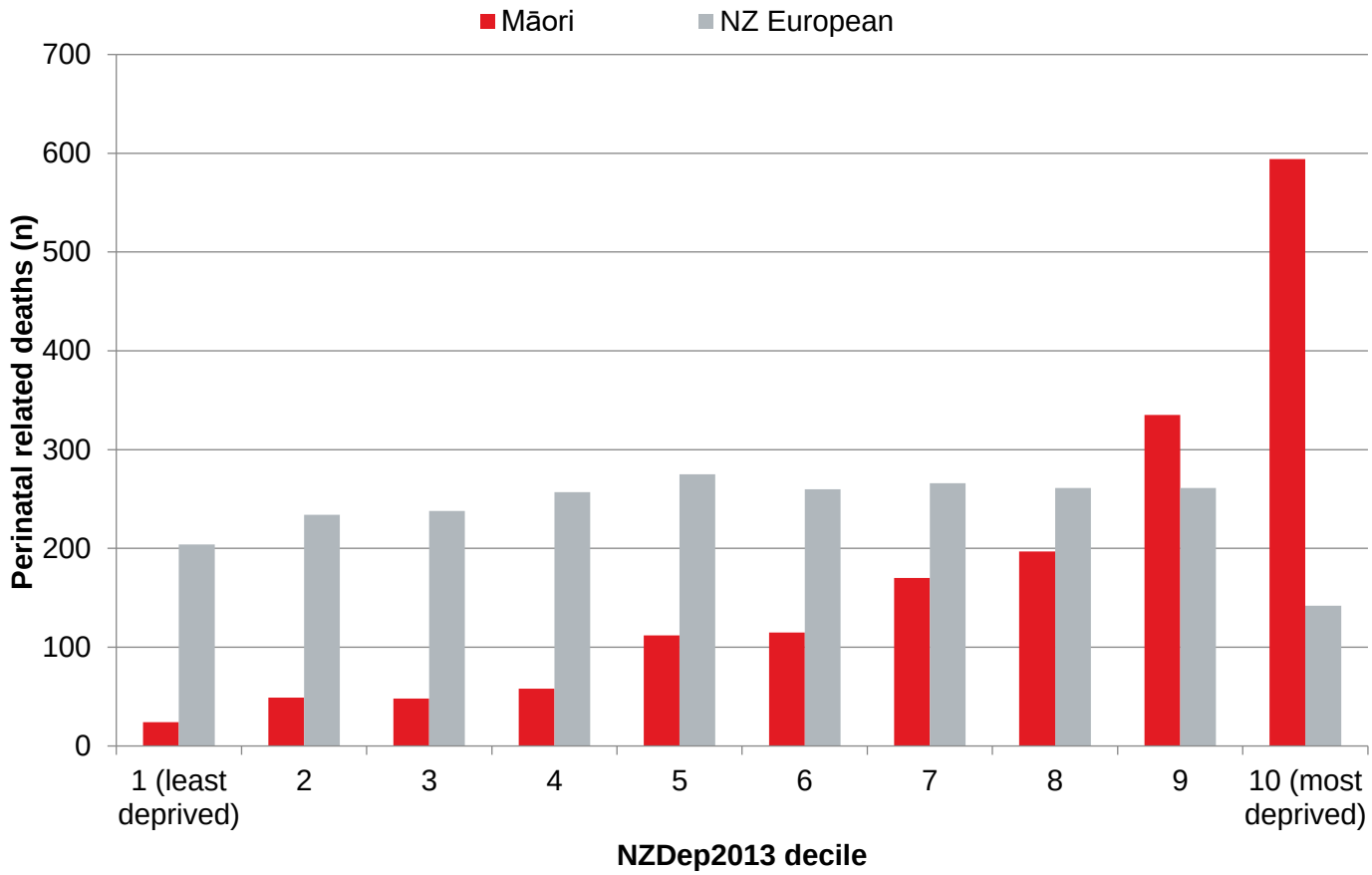
Source: MAT births 2009–2018.

Figure 3.13: Perinatal related mortality rates (per 1,000 births, with 95% CIs) by NZDep decile, Māori and New Zealand European 2009–2018



Sources: Numerator: PMMRC's perinatal data extract 2009–2018; Denominator: MAT births 2009–2018.

Figure 3.14: Perinatal related mortality (number of deaths) by NZDep decile, Māori and New Zealand European 2009–2018



Source: PMMRC's perinatal data extract 2009–2018.

Poverty

It is a consistent and enduring finding in this report series that living in the most deprived areas of Aotearoa/New Zealand is associated with increased mortality in babies. Area deprivation, as measured by NZDep2013, can only provide information on the area that people live in, rather than on their individual circumstances. However, the finding is clear and consistent that mortality increases with increasing area-level deprivation.

To hypothesise about how living in a deprived area might contribute to poor health outcomes, we have considered the literature on poverty. While we are not measuring individual-level poverty in this report, there is likely to be a strong correlation between a higher prevalence of poverty and living in a high-deprivation area.

Research on the relationship between individual and area-level poverty in Aotearoa/New Zealand is rare. However, one study, which looked only at a single area, found that while household-level socioeconomic status (as measured by an occupation-based index) did vary, the majority of households in high-deprivation areas were also considered to have low socioeconomic status.[26]

About 682,500 people, or one in seven households, live in poverty in Aotearoa/New Zealand, including around 220,000 children.[27] Poverty is not just limited to those receiving benefits, although it is common in this group. Plum et al[28] found that in households where at least one adult identified as being of Māori ethnicity (prioritised), 8.6%

[26] Jamieson LM, Thomson WM. 2006. Adult oral health inequalities described using area-based and household-based socioeconomic status measures. *Journal of Public Health Dentistry* 66(2): 104–9.

[27] New Zealand Council of Christian Social Services. nd. Facts about poverty in New Zealand. URL: https://nzccss.org.nz/work/poverty/facts-about-poverty/#:~:text=There%20is%20poverty%20amidst%20prosperity,households%2C%20including%20around%20220%2C000%20children (accessed 26 June 2020).

[28] Plum A, Pacheco G, Hick R. 2019. *In-work Poverty in New Zealand*. Auckland: New Zealand Work Research Institute.

experienced in-work poverty, compared with 5.9% of New Zealand Europeans. Other ethnic groups with higher rates of in-work poverty than New Zealand Europeans were Pacific peoples (9.5%), Asians (9.4%) and MELAA (9.5%).

Poverty can impact on health directly, in that people are unable to afford primary care, unable to pay for prescription medicines and less likely to have health insurance. Indirect ways in which poverty can contribute to poor health outcomes include food insecurity,[29] less access to transport and the stress of living with inadequate resources.[30,31] Lowly paid jobs are also less likely to allow employees the flexibility to have time off work to attend appointments. For those living in rural areas, poverty is compounded by difficulties of geographical access to health care.[32] The stress of living in poverty can affect all facets of life, reducing the control individuals have over their lives. Acting through a number of different pathways, poverty is associated with certain adverse perinatal outcomes, such as pre-eclampsia and preterm birth.[33]

Body mass index (BMI)

This report uses BMI as a proxy indicator of risk to the health of both the mother and baby. Higher BMI also has implications for the provision of care, as we discussed in our 13th report.[34]

Our analysis of data from both MAT (Table 3.20 and Figure 3.15) and the PMMRC (Table 3.21) shows that mortality from stillbirths, neonatal deaths and perinatal related deaths overall increased with increasing maternal BMI. Due to incomplete matching between the two data sets, some individuals who were in the PMMRC data set were not in MAT, and in other situations individuals in MAT could not be matched to the PMMRC records. Using PMMRC data for maternal BMI (numerator) had the net effect of reducing the number of women in BMI category 30.0–34.9 and increasing the numbers of women in BMI categories 35.0–39.9 and ≥40.0. This suggests that MAT records underestimate true maternal BMI.

[29] Smith C, Parnell WR, Brown RC, et al. 2012. Balancing diet and the budget: food purchasing practices of food-insecure families in New Zealand. *Nutrition & Dietetics* 70: 278–85.

[30] Saunders P. 1998. Poverty and health: exploring the links between financial stress and emotional stress in Australia. *Australian and New Zealand Journal of Public Health* 22(1):11–6.

[31] Carter KN, Kruse K, Blakely T, et al. 2011. The association of food security with psychological distress in New Zealand and any gender differences. *Social Science & Medicine* 72(9): 1463–71.

[32] Pearce J, Witten K, Hiscock R, et al. 2008. Regional and urban–rural variations in the association of neighbourhood deprivation with community resource access: a national study. *Environment and Planning* 40: 2469–89.

[33] Nagahawatte NT, Goldenberg RL. 2008. Poverty, maternal health, and adverse pregnancy outcomes. *Annals of the New York Academy of Sciences* 1136: 80–5.

[34] PMMRC. 2019. *Te Pūrongo ā-Tau Tekau mā Toru o te Komiti Arotake Mate Pēpi, Mate Whaea Hoki | Thirteenth Annual Report of the Perinatal and Maternal Mortality Review Committee: Te tuku pūrongo mō te mate me te whakamate 2017 | Reporting mortality and morbidity 2017.* Wellington: Health Quality & Safety Commission. URL: https://www.hqsc.govt.nz/assets/PMMRC/Publications/13thPMMRCreport/13thPMMRCAnnualReportWebFINAL.pdf (accessed 18 September 2020).

Table 3.20: Perinatal related mortality rates (per 1,000 births) by maternal BMI at registration with maternity care 2014–2018 using MAT data*

Maternal BMI (kg/m^2)	Total births		Fetal deaths						Neonatal deaths			Perinatal related deaths (total)		
			Termination of pregnancy			Stillbirths								
	N=275,887		n=550			n=1,260			n=655			n=2,465		
	N	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
<18.5	7,475	2.7	11	2.0	1.47	20	1.6	2.68	14	2.1	1.88	45	1.8	6.02
18.5–24.9	129,585	47.0	282	51.3	2.18	484	38.4	3.74	254	38.8	1.97	1,020	41.4	7.87
25.0–29.9	71,857	26.0	140	25.5	1.95	363	28.8	5.05	175	26.7	2.45	678	27.5	9.44
30.0–34.9	37,975	13.8	77	14.0	2.03	193	15.3	5.08	117	17.9	3.10	387	15.7	10.19
35.0–39.9	17,965	6.5	25	4.5	1.39	116	9.2	6.46	54	8.2	3.03	195	7.9	10.85
≥40.0	10,520	3.8	14	2.5	1.33	80	6.3	7.60	40	6.1	3.84	134	5.4	12.74
Unknown	510	0.2	<3	x	-	4	0.3	-	<3	x	-	6	0.2	-
Data not supplied to MAT			14			5			-3			16		

* All data limited to mothers who were registered for care with an LMC (a midwife, obstetrician or GP) claiming from the Section 88 Primary Maternity Services Notice.

BMI = body mass index.

'x' indicates percentage suppressed due to small numbers.

Sources: Numerator: PMMRC's perinatal data extract where matched to MAT data, 2014–2018; Denominator: MAT births 2014–2018.

Table 3.21: Perinatal related mortality rates (per 1,000 births) by maternal BMI at registration with maternity care 2014–2018 using PMMRC and MAT data*

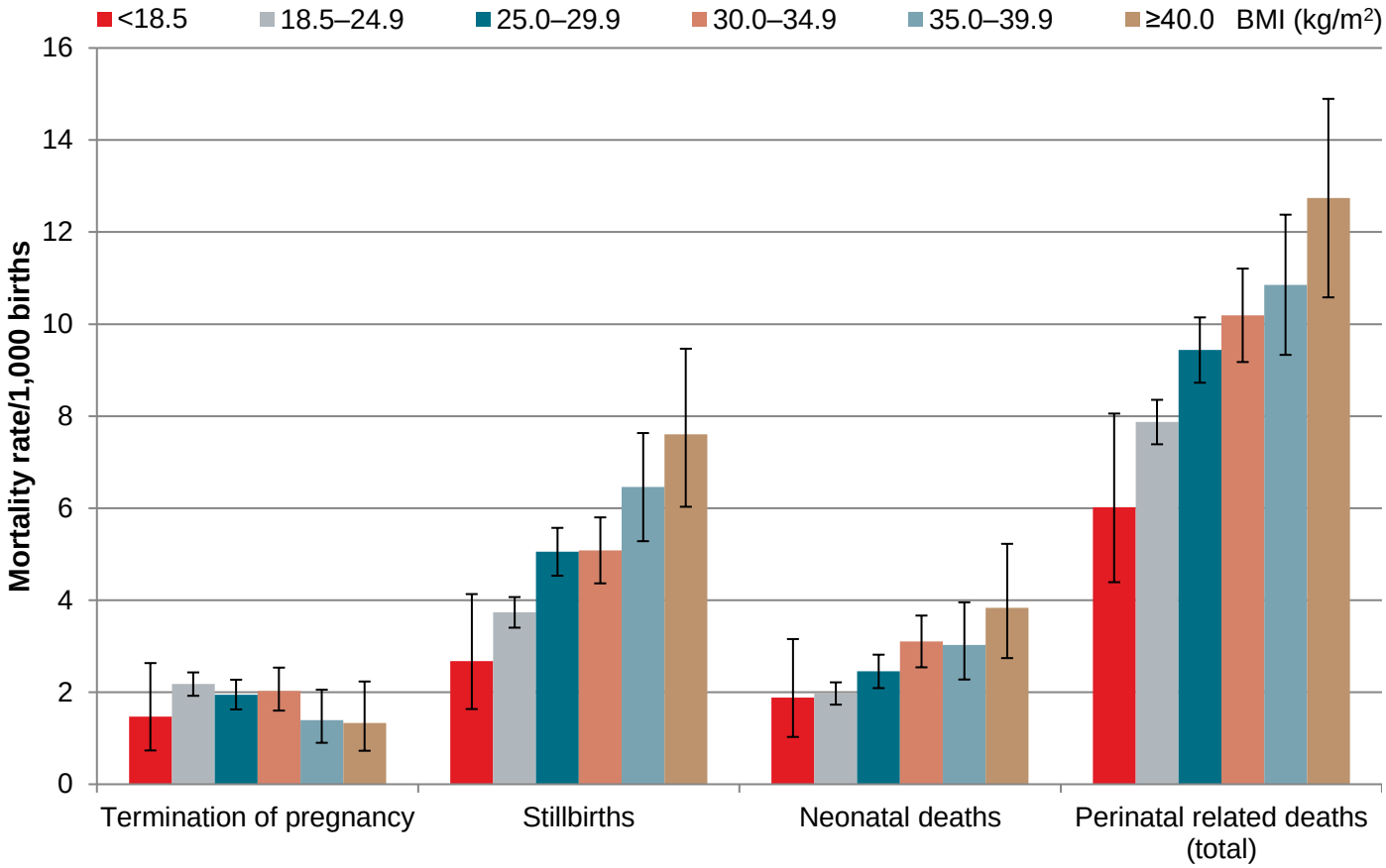
Maternal BMI (kg/m^2)	Total births		Fetal deaths						Neonatal deaths			Perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	N=275,887		n=564			n=1,265			n=652			n=2,481		
	N	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
<18.5	7,475	2.7	11	2.0	1.47	22	1.7	2.94	11	1.7	1.48	44	1.8	5.89
18.5–24.9	129,585	47.0	283	50.2	2.18	479	37.9	3.70	261	40.0	2.03	1,023	41.2	7.89
25.0–29.9	71,857	26.0	147	26.1	2.05	354	28.0	4.93	171	26.2	2.40	672	27.1	9.35
30.0–34.9	37,975	13.8	76	13.5	2.00	198	15.7	5.21	102	15.6	2.71	376	15.2	9.90
35.0–39.9	17,965	6.5	22	3.9	1.22	120	9.5	6.68	59	9.0	3.31	201	8.1	11.19
≥40.0	10,520	3.8	19	3.4	1.81	87	6.9	8.27	43	6.6	4.13	149	6.0	14.16
Unknown	510	0.2	6	1.1	-	5	0.4	-	5	0.8	-	16	0.6	-

* All data limited to mothers who were registered for care with an LMC (a midwife, obstetrician or GP) claiming from the Section 88 Primary Maternity Services Notice.

BMI = body mass index.

Sources: Numerator: PMMRC's perinatal data extract 2014–2018; Denominator: MAT births 2014–2018.

Figure 3.15: Perinatal related death rates (per 1,000 births, with 95% CIs) by maternal BMI* 2014–2018



* All data limited to mothers who were registered for care with an LMC (a midwife, obstetrician or GP) claiming from the Section 88 Primary Maternity Services Notice.

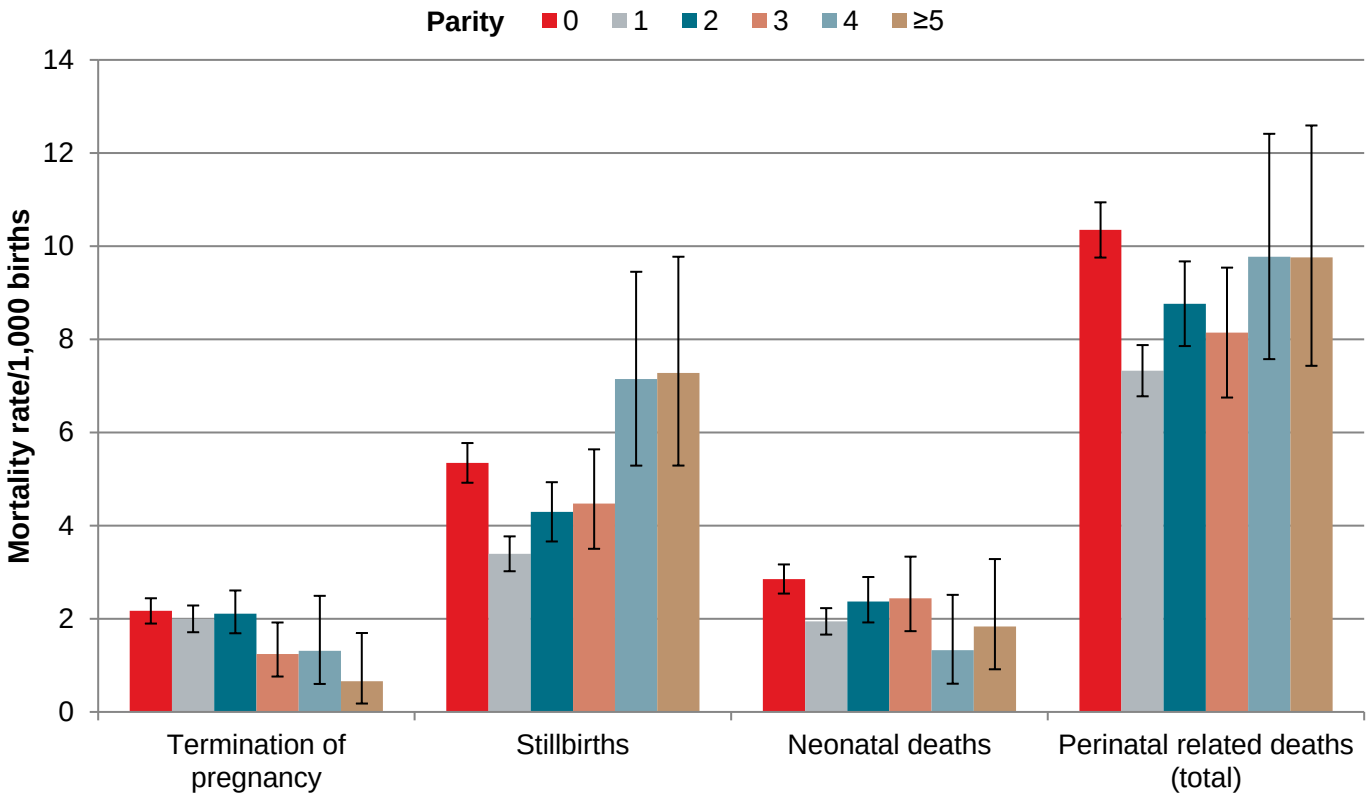
BMI = body mass index.

Sources: Numerator: PMMRC's perinatal data extract where matched to MAT data, 2014–2018; Denominator: MAT births 2014–2018.

Parity

Overall, mortality rates showed a U-shaped curve by parity, with the highest rates for primiparous women (women having their first baby after 20 weeks' gestation, also referred to as 'parity 0') and multiparous women with four or more previous babies. This was largely driven by the high rate of stillbirths. Rates of neonatal death were statistically significantly higher for primiparous women compared with women with one previous baby. Terminations of pregnancy showed no statistically significant variation in mortality by parity (Figure 3.16 and Table 3.22).

Figure 3.16: Perinatal related mortality rates (per 1,000 births, with 95% CIs) by maternal parity* 2014–2018



* All data limited to mothers who were registered for care with an LMC (a midwife, obstetrician or GP) claiming from the Section 88 Primary Maternity Services Notice.

Parity '0' indicates women having their first baby or babies of 20 weeks' or greater gestation.

Sources: Numerator: PMMRC's perinatal data extract where matched to MAT data, 2014–2018; Denominator: MAT births 2014–2018.

Table 3.22: Perinatal related mortality rates (per 1,000 births) by parity* 2014–2018

Parity	Total births		Fetal deaths						Neonatal deaths			Perinatal related deaths (total)		
			Termination of pregnancy			Stillbirths								
	N=275,887		n=550			n=1,260			n=655			n=2,465		
	N	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
0	112,965	40.9	245	44.5	2.17	604	47.9	5.35	320	48.9	2.85	1,169	47.4	10.35
1	93,086	33.7	186	33.8	2.00	316	25.1	3.39	180	27.5	1.94	682	27.7	7.33
2	40,733	14.8	86	15.6	2.11	175	13.9	4.30	96	14.7	2.37	357	14.5	8.76
3	16,084	5.8	20	3.6	1.24	72	5.7	4.48	39	6.0	2.44	131	5.3	8.14
4	6,855	2.5	9	1.6	1.31	49	3.9	7.15	9	1.4	1.32	67	2.7	9.77
≥5	6,044	2.2	4	0.7	0.66	44	3.5	7.28	11	1.7	1.83	59	2.4	9.76
Unknown	120	0.0	-	-	-	-	-	-	-	-	-	-	-	-
Data not supplied to MAT			15			14			<3			30		

* All data limited to mothers who were registered for care with an LMC (a midwife, obstetrician or GP) claiming from the Section 88 Primary Maternity Services Notice.

Parity '0' indicates women having their first baby or babies of 20 weeks' or greater gestation.

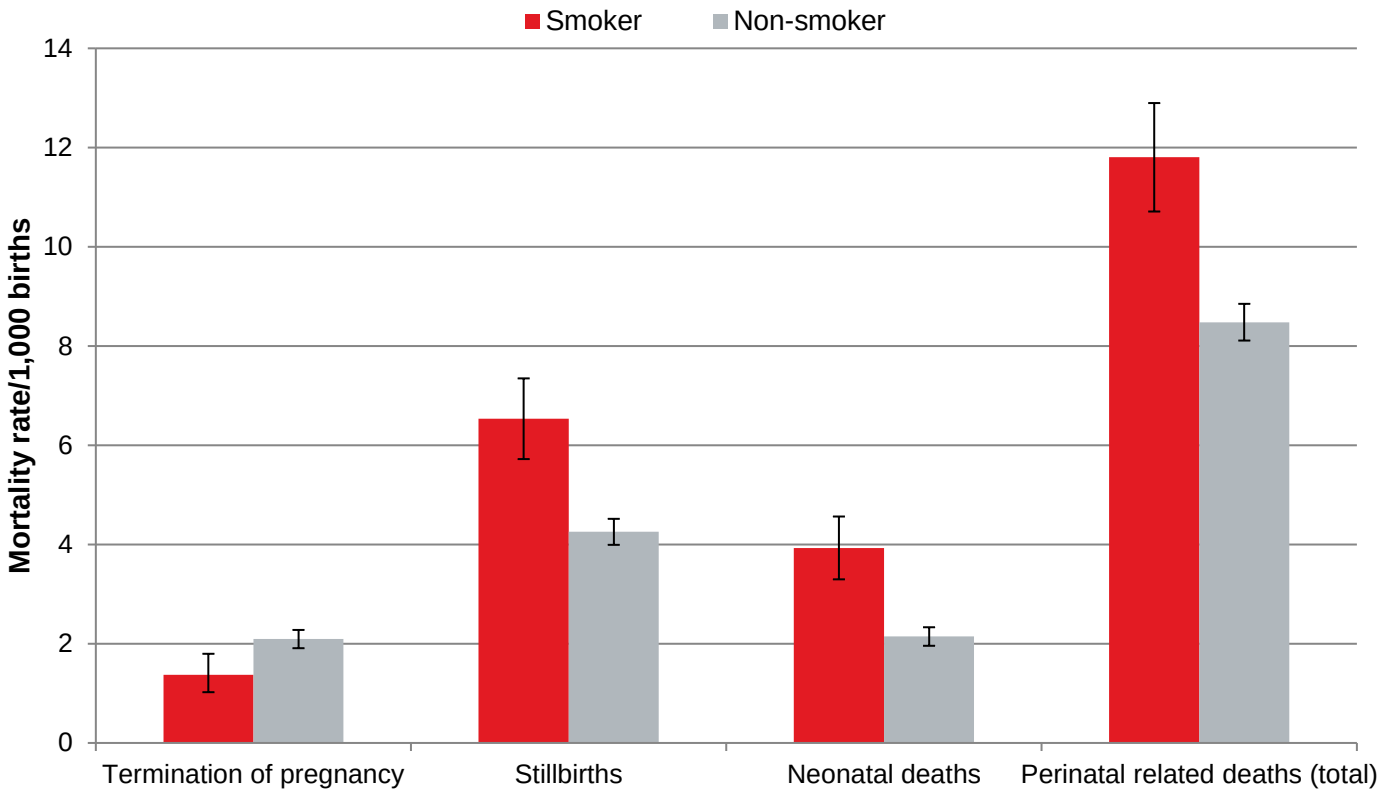
Sources: Numerator: PMMRC's perinatal data extract where matched to MAT data, 2014–2018; Denominator: MAT births 2014–2018.

Maternal smoking

Smoking is a significant risk to health outcomes for babies, and the literature provides evidence of improved outcomes after pregnant mothers stop smoking.[35] Data on smoking in pregnancy come from MAT and are based on LMC registration data; specifically, the smoking status of the woman at first LMC registration.[36]

Our data showed mortality rates were statistically significantly higher in babies of mothers who smoked, compared with those who did not smoke, for all types of death, except for termination of pregnancy (Figure 3.17 and Table 3.23).

Figure 3.17: Perinatal related mortality rates (per 1,000 births, with 95% CIs) by smoking at registration with maternity care* 2014–2018



* All data limited to mothers who were registered for care with an LMC (a midwife, obstetrician or GP) claiming from the Section 88 Primary Maternity Services Notice.

Sources: Numerator: PMMRC's perinatal data extract where matched to MAT data, 2014–2018; Denominator: MAT births 2014–2018.

[35] McCowan L, Dekker GA, Chan E, et al. 2009. Spontaneous preterm birth and small for gestational age infants in women who stop smoking early in pregnancy: prospective cohort study. *BMJ* 338: b1081. doi: 10.1136/bmj.b1081 (accessed 15 August 2019).

[36] National Health Board Business Unit. 2011. *National Maternity Collection Data Mart Data Dictionary*. URL: https://www.health.govt.nz/system/files/documents/publications/mat-dict-v1-0.pdf (accessed 28 November 2020), p 174.

Table 3.23: Perinatal related mortality rates (per 1,000 births) by smoking at registration with maternity care* 2014–2018

Maternal smoking at registration	Total births		Fetal deaths						Neonatal deaths			Perinatal related deaths (total)		
			Termination of pregnancy			Stillbirths								
	N=275,887		n=550			n=1,260			n=655			n=2,465		
	N	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Smoker	37,952	13.8	52	9.5	1.37	248	19.7	6.53	148	22.6	3.93	448	18.2	11.80
Non-smoker	237,849	86.2	498	90.5	2.09	1,012	80.3	4.25	507	77.4	2.15	2,017	81.8	8.48
Unknown	86	0.0	-	-	-	-	-	-	-	-	-	-	-	-
Data not supplied to MAT			15			14			<3			30		

* All data limited to mothers who were registered for care with an LMC (a midwife, obstetrician or GP) claiming from the Section 88 Primary Maternity Services Notice.

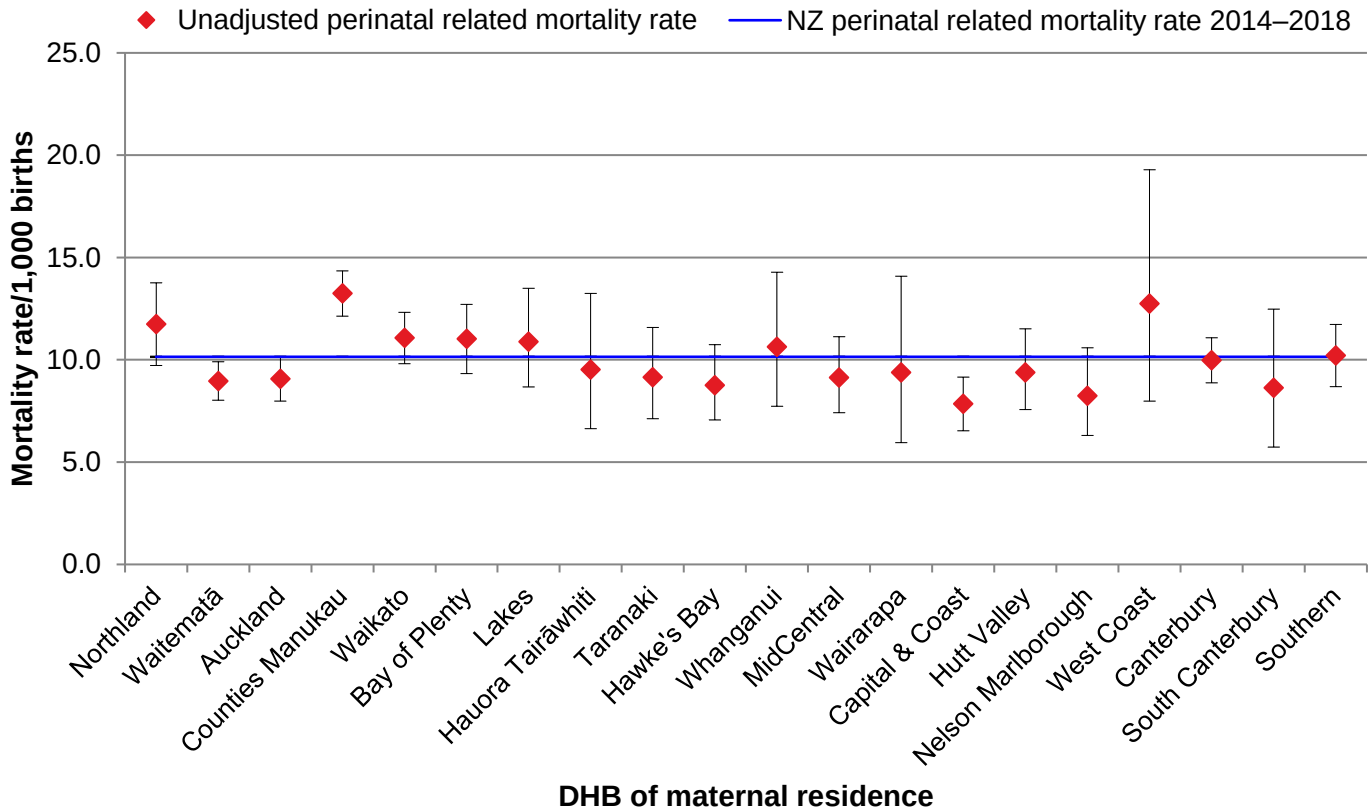
Sources: Numerator: PMMRC's perinatal data extract where matched to MAT data, 2014–2018; Denominator: MAT births 2014–2018.

DHB of residence

Mortality rates by DHB may vary for a number of reasons. Influences on mortality rates include underlying population characteristics, geographic isolation, resourcing, delivery of care and other factors. Despite this, DHBs are charged with meeting the needs of the population they serve. Furthermore, DHBs that have a mortality rate similar to the national rate may still have groups within their region who do not experience the same level of care and outcomes as others, suggesting that an assessment of any subgroups that are experiencing worse outcomes within each DHB could be beneficial.

Perinatal related mortality rates varied by DHB of residence. The rates in Waitematā and Capital & Coast DHBs were statistically significantly lower than the national rate of 10.15 per 1,000 births. Conversely, the rates in Counties Manukau DHB were statistically significantly higher than the national rate (Figure 3.18 and Table 3.24).

Figure 3.18: Unadjusted perinatal related mortality rates (per 1,000 births, with 95% CIs) by DHB of maternal residence compared with New Zealand perinatal related mortality 2014–2018



Sources: Numerator: PMMRC's perinatal data extract 2014–2018; Denominator: MAT births 2014–2018.

Table 3.24: Perinatal related mortality rates (per 1,000 births) by DHB of maternal residence 2014–2018

DHB of maternal residence	Total births		Fetal deaths						Neonatal deaths			Perinatal related deaths (total)		
			Termination of pregnancy			Stillbirths								
	N=300,205		n=673			n=1,545			n=828			n=3,046		
	N	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Northland	11,072	3.7	27	4.0	2.44	73	4.7	6.59	30	3.6	2.73	130	4.3	11.74
Waitematā	39,041	13.0	108	16.0	2.77	164	10.6	4.20	78	9.4	2.01	350	11.5	8.96
Auckland	29,548	9.8	85	12.6	2.88	116	7.5	3.93	67	8.1	2.28	268	8.8	9.07
Counties Manukau	41,695	13.9	100	14.9	2.40	279	18.1	6.69	173	20.9	4.19	552	18.1	13.24
Waikato	26,934	9.0	63	9.4	2.34	152	9.8	5.64	83	10.0	3.11	298	9.8	11.06
Bay of Plenty	14,794	4.9	26	3.9	1.76	86	5.6	5.81	51	6.2	3.47	163	5.4	11.02
Lakes	7,624	2.5	16	2.4	2.10	48	3.1	6.30	19	2.3	2.51	83	2.7	10.89
Hauora Tairāwhiti	3,675	1.2	4	0.6	1.09	23	1.5	6.26	8	1.0	2.19	35	1.1	9.52
Taranaki	7,540	2.5	13	1.9	1.72	31	2.0	4.11	25	3.0	3.34	69	2.3	9.15
Hawke's Bay	10,506	3.5	18	2.7	1.71	55	3.6	5.24	19	2.3	1.82	92	3.0	8.76
Whanganui	4,136	1.4	6	0.9	1.45	22	1.4	5.32	16	1.9	3.89	44	1.4	10.64
MidCentral	10,732	3.6	21	3.1	1.96	44	2.8	4.10	33	4.0	3.09	98	3.2	9.13
Wairarapa	2,450	0.8	3	0.4	1.22	15	1.0	6.12	5	0.6	2.06	23	0.8	9.39
Capital & Coast	17,468	5.8	19	2.8	1.09	80	5.2	4.58	38	4.6	2.19	137	4.5	7.84
Hutt Valley	9,801	3.3	12	1.8	1.22	52	3.4	5.31	28	3.4	2.88	92	3.0	9.39
Nelson Marlborough	7,402	2.5	16	2.4	2.16	26	1.7	3.51	19	2.3	2.58	61	2.0	8.24
West Coast	1,727	0.6	3	0.4	1.74	14	0.9	8.11	5	0.6	2.92	22	0.7	12.74
Canterbury	31,582	10.5	78	11.6	2.47	158	10.2	5.00	79	9.5	2.52	315	10.3	9.97
South Canterbury	3,243	1.1	5	0.7	1.54	13	0.8	4.01	10	1.2	3.10	28	0.9	8.63
Southern	16,947	5.6	48	7.1	2.83	91	5.9	5.37	34	4.1	2.02	173	5.7	10.21
Other*	2,288	0.8	<3	x	-	3	0.2	-	8	1.0	-	13	0.4	-
Total	**300,205**	**100.0**	**673**	**100.0**	**2.24**	**1,545**	**100.0**	**5.15**	**828**	**100.0**	**2.78**	**3,046**	**100.0**	**10.15**

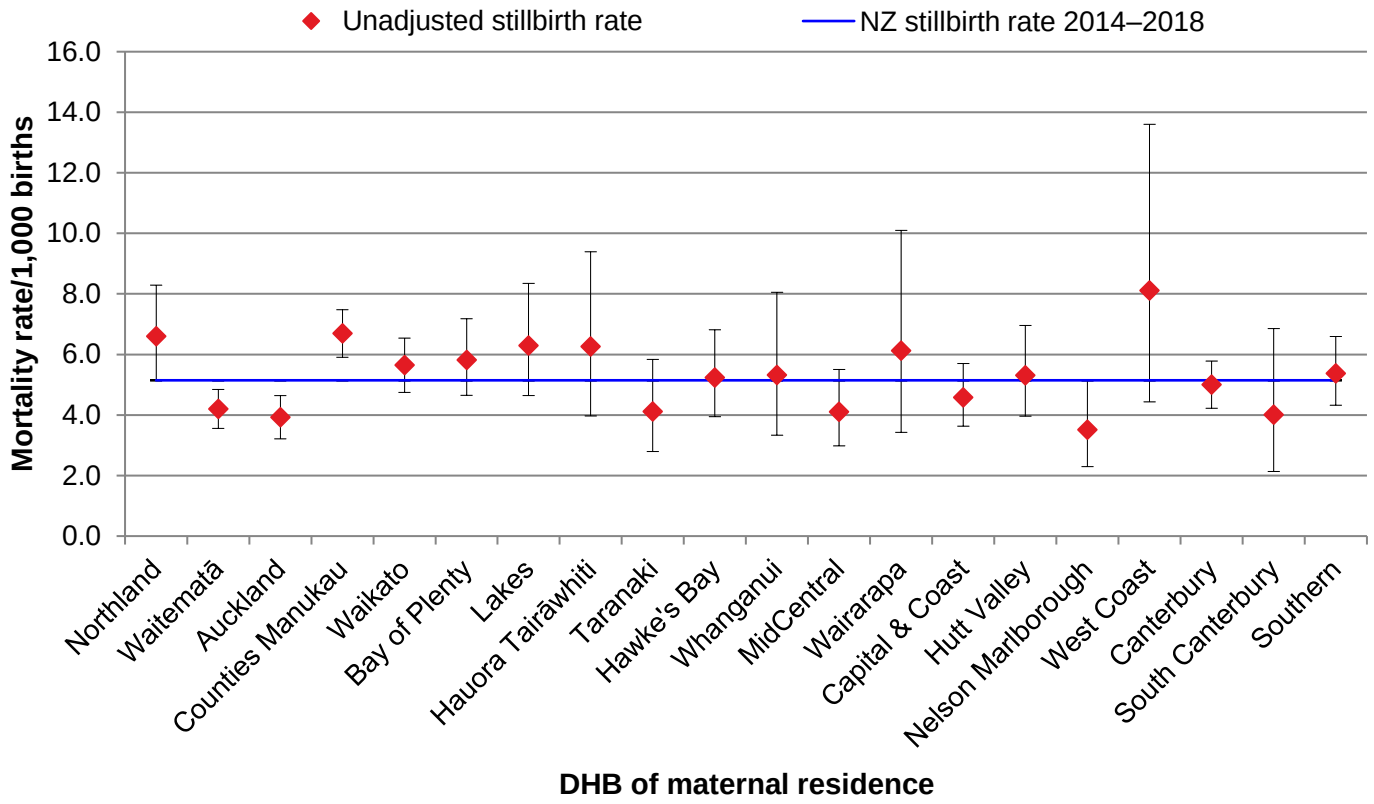
* Other includes Overseas, Unknown and Other.

'x' indicates percentage suppressed due to small numbers.

Sources: Numerator: PMMRC's perinatal data extract 2014–2018; Denominator: MAT births 2014–2018.

Stillbirth rates varied substantially by DHB of residence. Compared with mothers nationally, mothers in Waitematā and Auckland DHBs had statistically significantly lower rates. In contrast, mothers living in Northland and Counties Manukau DHBs had statistically significantly higher rates than the national rate (Figure 3.19).

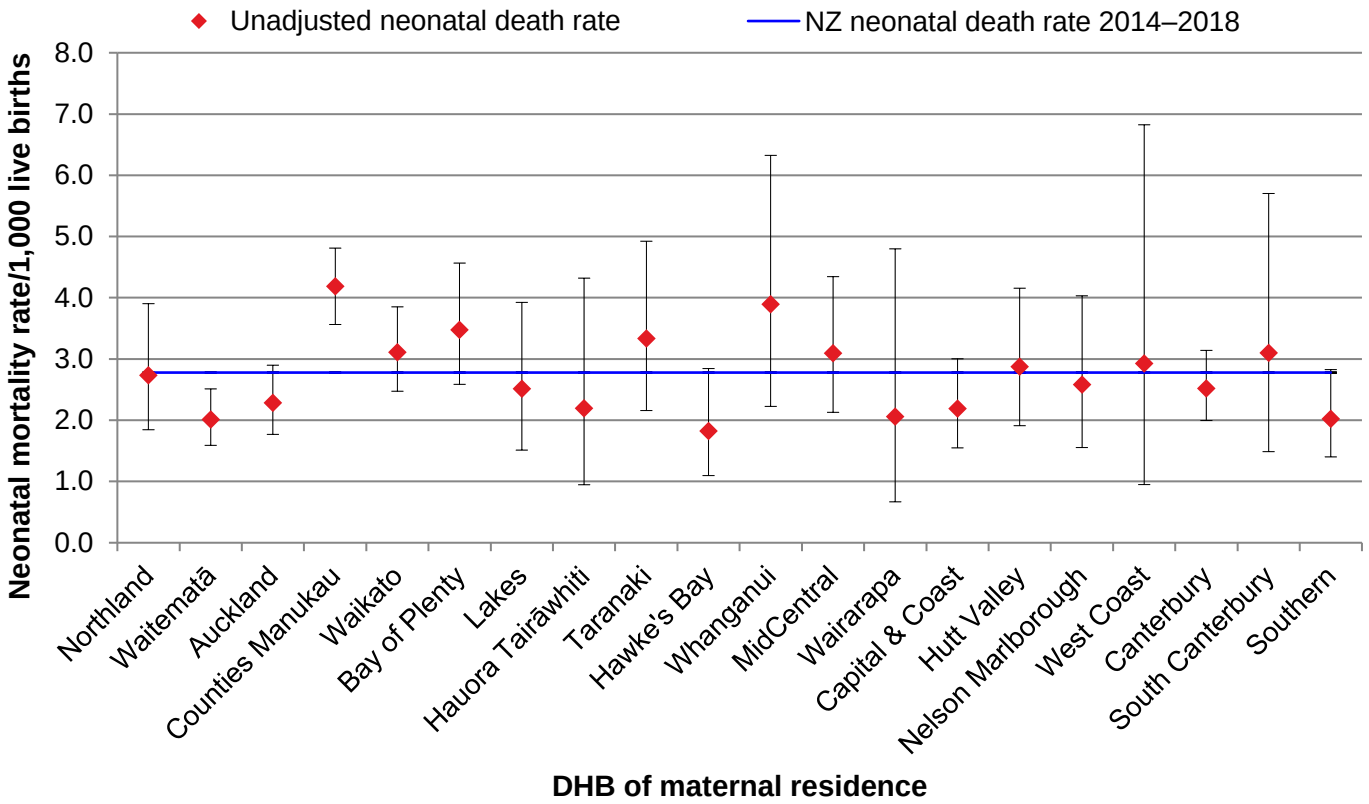
Figure 3.19: Unadjusted stillbirth rates (per 1,000 births, with 95% CIs) by DHB of maternal residence compared with average stillbirth rates 2014–2018



Sources: Numerator: PMMRC's perinatal data extract stillbirths only, 2014–2018; Denominator: MAT births 2014–2018.

Because they involve smaller numbers, the neonatal death rates by DHB of residence are more prone to variation and have wider confidence intervals. When compared with the national rate, Waitematā DHB had a statistically significantly lower rate, while Counties Manukau DHB had a statistically significantly higher rate (Figure 3.20).

Figure 3.20: Unadjusted neonatal mortality rates (per 1,000 live births, with 95% CIs) by DHB of maternal residence compared with New Zealand neonatal mortality 2014–2018

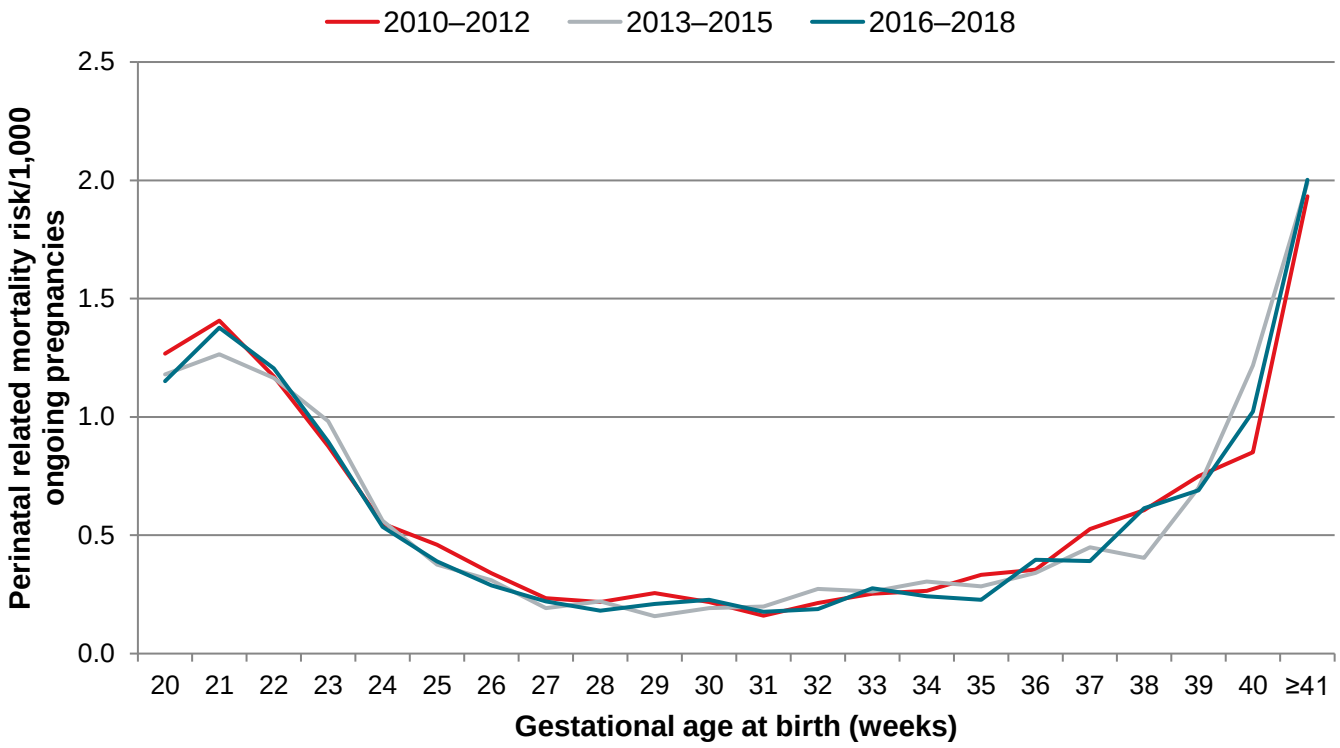


Sources: Numerator: PMMRC's perinatal data extract, neonatal deaths only, 2014–2018; Denominator: MAT births excluding fetal deaths 2014–2018.

Gestational age and birthweight

Perinatal related mortality by gestational age has seen little change over the period 2010–2018. While the risk of death appears highest from 41 weeks' gestation onwards, this is influenced by the number of ongoing pregnancies (the denominator). As there are fewer ongoing pregnancies at this gestational age compared with 23–24 weeks' gestation, the mortality ratio (per 1,000 ongoing pregnancies) is higher from 41 weeks (Figure 3.21). While the rate of death at later gestational ages is lower (1.70 per 1,000 births at ≥41 weeks' gestation compared with 735.54 per 1,000 births at 23–24 weeks' gestation) (Table 3.25), a higher proportion of pregnancies at this gestational age is at risk of adverse outcomes.

Figure 3.21: Perinatal related mortality risk (per 1,000 ongoing pregnancies) by gestational age at birth and year 2010–2018



Sources: Numerator: PMMRC's perinatal data extract 2010–2018; Denominator: MAT births 2010–2018.

Table 3.25: Perinatal related mortality rates (per 1,000 births) by gestational age and birthweight 2018

	Total births		Fetal deaths						Neonatal deaths			Perinatal related deaths (total)		
			Termination of pregnancy			Stillbirths								
	N	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Gestational age at birth (weeks)														
20–22	228	0.4	87	64.4	*	100	31.7	*	51	33.1	*	238	39.4	*
23–24	121	0.2	26	19.3	214.88	29	9.2	239.67	34	22.1	515.15	89	14.7	735.54
25–27	170	0.3	16	11.9	94.12	23	7.3	135.29	6	3.9	45.80	45	7.5	264.71
28–31	469	0.8	<3	x	s	27	8.6	57.57	14	9.1	31.82	43	7.1	91.68
32–36	3,553	6.0	3	2.2	0.84	56	17.8	15.76	15	9.7	4.29	74	12.3	20.83
37–40	45,126	76.2	<3	x	s	69	21.9	1.53	31	20.1	0.69	101	16.7	2.24
≥41	8,217	13.9	-	-	-	11	3.5	1.34	3	1.9	0.37	14	2.3	1.70
Unknown	1,374	2.3	-	-	-	-	-	-	-	-	-	-	-	-
Birthweight (g)														
<500	258	0.4	92	68.1	*	125	39.7	*	44	28.6	*	261	43.2	*
500–999	267	0.5	36	26.7	134.83	41	13.0	153.56	50	32.5	263.16	127	21.0	475.66
1,000–1,499	358	0.6	5	3.7	13.97	26	8.3	72.63	9	5.8	27.52	40	6.6	111.73
1,500–1,999	655	1.1	<3	x	s	19	6.0	29.01	8	5.2	12.60	28	4.6	42.75
2,000–2,499	2,118	3.6	<3	x	s	20	6.3	9.44	11	7.1	5.25	32	5.3	15.11
2,500–2,999	7,940	13.4	-	-	-	24	7.6	3.02	11	7.1	1.39	35	5.8	4.41
3,000–3,499	18,568	31.3	-	-	-	34	10.8	1.83	9	5.8	0.49	43	7.1	2.32
3,500–3,999	17,168	29.0	-	-	-	11	3.5	0.64	6	3.9	0.35	17	2.8	0.99
4,000–4,499	6,466	10.9	-	-	-	7	2.2	1.08	5	3.2	0.77	12	2.0	1.86
≥4,500	1,299	2.2	-	-	-	<3	x	s	<3	x	s	3	0.5	2.31
Unknown	4,161	7.0	-	-	-	6	1.9	-	-	-	-	6	1.0	-

* Denominator data unreliable and therefore rates have not been calculated.

'x' indicates percentage suppressed due to small numbers.

's' indicates rate suppressed due to small numbers.

Sources: Numerator: PMMRC's perinatal data extract 2018; Denominator: MAT births 2018.

Over the period 2007–2018, there is some evidence of a statistically significant decrease in the risk of death for babies born at 28–31, 37–38 and ≥41 weeks' gestation (see Table 3.26 for years 2009–2018).

Table 3.26: Perinatal related mortality risk (per 1,000 ongoing pregnancies) by year 2009–2018

Gestation at birth (weeks)	2009		2010		2011		2012		2013		2014		2015		2016		2017		2018	
	Total births	n	Total births	n	Total births	n	Total births	n	Total births	n	Total births	n	Total births	n	Total births	n	Total births	n	Total births	n
20–22	210	216	231	248	230	235	231	247	215	217	245	253	169	175	206	216	211	210	228	238
23–24	137	105	122	81	129	95	119	94	123	85	137	98	117	92	126	84	110	81	121	89
25–27	237	70	227	73	185	52	219	70	192	55	187	49	206	52	189	50	212	64	170	45
28–31	539	66	560	52	511	58	505	50	471	49	462	46	458	41	483	48	477	49	469	43
32–36	3,978	90	4,005	101	3,909	87	3,933	73	3,724	91	3,729	85	3,652	78	3,824	79	3,750	76	3,553	74
37–38	13,145	78	13,611	62	13,175	64	13,445	65	13,398	38	13,682	56	13,604	42	14,499	59	14,713	45	14,362	53
39–40	34,633	72	34,595	65	33,874	59	33,596	51	32,208	51	32,161	60	32,134	69	32,084	56	32,032	51	30,764	48
≥41	11,740	32	11,547	26	10,729	17	10,325	20	9,479	14	9,093	12	9,075	29	8,787	20	8,467	17	8,217	14
Unknown	584	<3	551	-	501	-	913	-	327	-	384	-	368	-	408	-	506	-	1,374	-

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
	Risk	Risk	Risk	Risk	Risk	Risk	Risk	Risk	Risk	Risk
20–22	3.34	3.82	3.75	3.96	3.63	4.24	2.95	3.59	3.50	4.11
23–24	1.63	1.25	1.52	1.51	1.43	1.65	1.55	1.40	1.36	1.54
25–27	1.09	1.13	0.83	1.13	0.92	0.83	0.88	0.84	1.07	0.78
28–31	1.03	0.81	0.93	0.81	0.83	0.78	0.70	0.80	0.82	0.75
32–36	1.42	1.58	1.41	1.19	1.55	1.45	1.33	1.33	1.29	1.30
37–38	1.31	1.04	1.11	1.13	0.69	1.02	0.77	1.07	0.82	0.99
39–40	1.55	1.41	1.32	1.16	1.22	1.45	1.67	1.37	1.26	1.23
≥41	2.73	2.25	1.58	1.94	1.48	1.32	3.20	2.28	2.01	1.70
Unknown	-	-	-	-	-	-	-	-	-	-

Sources: Numerator: PMMRC's perinatal data extract 2009–2018; Denominator: MAT births 2009–2018.

No significant change in termination of pregnancy rates by gestational age (from 20 weeks' gestation onwards) occurred over the study period 2007–2018 (data not shown). Table 3.27 presents the rates of termination of pregnancy by gestational age for the years 2009–2018.

Table 3.27: Termination of pregnancy risk (per 1,000 ongoing pregnancies) by year 2009–2018

Gestation at birth (weeks)	2009		2010		2011		2012		2013		2014		2015		2016		2017		2018	
	Total births	n	Total births	n	Total births	n	Total births	n	Total births	n	Total births	n	Total births	n	Total births	n	Total births	n	Total births	n
20–22	210	88	231	92	230	107	231	118	215	83	245	91	169	66	206	87	211	81	228	87
23–24	137	31	122	20	129	29	119	32	123	32	137	31	117	27	126	32	110	25	121	26
25–27	237	9	227	20	185	15	219	14	192	16	187	10	206	8	189	13	212	16	170	16
28–31	539	4	560	6	511	11	505	5	471	5	462	7	458	3	483	14	477	5	469	<3
≥32	63,496	6	63,758	13	61,687	9	61,299	3	58,809	5	58,665	11	58,465	3	59,194	<3	58,962	6	56,896	4
Unknown	584	-	551	-	501	-	913	-	327	-	384	-	368	-	408	-	506	-	1,374	-

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
	Risk	Risk	Risk	Risk	Risk	Risk	Risk	Risk	Risk	Risk
20–22	1.36	1.42	1.71	1.89	1.39	1.52	1.11	1.45	1.35	1.50
23–24	0.48	0.31	0.46	0.51	0.54	0.52	0.46	0.53	0.42	0.45
25–27	0.14	0.31	0.24	0.23	0.27	0.17	0.14	0.22	0.27	0.28
28–31	0.06	0.09	0.18	0.08	0.08	0.12	0.05	0.23	0.08	s
≥32	0.09	0.20	0.15	0.05	0.09	0.19	0.05	s	0.10	0.07
Unknown	-	-	-	-	-	-	-	-	-	-

's' indicates rate suppressed due to small numbers.

Sources: Numerator: PMMRC's perinatal data extract, terminations of pregnancy only, 2009–2018; Denominator: MAT births 2009–2018.

There is some evidence of a statistically significant decrease in stillbirths at 28–31 weeks' gestation,[37] and strong evidence for a decrease at term (37–40 weeks)[38] over the period 2007–2018. Table 3.28 shows the risk of stillbirth per 1,000 ongoing pregnancies by year.

[37] Chi-squared test for trend p=0.012.

[38] Chi-squared test for trend p=0.0014.

Table 3.28: Stillbirth risk (per 1,000 ongoing pregnancies) by year 2009–2018

Gestation at birth (weeks)	2009		2010		2011		2012		2013		2014		2015		2016		2017		2018	
	Total births	n	Total births	n	Total births	n	Total births	n	Total births	n	Total births	n	Total births	n	Total births	n	Total births	n	Total births	n
Stillbirths																				
20–22	210	88	231	94	230	90	231	85	215	88	245	110	169	73	206	83	211	72	228	100
23–24	137	43	122	31	129	37	119	28	123	29	137	28	117	32	126	29	110	27	121	29
25–27	237	39	227	32	185	24	219	36	192	25	187	25	206	31	189	26	212	30	170	23
28–31	539	48	560	32	511	34	505	30	471	32	462	31	458	29	483	22	477	31	469	27
32–36	3,978	60	4,005	66	3,909	55	3,933	54	3,724	63	3,729	58	3,652	48	3,824	60	3,750	48	3,553	56
37–40	47,778	111	48,206	78	47,049	83	47,041	78	45,606	60	45,843	72	45,738	72	46,583	76	46,745	68	45,126	69
≥41	11,740	19	11,547	14	10,729	9	10,325	9	9,479	9	9,093	3	9,075	20	8,787	14	8,467	12	8,217	11
Unknown	584	<3	551	-	501	-	913	-	327	-	384	-	368	-	408	-	506	-	1,374	-

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
	Risk	Risk	Risk	Risk	Risk	Risk	Risk	Risk	Risk	Risk
Stillbirths										
20–22	1.36	1.45	1.43	1.36	1.47	1.84	1.23	1.38	1.20	1.73
23–24	0.67	0.48	0.59	0.45	0.49	0.47	0.54	0.48	0.45	0.50
25–27	0.61	0.50	0.38	0.58	0.42	0.42	0.52	0.43	0.50	0.40
28–31	0.75	0.50	0.55	0.49	0.54	0.52	0.49	0.37	0.52	0.47
32–36	0.94	1.04	0.89	0.88	1.07	0.99	0.82	1.01	0.81	0.98
37–40	1.86	1.31	1.44	1.36	1.09	1.31	1.31	1.37	1.23	1.29
≥41	1.62	1.21	0.84	0.87	0.95	0.33	2.20	1.59	1.42	1.34
Unknown	-	-	-	-	-	-	-	-	-	-

Sources: Numerator: PMMRC's perinatal data extract, stillbirths only, 2009–2018; Denominator: MAT births 2009–2018.

During the period 2007–2018 there was a statistically significant reduction in the rates of neonatal death for those born at ≥41 weeks' gestation,[39] but a statistically significant increase in deaths at 20–22 weeks' gestation.[40] Table 3.29 shows the risk of neonatal death per 1,000 ongoing pregnancies by year.

[39] Chi-squared test for trend p=0.006.

[40] Chi-squared test for trend p=0.001.

Table 3.29: Neonatal death risk (per 1,000 ongoing pregnancies) by year 2009–2018

Gestation at birth (weeks)	2009		2010		2011		2012		2013		2014		2015		2016		2017		2018	
	Total births	n	Total births	n	Total births	n	Total births	n	Total births	n	Total births	n	Total births	n	Total births	n	Total births	n	Total births	n
20–22	34	40	45	62	33	38	28	44	44	46	44	52	30	36	36	46	58	57	41	51
23–24	63	31	71	30	63	29	59	34	62	24	78	39	58	33	65	23	58	29	66	34
25–27	189	22	175	21	146	13	169	20	151	14	152	14	167	13	150	11	166	18	131	6
28–31	487	14	522	14	466	13	470	15	434	12	424	8	426	9	447	12	441	13	440	14
32–36	3,913	25	3,930	26	3,846	24	3,876	16	3,657	24	3,666	22	3,601	27	3,762	17	3,697	23	3,494	15
37–40	47,666	38	48,124	45	46,965	39	46,963	38	45,545	28	45,765	38	45,666	39	46,507	39	46,676	27	45,056	31
≥41	11,721	13	11,533	12	10,720	8	10,316	11	9,470	5	9,090	9	9,055	9	8,773	6	8,455	5	8,206	3
Unknown	583	-	551	-	501	-	913	-	327	-	384	-	368	-	408	-	506	-	1,374	-

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
	Risk	Risk	Risk	Risk	Risk	Risk	Risk	Risk	Risk	Risk
20–22	0.62	0.96	0.61	0.71	0.77	0.88	0.61	0.77	0.96	0.89
23–24	0.48	0.47	0.47	0.55	0.40	0.66	0.56	0.39	0.49	0.59
25–27	0.34	0.33	0.21	0.32	0.24	0.24	0.22	0.18	0.30	0.10
28–31	0.22	0.22	0.21	0.24	0.20	0.14	0.15	0.20	0.22	0.24
32–36	0.39	0.41	0.39	0.26	0.41	0.38	0.46	0.29	0.39	0.26
37–40	0.64	0.75	0.68	0.66	0.51	0.69	0.71	0.71	0.49	0.58
≥41	1.11	1.04	0.75	1.07	0.53	0.99	0.99	0.68	0.59	0.37
Unknown	-	-	-	-	-	-	-	-	-	-

Sources: Numerator: PMMRC's perinatal data extract specific neonatal deaths 2009–2018; Denominator: MAT births excluding fetal deaths 2009–2018.

Over the period 2007–2018, there was some evidence of a decrease in the mortality rate from intrapartum stillbirth in babies aged 23–27 weeks.[41] Strong evidence points to a reduction in intrapartum stillbirth in babies born at term (37 weeks onwards)[42] (Table 3.30 and Figure 3.22). The reduction in deaths of babies in Māori mothers was similar to that in New Zealand European mothers (data not shown).

[41] Chi-squared test for trend p=0.016.

[42] Chi-squared test for trend p<0.001.

Table 3.30: Intrapartum stillbirth risk (per 1,000 ongoing pregnancies) by gestational age excluding congenital anomalies by year 2009–2018

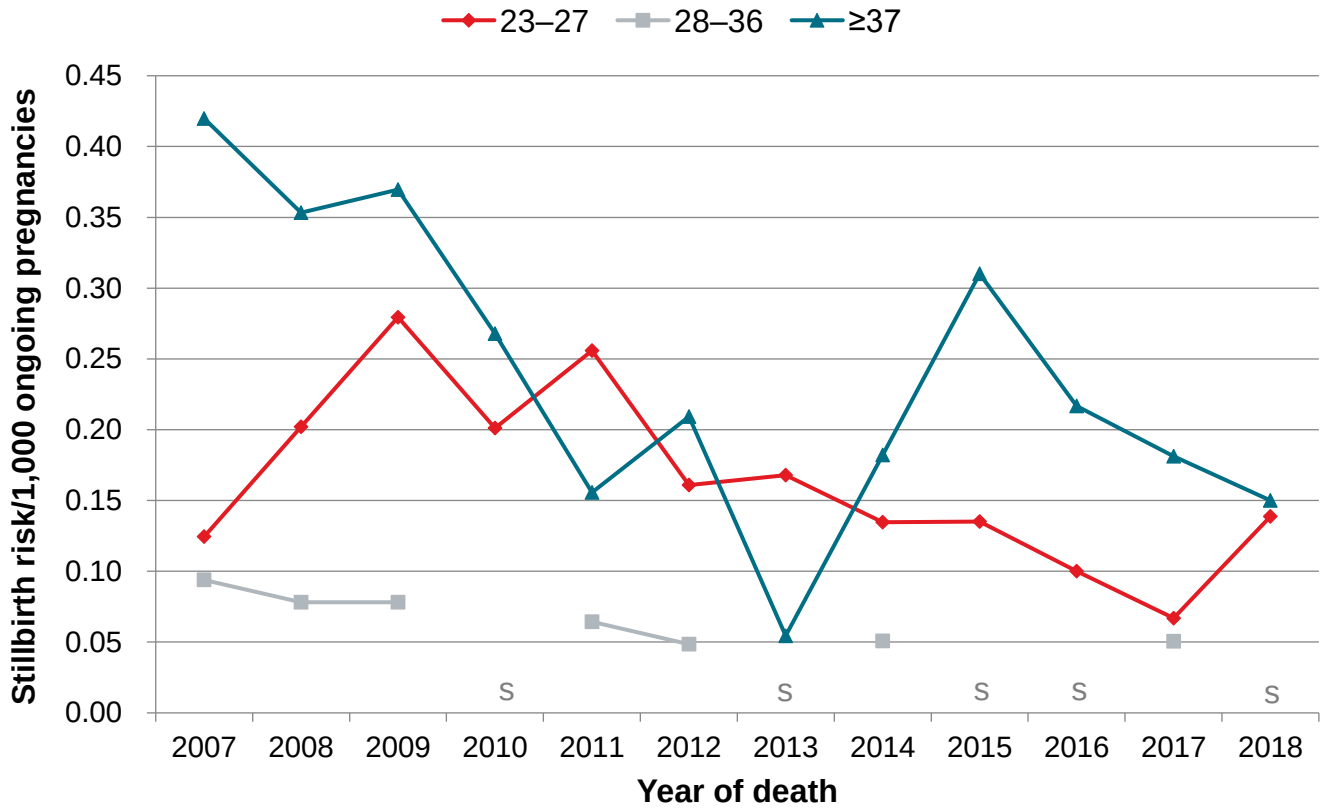
Gestation at birth (weeks)	2009		2010		2011		2012		2013		2014		2015		2016		2017		2018	
	n	N	n	N	n	N	n	N	n	N	n	N	n	N	n	N	n	N	n	N
23–27	18	64,409	13	64,667	16	62,512	10	62,142	10	59,595	8	59,451	8	59,246	6	59,992	4	59,761	8	57,656
28–36	5	64,035	<3	64,318	4	62,198	3	61,804	<3	59,280	3	59,127	<3	58,923	<3	59,677	3	59,439	<3	57,365
≥37	22	59,518	16	59,753	9	57,778	12	57,366	3	55,085	10	54,936	17	54,813	12	55,370	10	55,212	8	53,343

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
	Rate	Rate	Rate	Rate	Rate	Rate	Rate	Rate	Rate	Rate
23–27	0.28	0.20	0.26	0.16	0.17	0.13	0.14	0.10	0.07	0.14
28–36	0.08	s	0.06	0.05	s	0.05	s	s	0.05	s
≥37	0.37	0.27	0.16	0.21	0.05	0.18	0.31	0.22	0.18	0.15

‘s’ indicates rate suppressed due to small numbers.

Sources: Numerator: PMMRC’s perinatal data extract, stillbirths only (excluding congenital anomalies) 2009–2018; Denominator: MAT births 2009–2018.

Figure 3.22: Intrapartum stillbirth risks (per 1,000 ongoing pregnancies) by gestational age at birth (weeks) excluding congenital anomalies 2007–2018



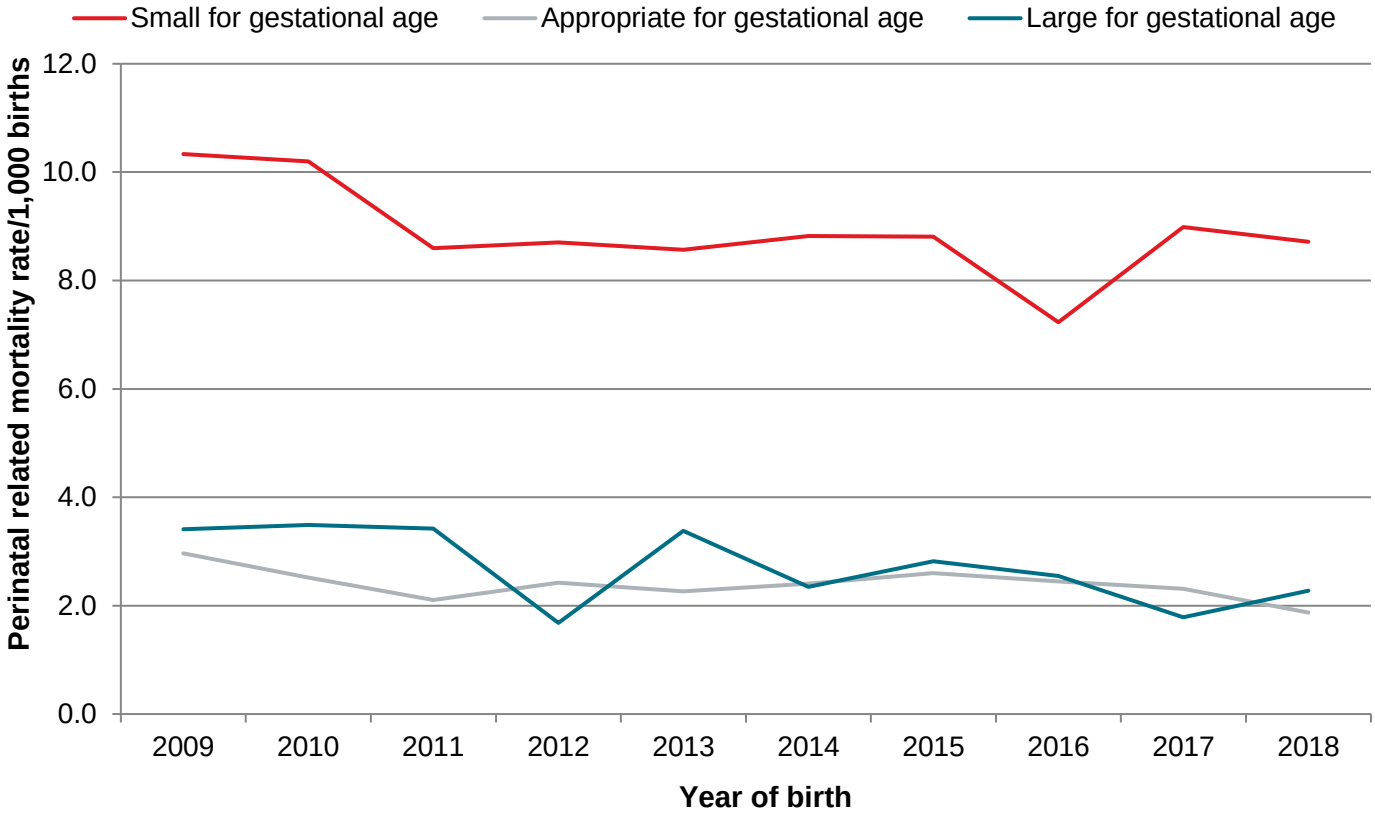
's' indicates risk suppressed due to small numbers.

Sources: Numerator: PMMRC's perinatal data extract, stillbirths only (excluding congenital anomalies), 2007–2018; Denominator: MAT births 2007–2018.

Mortality by customised birthweight centile group

Very little change has occurred in the perinatal related mortality rate in singleton babies who have no congenital anomalies and are appropriate or large for gestational age over the last 10 years. However, deaths in small for gestational age babies are trending down (Figure 3.23 and Table 3.31).

Figure 3.23: Perinatal related mortality rates by customised centile group among singleton births* from 26 weeks' gestation without congenital anomalies and by year 2009–2018



* All data limited to mothers who were registered for care with an LMC (a midwife, obstetrician or GP) claiming from the Section 88 Primary Maternity Services Notice.

Sources: Numerator: PMMRC's perinatal data extract where matched to MAT data, from 26 weeks' gestation without congenital anomalies 2009–2018; Denominator: MAT births among singleton births from 26 weeks' gestation 2009–2018.

Table 3.31: Perinatal related mortality rates by customised birthweight centile group among singleton births* from 26 weeks' gestation without congenital anomalies and by year 2009–2018

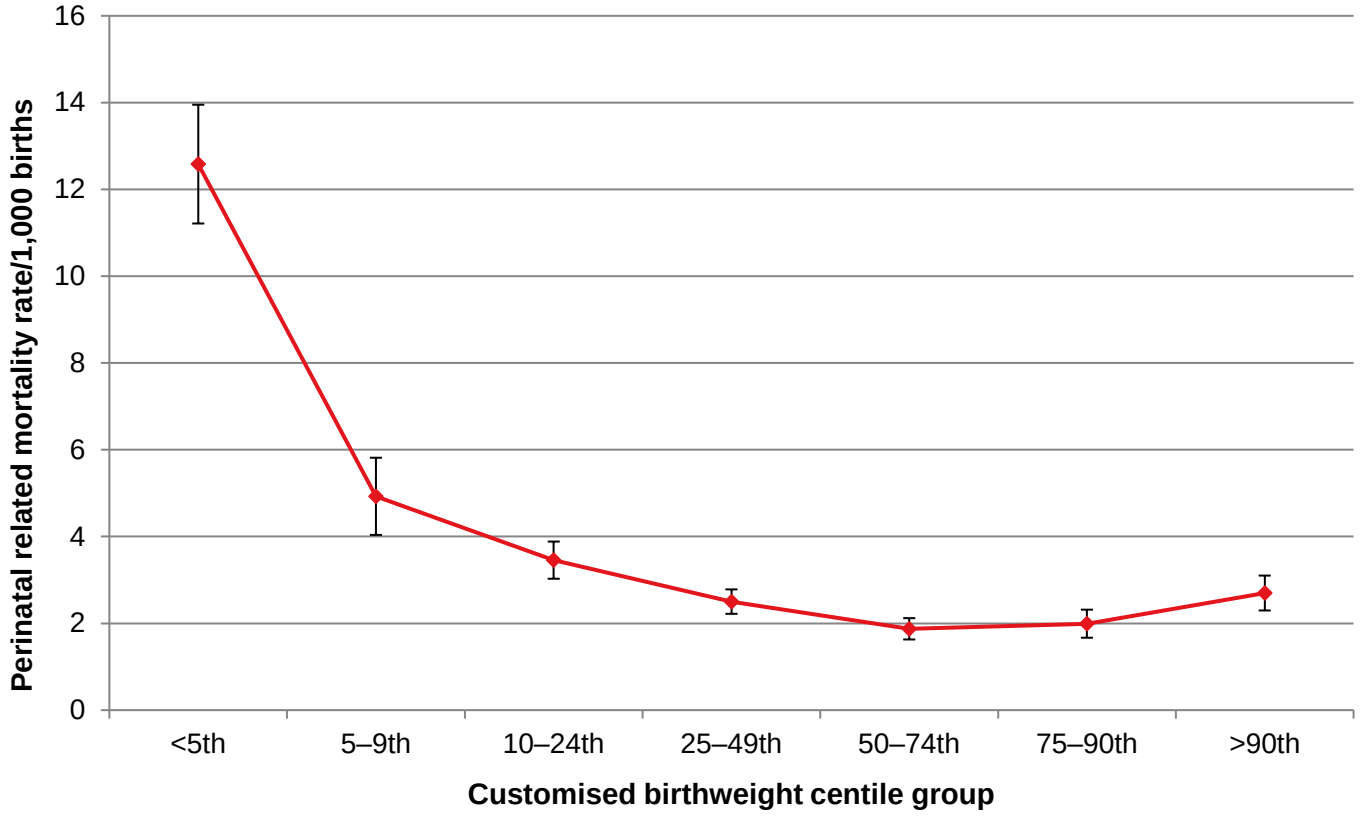
Year of death	Small for gestational age			Appropriate for gestational age			Large for gestational age			Unknown/missing data			Total		
	N=54,602	n=493		N=422,681	n=1,020		N=70,263	n=192		N=27,235	n=116		N=574,781	n=1,821	
	N	n	Rate	N	n	Rate	N	n	Rate	N	n	Rate	N	n	Rate
2009	5,032	52	10.33	37,102	110	2.96	6,159	21	3.41	2,566	19	7.40	50,859	202	3.97
2010	5,100	52	10.20	38,167	96	2.52	6,305	22	3.49	2,690	7	2.60	52,262	177	3.39
2011	5,117	44	8.60	37,977	80	2.11	6,137	21	3.42	2,748	13	4.73	51,979	158	3.04
2012	5,054	44	8.71	39,200	95	2.42	6,540	11	1.68	2,248	6	2.67	53,042	156	2.94
2013	4,903	42	8.57	37,975	86	2.26	6,208	21	3.38	2,362	7	2.96	51,448	156	3.03
2014	4,988	44	8.82	38,668	93	2.41	6,390	15	2.35	2,261	5	2.21	52,307	157	3.00
2015	4,881	43	8.81	39,217	102	2.60	6,383	18	2.82	2,477	6	2.42	52,958	169	3.19
2016	4,979	36	7.23	39,602	97	2.45	6,670	17	2.55	2,417	16	6.62	53,668	166	3.09
2017	4,786	43	8.98	39,832	92	2.31	6,713	12	1.79	2,271	10	4.40	53,602	157	2.93
2018	4,934	43	8.72	38,455	72	1.87	6,589	15	2.28	2,485	10	4.02	52,463	140	2.67

* MAT data limited to mothers who were registered for care with an LMC (a midwife, obstetrician or GP) claiming from the Section 88 Primary Maternity Services Notice.

Sources: Numerator: PMMRC's perinatal data extract where matched to MAT data, among singleton births from 26 weeks' gestation without congenital anomalies 2009–2018; Denominator: MAT births among singleton births from 26 weeks' gestation 2009–2018.

From 26 weeks' gestation onwards, mortality decreased significantly as baby birthweight approached the 50th–74th customised centile group. Those babies with a customised birthweight under the 5th centile had a substantially higher mortality rate, even compared with those in the 5th–9th centile. Mortality was lowest in those with a birthweight in the 50th–74th centile group. Babies with a birthweight in the customised centile group 90th or above had a statistically significantly higher mortality rate than those in the 50th–74th centile group (Figure 3.24).

Figure 3.24: Perinatal related mortality rates (with 95% CIs) by customised birthweight centile group among singleton births from 26 weeks' gestation without congenital anomalies 2009–2018*



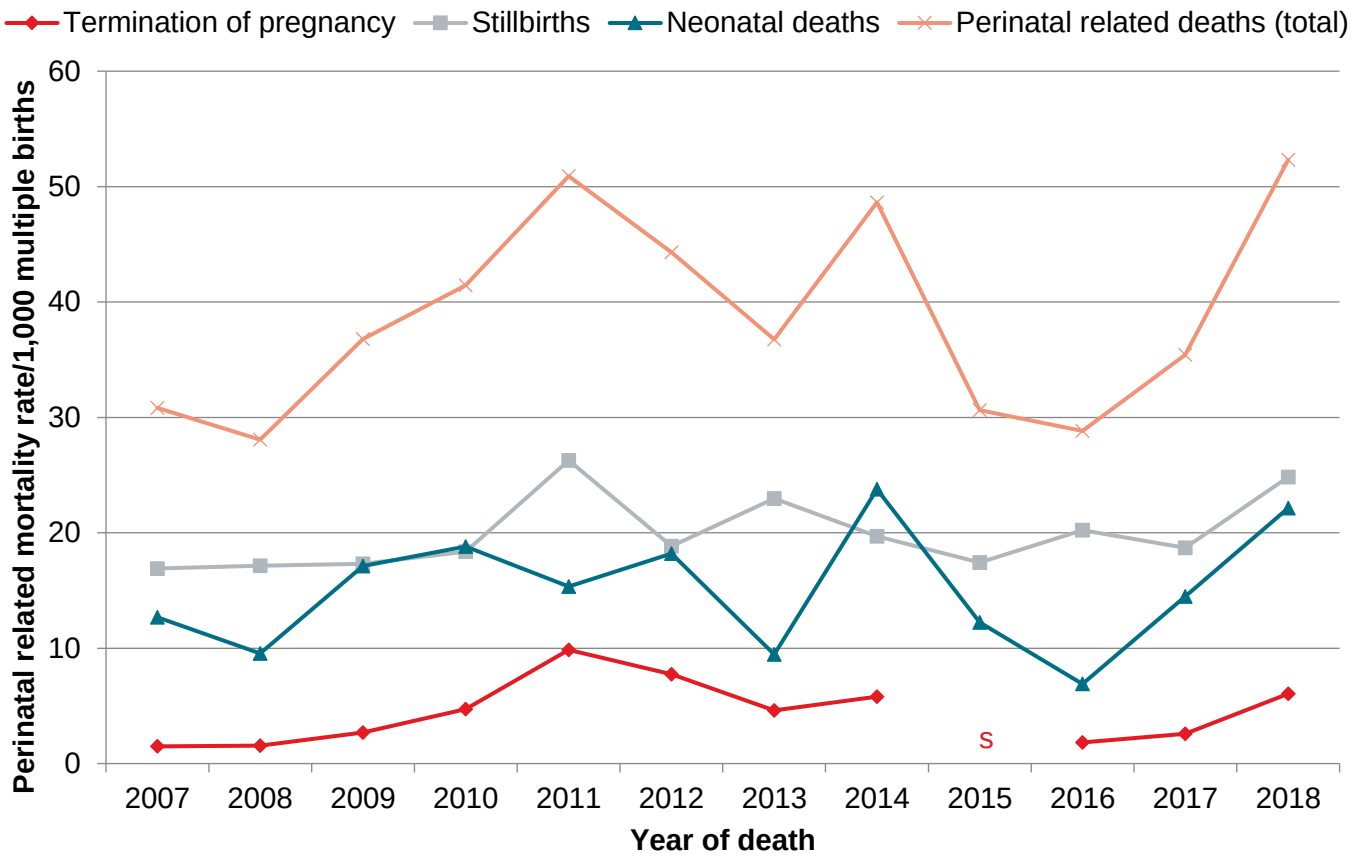
* All data limited to mothers who were registered for care with an LMC (a midwife, obstetrician or GP) claiming from the Section 88 Primary Maternity Services Notice.

Sources: Numerator: PMMRC's perinatal data extract where matched to MAT data, among singleton births from 26 weeks' gestation without congenital anomalies 2009–2018; Denominator: MAT births among singleton births from 26 weeks' gestation 2009–2018.

Multiple pregnancies

Mortality rates for babies born in multiple pregnancies, at 38.6 per 1,000 births, are four times higher than those in singletons, at 9.7 per 1,000 births.[43] The mortality rates in multiple pregnancies have not changed significantly over the period 2007–2018 (Figure 3.25 and Table 3.32). However, there has been a statistically significant reduction in mortality in singletons over this time.[44]

Figure 3.25: Perinatal related mortality rates (per 1,000 births) among babies born in multiple pregnancies by year 2007–2018



Sources: Numerator: PMMRC's perinatal data extract among babies born in multiple pregnancies 2007–2018; Denominator: MAT births among babies born in multiple pregnancies 2007–2018.

[43] Multiple:singleton mortality rate ratio is 3.99, 95% CI 3.71–4.28.

[44] Chi-squared test for trend p=0.005.

Table 3.32: Perinatal related mortality rates among babies born in multiple pregnancies by year 2007–2018

Year of death	Total multiple births	Fetal deaths				Neonatal deaths		Perinatal related deaths (total)	
		Termination of pregnancy		Stillbirths					
		n	Rate	n	Rate	n	Rate	n	Rate
2007	2,011	3	1.49	34	16.91	25	12.66	62	30.83
2008	1,924	3	1.56	33	17.15	18	9.53	54	28.07
2009	1,849	5	2.70	32	17.31	31	17.11	68	36.78
2010	1,906	9	4.72	35	18.36	35	18.80	79	41.45
2011	1,827	18	9.85	48	26.27	27	15.33	93	50.90
2012	1,806	14	7.75	34	18.83	32	18.20	80	44.30
2013	1,741	8	4.60	40	22.98	16	9.45	64	36.76
2014	1,727	10	5.79	34	19.69	40	23.77	84	48.64
2015	1,665	<3	s	29	17.42	20	12.24	51	30.63
2016	1,631	3	1.84	33	20.23	11	6.90	47	28.82
2017	1,552	4	2.58	29	18.69	22	14.48	55	35.44
2018	1,491	9	6.04	37	24.82	32	22.15	78	52.31
Chi-squared test for trend (p)		**0.47**		**0.20**		**0.39**		**0.091**	

‘s’ indicates rate suppressed due to small numbers.

Sources: Numerator: PMMRC’s perinatal data extract among babies born in multiple pregnancies 2007–2018; Denominator: MAT births among babies born in multiple pregnancies 2007–2018.

Death investigation

Overall, around 40% of babies had optimal investigation into the cause(s) of their death. ‘Optimal investigation’ is defined here as post-mortem or karyotype confirming chromosomal abnormality, or clinical examination or investigation confirming the diagnosis. What is considered to be ‘optimal’ will vary depending on the clinical picture. The rate of optimal investigation was higher for terminations of pregnancy, and lower for stillbirths and neonatal deaths (Table 3.33).

Table 3.33: Perinatal related deaths and completeness of perinatal death investigations 2018

Perinatal death investigation	Fetal deaths				Neonatal deaths		Perinatal related deaths (total)	
	Termination of pregnancy		Stillbirths					
	n	%	n	%	n	%	n	%
Optimal investigation*	67	49.63	125	39.68	58	37.66	250	41.39
Post-mortem	35	25.93	108	34.29	37	24.03	180	29.80
Karyotype	29	21.48	16	5.08	14	9.09	59	9.77
Clinical examination/investigations confirm diagnosis	7	5.19	13	4.13	9	5.84	29	4.80
Partial investigations#	54	40.00	139	44.13	80	51.95	273	45.20
Placental pathology performed+	62	45.93	235	74.60	112	72.73	409	67.72
No investigation^	12	8.89	46	14.60	13	8.44	71	11.75
Unknown	<3	x	5	1.59	3	1.95	10	1.66

* Optimal investigation is defined as post-mortem or karyotype confirming congenital abnormality, or clinical examination or investigation confirming diagnosis. Note: more than one option can be selected for each case.

No full post-mortem undertaken; investigations may have included placental pathology, magnetic resonance imaging (MRI), ultrasound scan or x-ray.

+ Includes both placental histology with post-mortem and as part of partial investigation.

^ No post-mortem, placental pathology, MRI, ultrasound scan or x-ray.

‘x’ indicates percentage not calculated due to small numbers.

Source: PMMRC’s perinatal data extract 2018.

Table 3.34 shows the degree to which perinatal deaths were investigated. A higher proportion of Māori mothers was offered a post-mortem that was then not undertaken, and consequently a higher number of Māori babies had no investigation than other ethnic groups. The proportion of women who were not offered a post-mortem for their babies was reasonably consistent among prioritised ethnic groups, with the

exception of MELAA, who were not offered a post-mortem more frequently than other groups (Table 3.34). In some clinical situations, a full post-mortem is not required to identify the cause of death.

Table 3.34: Perinatal related deaths and perinatal death investigations by maternal prioritised ethnic group* 2014–2018

Post-mortem examination offered	Māori		Pacific peoples		Asian						MELAA		European						Perinatal related deaths (total)	
					Indian		Other Asian		Total Asian				NZ European		Other European		Total European			
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Full post-mortem offered and undertaken	180	22.2	116	30.4	96	39.2	106	39.4	202	39.3	28	43.1	495	45.2	88	49.2	583	45.8	1,111	36.5
Full post-mortem offered and not undertaken	557	68.8	239	62.6	138	56.3	145	53.9	283	55.1	30	46.2	524	47.9	71	39.7	595	46.7	1,704	55.9
Full post-mortem not offered	63	7.8	23	6.0	8	3.3	18	6.7	26	5.1	7	10.8	63	5.8	17	9.5	80	6.3	199	6.5
Unknown[#]	10	1.2	4	1.0	3	1.2	-	-	3	0.6	-	-	12	1.1	3	1.7	15	1.2	32	1.1
Karyotype	41	5.1	28	7.3	20	8.2	39	14.5	59	11.5	11	16.9	115	10.5	23	12.8	138	10.8	277	9.1
Clinical examination/investigations confirm diagnosis[ł]	34	4.2	11	2.9	5	2.0	11	4.1	16	3.1	<3	x	52	4.8	7	3.9	59	4.6	121	4.0
Partial investigations[^]	367	45.3	193	50.5	117	47.8	104	38.7	221	43.0	22	33.8	420	38.4	52	29.1	472	37.1	1,275	41.9
No investigation	195	24.1	41	10.7	11	4.5	15	5.6	26	5.1	4	6.2	52	4.8	15	8.4	67	5.3	333	10.9
Investigations unknown	5	0.6	<3	x	-	-	<3	x	<3	x	-	-	10	0.9	-	-	10	0.8	18	0.6

ł In some clinical situations, a full post-mortem is not required to determine the cause of death.

* Excludes two unknown maternal ethnicity.

Includes unknown and two cases where a post-mortem was offered and consent unknown.

^ Investigations may have included partial post-mortem, placental pathology, magnetic resonance imaging (MRI), ultrasound scan or x-ray.

'x' indicates percentage suppressed due to small numbers.

Source: PMMRC's perinatal data extract 2014–2018.

Contributory factors

Local review of cases showed a number of deaths had potentially avoidable aspects. Contributory factors were thought to be present in around one quarter of perinatal related deaths (excluding termination of pregnancy) (Table 3.35).

Table 3.35: Contributory factors and potentially avoidable perinatal related deaths 2018

	Fetal deaths				Neonatal deaths		Perinatal related deaths (total)	
	Termination of pregnancy		Stillbirths					
	n	%	n	%	n	%	n	%
Contributory factors								
Present	16	11.9	91	28.9	46	29.9	153	25.3
Absent	117	86.7	218	69.2	108	70.1	443	73.3
Missing data	<3	x	6	1.9	-	-	8	1.3
Potentially avoidable								
Yes	7	5.2	44	14.0	28	18.2	79	13.1
Contributory factors present but not potentially avoidable	9	6.7	42	13.3	17	11.0	68	11.3
Contributory factors present but avoidability unknown	-	-	3	1.0	<3	x	4	0.7

'x' indicates percentage suppressed due to small numbers.

Source: PMMRC's perinatal data extract 2018, local review data.

Contributory factors included organisational and/or management factors, personnel factors, and barriers to access. Of these, 'barriers to access and/or engagement with care' was the most common contributory factor cited (Table 3.36).

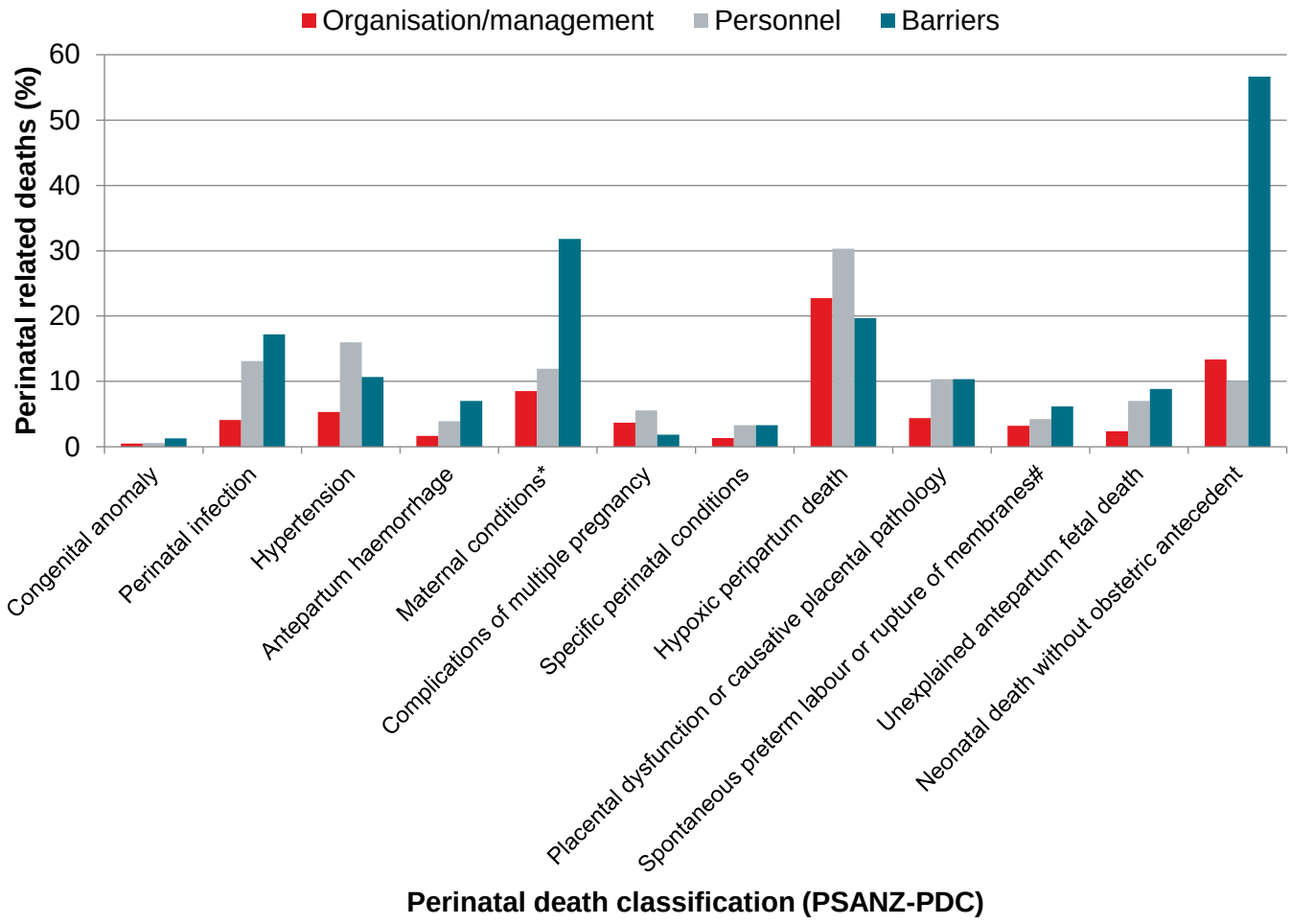
Table 3.36: Details of contributory factors among perinatal related deaths 2009–2018

Contributory factors	2009–2018	
	n	%
Any contributory factor	1,693	26.4
Organisational and/or management factors	335	5.2
Personnel factors	524	8.2
Barriers to access and/or engagement with care	1,211	18.9

Source: PMMRC's perinatal data extract 2009–2018, local review data.

Barriers to care were most notable for perinatal infection, maternal conditions and situations with no obstetric antecedent. Personnel factors were more common in hypertension and hypoxic peripartum death (Figure 3.26 and Table 3.37).

Figure 3.26: Main contributory factor(s)* in potentially avoidable perinatal related deaths (as a percentage of all deaths in each PSANZ-PDC category) by perinatal death classification (PSANZ-PDC) 2014–2018



* Excludes one death where the contributory factor was not identified.

Spontaneous preterm labour or rupture of membranes (<37 weeks' gestation).

Source: PMMRC's perinatal data extract 2014–2018, local review data.

Table 3.37: Main contributory factor(s)* in potentially avoidable perinatal related death by perinatal death classification (PSANZ-PDC) 2014–2018

Perinatal death classification (PSANZ-PDC)	Perinatal related deaths	Potentially avoidable					
		Organisation/ management		Personnel		Barriers to care	
	n	n	%	n	%	n	%
Congenital anomaly	856	4	0.5	5	0.6	11	1.3
Perinatal infection	122	5	4.1	16	13.1	21	17.2
Hypertension	75	4	5.3	12	16.0	8	10.7
Antepartum haemorrhage	357	6	1.7	14	3.9	25	7.0
Maternal conditions	176	15	8.5	21	11.9	56	31.8
Complications of multiple pregnancy	108	4	3.7	6	5.6	<3	x
Specific perinatal conditions	151	<3	x	5	3.3	5	3.3
Hypoxic peripartum death	66	15	22.7	20	30.3	13	19.7
Placental dysfunction or causative placental pathology	251	11	4.4	26	10.4	26	10.4
Spontaneous preterm labour or rupture of membranes (<37 weeks' gestation)	470	15	3.2	20	4.3	29	6.2
Unexplained antepartum fetal death	384	9	2.3	27	7.0	34	8.9
Neonatal death without obstetric antecedent	30	4	13.3	3	10.0	17	56.7

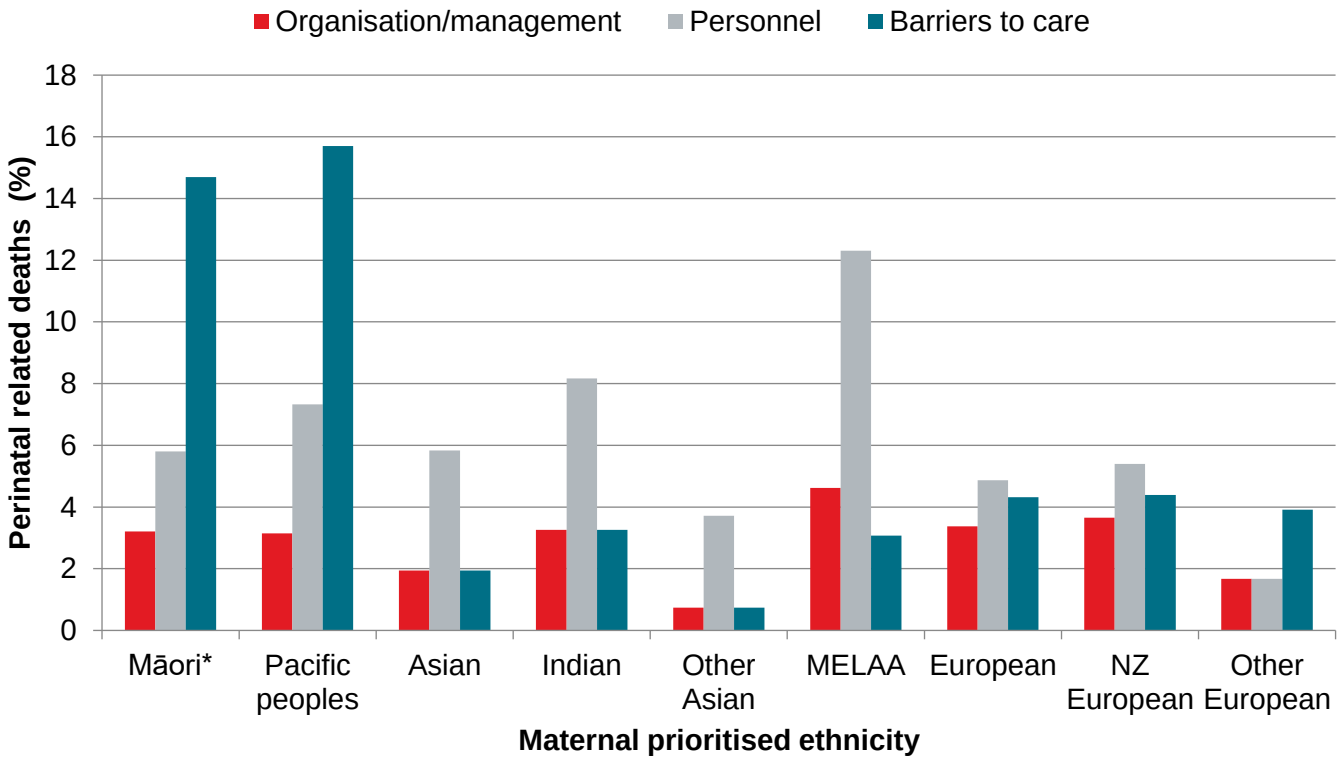
* Excludes one death where the contributory factor was not identified.

'x' indicates percentage suppressed due to small numbers.

Source: PMMRC's perinatal data extract 2014–2018, local review data.

Barriers to accessing care were frequent among Māori and Pacific mothers, while personnel was the most significant factor identified for those in Indian and MELAA ethnic groups (Figure 3.27 and Table 3.38).

Figure 3.27: Main contributory factor(s) in potentially avoidable perinatal related deaths (as a percentage of all deaths) by maternal prioritised ethnic group 2014–2018



* Excludes one death where the contributory factor was not identified.

MELAA = Middle Eastern, Latin American, or African.

Source: PMMRC's perinatal data extract 2014–2018, local review data.

Table 3.38: Main contributory factor(s) in potentially avoidable perinatal related deaths by maternal prioritised ethnic group* 2014–2018

Maternal prioritised ethnic group	Perinatal related deaths	Potentially avoidable					
		Organisation/management		Personnel		Barriers to care	
	n	n	%	n	%	n	%
Māori#	810	26	3.2	47	5.8	119	14.7
Pacific peoples	382	12	3.1	28	7.3	60	15.7
Asian	514	10	1.9	30	5.8	10	1.9
Indian	245	8	3.3	20	8.2	8	3.3
Other Asian	269	<3	x	10	3.7	<3	x
MELAA	65	3	4.6	8	12.3	<3	x
European	1,273	43	3.4	62	4.9	55	4.3
NZ European	1,094	40	3.7	59	5.4	48	4.4
Other European	179	3	1.7	3	1.7	7	3.9

* Excludes two perinatal related deaths (total) with unknown maternal ethnicity.

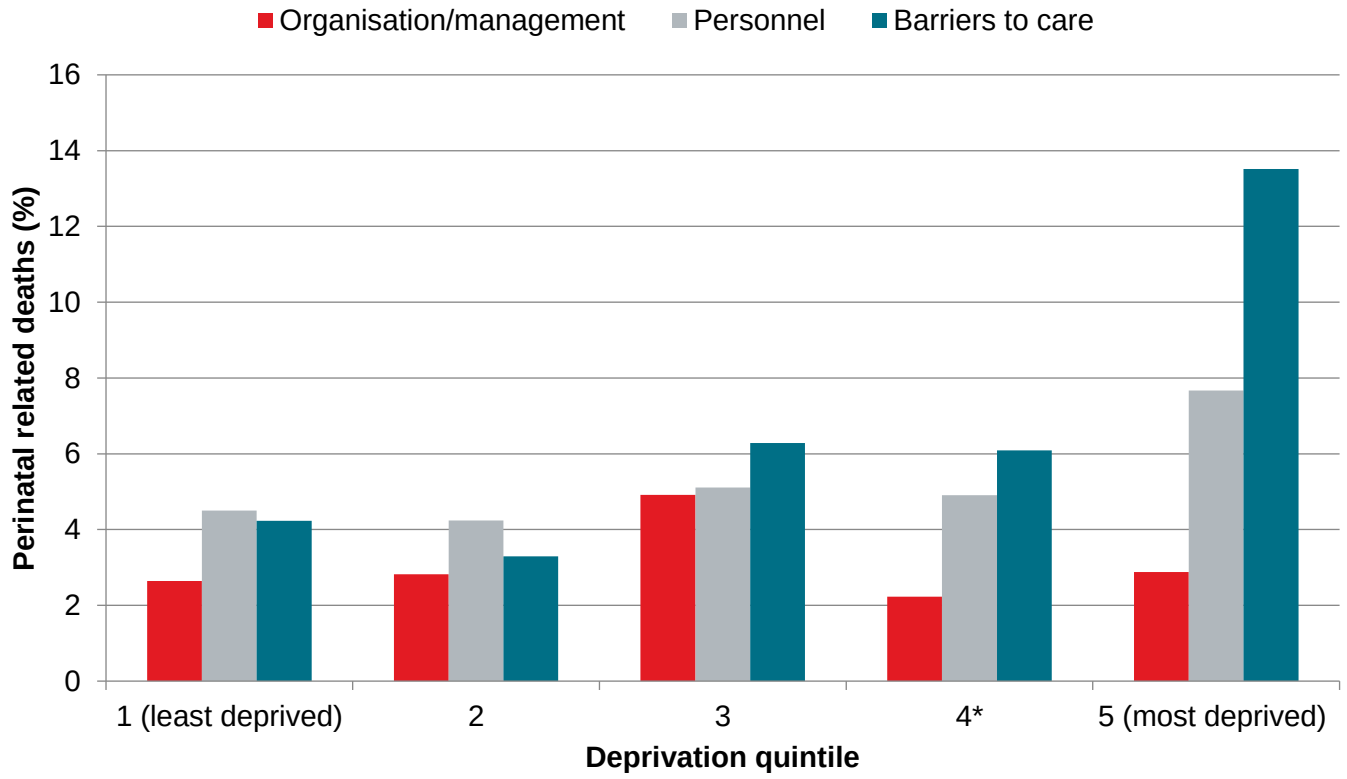
Excludes one death where the contributory factor was not identified.

'x' indicates percentage suppressed due to small numbers.

Source: PMMRC's perinatal data extract 2014–2018, local review data.

As the level of deprivation increased, barriers to accessing care became more significant, particularly among mothers living in NZDep2013 quintile 5 (Figure 3.28 and Table 3.39).

Figure 3.28: Main contributory factor(s) in potentially avoidable perinatal related deaths (as a percentage of all deaths) by NZDep2013 quintile 2014–2018



* Excludes one death where the contributory factor was not identified.

Source: PMMRC's perinatal data extract 2014–2018, local review data.

Table 3.39: Main contributory factor(s) in potentially avoidable perinatal related deaths by NZDep2013 quintile 2014–2018

Deprivation quintile	Perinatal related deaths	Potentially avoidable					
		Organisation/ management		Personnel		Barriers to care	
	n	n	%	n	%	n	%
1 (least deprived)	378	10	2.6	17	4.5	16	4.2
2	425	12	2.8	18	4.2	14	3.3
3	509	25	4.9	26	5.1	32	6.3
4*	673	15	2.2	33	4.9	41	6.1
5 (most deprived)	1,043	30	2.9	80	7.7	141	13.5
Unknown	18	<3	x	<3	x	3	16.7

* Excludes one death where the contributory factor was not identified.

'x' indicates percentage suppressed due to small numbers.

Source: PMMRC's perinatal data extract 2014–2018, local review data.

Resuscitation

Resuscitation of babies born at 23–26 weeks' gestation requires careful discussion with parents about the implications of resuscitating and of not doing so. We are unable to identify the babies for whom resuscitation was discussed, offered and declined, and the babies for whom resuscitation was not discussed or offered. Table 3.40 shows the number of babies for whom resuscitation was attempted, by maternal prioritised ethnic group.

Table 3.40: Resuscitation and survival (to 28 days) by maternal prioritised ethnic group for live born babies at 23–26 weeks' gestation without congenital anomalies 2009–2018

Maternal prioritised ethnic group	Total live births*	Neonatal deaths				
		Resuscitation attempted		Resuscitation not attempted		Total
		n	%	n	%	
Māori	556	114	20.5	40	7.2	154
Pacific	230	42	18.3	27	11.7	69
Asian	209	36	17.2	15	7.2	51
Indian	89	14	15.7	12	13.5	26
Other Asian	120	22	18.3	3	2.5	25
MELAA	31	5	16.1	3	9.7	8
European	593	103	17.4	27	4.6	130
NZ European	482	87	18.0	23	4.8	110
Other European	111	16	14.4	4	3.6	20
Unknown/Other	-	-	-	-	-	-
Total	**1,619**	**300**		**112**		**412**

* Includes babies with congenital anomalies.

MELAA = Middle Eastern, Latin American, or African.

Sources: Numerator: PMMRC's perinatal data extract where matched to MAT data, 23–26 weeks' gestation, 2009–2018; Denominator: Live births: MAT data 2009–2018.

Perinatal mortality appended tables

Table 3.41: Perinatal related death and perinatal death classification (PSANZ-PDC) 2018

Refer to Table 3.44 for the full code list.

Perinatal death classification (PSANZ-PDC)		2018 n=604	
		n	Rate
1	**Congenital anomaly**		
1.1	Structural anomaly	<3	s
1.11	Nervous system	25	0.42
1.12	Cardiovascular system	25	0.42
1.13	Genitourinary system	10	0.17
1.15	Musculoskeletal	10	0.17
1.151	Congenital diaphragmatic hernia	<3	s
1.18	Multiple congenital anomaly (no chromosomal/genetic cause or not tested)	15	0.25
1.19	Other congenital anomaly		
1.192	Idiopathic hydrops fetalis	<3	s
1.193	Fetal tumour (includes sacro-coccygeal teratoma)	<3	s
1.198	Other specified	3	0.05
1.199	Congenital anomaly, unspecified	<3	s
1.2	Chromosomal anomaly	<3	s
1.21	Trisomy 21 (Down syndrome)	13	0.22
1.22	Trisomy 18 (Edward syndrome) and Trisomy 13 (Patau syndrome)	22	0.37
1.23	Other trisomies and partial trisomies of the autosomes, not elsewhere classified (includes pathogenic duplications, unbalanced translocations and insertions)	6	0.10
1.24	Monosomies and deletions from the autosomes, not elsewhere classified (includes pathogenic deletions, eg, 22q11.2 deletion syndrome (diGeorge syndrome), Wolff-Hirschorn syndrome, Cri-du-chat syndrome	7	0.12
1.25	Turner syndrome (monosomy X)	<3	s
1.28	Other chromosomal abnormalities, not elsewhere specified (includes triploidy)	6	0.10
1.3	Genetic condition		
1.31	Genetic condition, specified (includes inborn errors of metabolism (eg, Tay-Sachs disease, Fragile X syndrome, imprinting syndromes) and other syndromes with demonstrated genetic mutations (eg, Kabuki syndrome, Fraser syndrome)	6	0.10
1.32	Syndrome/association with demonstrated chromosomal/gene anomaly	4	0.07
2	**Perinatal infection**		
2.1	Bacterial		
2.11	Group B Streptococcus	5	0.08
2.12	E coli	<3	s
2.14	Spirochaetal, eg, syphilis	<3	s
2.18	Other bacterial	<3	s
2.19	Unspecified bacterial	3	0.05
2.2	Viral		
2.21	Cytomegalovirus	<3	s
2.22	Parvovirus	<3	s
2.23	Herpes simplex virus	<3	s
2.3	Protozoal, eg, toxoplasma	<3	s
2.9	Other unspecified organism or no organism identified	3	0.05
3	**Hypertension**		
3.1	Chronic hypertension: essential	3	0.05
3.5	Pre-eclampsia	13	0.22
3.6	Pre-eclampsia superimposed on chronic hypertension	3	0.05
4	**Antepartum haemorrhage (APH)**		
4.1	Placental abruption	18	0.30
4.2	Placenta praevia	<3	s
4.9	APH of undetermined origin	39	0.66

Perinatal death classification (PSANZ-PDC)		2018 n=604	
		n	Rate
5	**Maternal conditions**		
5.1	Termination of pregnancy for maternal psychosocial indications	8	0.14
5.2	Diabetes		
5.21	Gestational diabetes	<3	s
5.22	Pre-existing diabetes	14	0.24
5.3	Maternal injury	<3	s
5.31	Accidental	6	0.10
5.32	Non-accidental	<3	s
5.4	Maternal sepsis	<3	s
5.5	Antiphospholipid syndrome	<3	s
5.6	Obstetric cholestasis	<3	s
5.8	Other specified maternal conditions		
5.88	Other specified maternal medical or surgical conditions	6	0.10
6	**Complications of multiple pregnancy**		
6.1	Monochorionic twins	<3	s
6.11	Twin to twin transfusion syndrome (TTTS)	12	0.20
6.12	Selective fetal growth restriction (FGR) (ie, affecting only one twin)	5	0.08
6.13	Monoamniotic twins (including cord entanglement)	3	0.05
6.18	Other	<3	s
6.19	Unknown or unspecified	3	0.05
6.2	Dichorionic twins		
6.21	Early fetal death in a multiple pregnancy (<20 weeks' gestation)	4	0.07
6.28	Other	<3	s
6.29	Unknown or unspecified	<3	s
7	**Specific perinatal conditions**		
7.1	Fetomaternal haemorrhage	7	0.12
7.2	Antepartum cord or fetal vessel complications (excludes monochorionic twins or higher order multiples)		
7.21	Cord vessel haemorrhage	<3	s
7.22	Cord occlusion (true knot with evidence of occlusion or other)	<3	s
7.28	Other cord complications	5	0.08
7.3	Uterine abnormalities		
7.31	Developmental anatomical abnormalities (eg, bicornuate uterus)	<3	s
7.5	Fetal antenatal intracranial injury		
7.52	Fetal antenatal ischaemic brain injury	<3	s
7.53	Fetal antenatal haemorrhagic brain injury	4	0.07
7.6	Other specific perinatal conditions		
7.63	Amniotic band	4	0.07
7.68	Other	<3	s
8	**Hypoxic peripartum death**		
8.1	With intrapartum complications (sentinel events)		
8.12	Cord prolapse	<3	s
8.15	Birth trauma	<3	s
8.2	Evidence of significant fetal compromise (excluding other complications)	3	0.05
8.9	Unspecified hypoxic peripartum death	<3	s
9	**Placental dysfunction or causative placental pathology**		
9.1	Maternal vascular malperfusion	17	0.29
9.2	Fetal vascular malperfusion	13	0.22
9.3	High grade villitis of unknown etiology (VUE)	9	0.15
9.4	Massive perivillous fibrin deposition/maternal floor infarction	<3	s
9.5	Severe chronic intervillositis (Histiocytic intervillositis)	3	0.05
9.6	Placental hypoplasia (small for gestation placenta)	4	0.07
9.7	No causal placental pathology demonstrated, with antenatal evidence of poor placental function identified (such as abnormal fetal umbilical artery Doppler)	<3	s

Perinatal death classification (PSANZ-PDC)		2018 n=604	
		n	Rate
9.8	Placental pathological examination was not performed, with antenatal evidence of poor placental function was identified (such as abnormal fetal umbilical artery Doppler)	3	0.05
9.9	Other placental pathology (eg, multiple pathologies with evidence of loss of placental function leading to death)	4	0.07
10	**Spontaneous preterm labour or rupture of membranes (<37 weeks' gestation)**		
10.1	Spontaneous preterm	<3	s
10.11	With histological chorioamnionitis	42	0.71
10.12	Without histological chorioamnionitis	15	0.25
10.13	With clinical evidence of chorioamnionitis, no examination of placenta	4	0.07
10.17	No clinical signs of chorioamnionitis, no examination of placenta	9	0.15
10.19	Unspecified or not known whether placenta examined	<3	s
10.2	Spontaneous preterm preceded by premature cervical shortening	26	0.44
11	**Unexplained antepartum fetal death**		
11.1	Unexplained antepartum fetal death despite full investigation	22	0.37
11.2	Unclassifiable antepartum fetal death with incomplete investigation	54	0.91
11.3	Unclassifiable antepartum fetal death due to unknown level of investigation	<3	s
12	**Neonatal death without obstetric antecedent**		
12.1	Neonatal death with no obstetric antecedent factors despite full investigation	<3	s

Categories where no deaths occurred have been removed from the table (refer to Table 3.44 for full code list).

's' indicates rate suppressed due to small numbers.

Sources: Numerator: PMMRC's perinatal data extract 2018; Denominator: MAT births 2018.

Table 3.42: Neonatal death and primary neonatal death classification (PSANZ-NDC) 2018

Refer to Table 3.45 for the full code list.

Neonatal death classification (PSANZ-NDC)		2018 n=154	
		n	Rate
1	**Congenital anomaly**		
1.1	Structural anomaly	<3	s
1.11	Nervous system	<3	s
1.12	Cardiovascular system	6	0.10
1.13	Genitourinary system	<3	s
1.15	Musculoskeletal	<3	s
1.151	Congenital diaphragmatic hernia	<3	s
1.18	Multiple congenital anomaly (no chromosomal/genetic cause or not tested)	4	0.07
1.19	Other congenital anomaly		
1.193	Fetal tumour (includes sacro-coccygeal teratoma)	<3	s
1.2	Chromosomal anomaly	<3	s
1.21	Trisomy 21 (Down syndrome)	<3	s
1.22	Trisomy 18 (Edward syndrome) and Trisomy 13 (Patau syndrome)	8	0.14
1.23	Other trisomies and partial trisomies of the autosomes, not elsewhere classified (includes pathogenic duplications, unbalanced translocations and insertions)	<3	s
1.24	Monosomies and deletions from the autosomes, not elsewhere classified (includes pathogenic deletions, eg, 22q11.2 deletion syndrome (diGeorge syndrome), Wolff-Hirschorn syndrome, Cri-du-chat syndrome	<3	s
1.28	Other chromosomal abnormalities, not elsewhere specified (includes triploidy)	<3	s
1.3	Genetic condition		
1.31	Genetic condition, specified (includes inborn errors of metabolism (eg, Tay-Sachs disease, Fragile X syndrome, imprinting syndromes) and other syndromes with demonstrated genetic mutations (eg, Kabuki syndrome, Fraser syndrome)	4	0.07
1.32	Syndrome/association with demonstrated chromosomal/gene anomaly	<3	s
2	**Periviable infants (typically <24 weeks)**		
2.1	Not resuscitated (including infants where there is an antenatal plan for no resuscitation at birth or in the circumstance of re-directed care)	55	0.94
2.2	Unsuccessful resuscitation	8	0.14
3	**Cardio-respiratory disorders**		
3.1	Hyaline membrane disease/Respiratory distress syndrome (RDS)	9	0.15

Neonatal death classification (PSANZ-NDC)		2018 n=154	
		n	Rate
3.2	Meconium aspiration syndrome	<3	s
3.3	Primary persistent pulmonary hypertension	<3	s
3.4	Pulmonary hypoplasia	<3	s
3.6	Air leak syndromes		
3.6.1	Pneumothorax	<3	s
3.9	Other		
3.9.1	Neonatal anaemia/hypovolaemia	<3	s
4	**Neonatal infection**		
4.1	Congenital/Perinatal bacterial infection (early onset <48 hrs)		
4.11	Blood stream infection/septicaemia		
4.111	Positive culture of a pathogen	4	0.07
4.13	Bacterial pneumonia	<3	s
4.15	Multiple site bacterial infection	<3	s
4.19	Unspecified congenital infection	<3	s
4.4	Acquired bacterial infection (late onset >48hrs)		
4.41	Blood stream infection/septicaemia		
4.411	Positive culture of a pathogen	4	0.07
5	**Neurological**		
5.1	Hypoxic ischaemic encephalopathy/Perinatal asphyxia	13	0.22
5.2	Cranial haemorrhage		
5.21	Intraventricular haemorrhage	3	0.05
6	**Gastrointestinal**		
6.1	Necrotising enterocolitis (NEC)	7	0.12
6.3	Gastric or intestinal perforation (excluding NEC)	<3	s
6.8	Other	<3	s
7	**Other**		
7.1	Sudden unexpected death in infancy (SUDI)		
7.13	Unclassified sudden infant death in the neonatal period		
7.131	Bed sharing/unsafe sleep	<3	s
7.2	Multisystem failure		
7.29	Unspecified/undetermined primary cause or trigger event	<3	s
7.3	Trauma		
7.31	Accidental	<3	s
7.4	Treatment complications		
7.41	Surgical	<3	s

Categories where no deaths occurred have been removed from the table (refer to Table 3.45 for full code list).

's' indicates rate suppressed due to small numbers.

Sources: Numerator: PMMRC's perinatal data extract, neonatal deaths only, 2018; Denominator: MAT births excluding fetal deaths 2018.

Table 3.43: Summary of New Zealand perinatal related mortality rates using New Zealand definition (≥20 weeks or ≥400g if gestation unknown), babies of ngā māmā Māori and New Zealand European mothers by year 2009–2018

Māori

Maternal prioritised ethnic group: Māori	n									
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Total births	17,224	17,102	16,518	16,391	15,241	14,881	15,116	15,367	15,244	14,898
Fetal deaths (terminations of pregnancy and stillbirths)*	140	124	126	111	106	108	91	120	94	119
Terminations of pregnancy	29	19	31	34	24	20	20	35	21	21
Stillbirths	111	105	95	77	82	88	71	85	73	98
Early neonatal deaths <7 days	49	53	39	43	44	47	38	48	48	34
Late neonatal deaths 7–27 days	20	16	11	9	6	11	14	14	11	13
Neonatal deaths <28 days#	69	69	50	52	50	58	52	62	59	47
Perinatal mortalities+	189	177	165	154	150	155	129	168	142	153
Perinatal related mortalities^	209	193	176	163	156	166	143	182	153	166
Perinatal mortalities excluding lethal and terminated fetal abnormalities•	155	146	119	112	111	127	101	124	115	132
Perinatal related mortalities excluding lethal and terminated fetal abnormalities•	168	158	127	120	116	135	110	136	125	143
	Rate									
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Total births										
Fetal deaths (terminations of pregnancy and stillbirths)*	8.13	7.25	7.63	6.77	6.95	7.26	6.02	7.81	6.17	7.99
Terminations of pregnancy	1.68	1.11	1.88	2.07	1.57	1.34	1.32	2.28	1.38	1.41
Stillbirths	6.44	6.14	5.75	4.70	5.38	5.91	4.70	5.53	4.79	6.58
Early neonatal deaths <7 days										
Late neonatal deaths 7–27 days										
Neonatal deaths <28 days#	4.04	4.06	3.05	3.19	3.30	3.93	3.46	4.07	3.89	3.18
Perinatal mortalities+	10.97	10.35	9.99	9.40	9.84	10.42	8.53	10.93	9.32	10.27
Perinatal related mortalities^	12.13	11.29	10.66	9.94	10.24	11.16	9.46	11.84	10.04	11.14
Perinatal mortalities excluding lethal and terminated fetal abnormalities•	9.00	8.54	7.20	6.83	7.28	8.53	6.68	8.07	7.54	8.86
Perinatal related mortalities excluding lethal and terminated fetal abnormalities•	9.75	9.24	7.69	7.32	7.61	9.07	7.28	8.85	8.20	9.60

* Fetal death rate per 1,000 babies born (includes terminations and stillbirths).

Neonatal death rate per 1,000 live born babies.

+ Fetal deaths and early neonatal deaths per 1,000 babies born.

^ Fetal deaths and early and late neonatal deaths per 1,000 babies born.

• Lethal and terminated fetal abnormalities are all perinatal related deaths with Perinatal Society of Australia and New Zealand Perinatal Death Classification (PSANZ-PDC) of congenital anomaly, and neonatal deaths with PSANZ Neonatal Death Classification (PSANZ-NDC) of congenital anomaly.

Sources: Numerator: PMMRC's perinatal data extract 2009–2018; Denominator: MAT births 2009–2018.

Table 3.43: Summary of New Zealand perinatal related mortality rates using New Zealand definition (≥20 weeks or ≥400g if gestation unknown), babies of ngā māmā Māori and New Zealand European mothers by year 2009–2018 (continued)

NZ European

Maternal prioritised ethnic group: NZ European	n									
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Total births	26,541	26,105	24,820	24,040	22,895	22,304	21,900	21,379	20,929	20,209
Fetal deaths (terminations of pregnancy and stillbirths)*	234	201	205	189	179	203	172	168	137	159
Terminations of pregnancy	69	74	77	66	59	70	58	56	51	54
Stillbirths	165	127	128	123	120	133	114	112	86	105
Early neonatal deaths <7 days	43	55	51	47	35	53	41	34	31	47
Late neonatal deaths 7–27 days	15	15	7	14	16	6	11	5	15	12
Neonatal deaths <28 days#	58	70	58	61	51	59	52	39	46	59
Perinatal mortalities+	277	256	256	236	214	256	213	202	168	206
Perinatal related mortalities^	292	271	263	250	230	262	224	207	183	218
Perinatal mortalities excluding lethal and terminated fetal abnormalities•	191	166	171	166	153	172	146	139	113	138
Perinatal related mortalities excluding lethal and terminated fetal abnormalities•	202	176	175	173	164	176	150	143	124	146
	Rate									
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Total births										
Fetal deaths (terminations of pregnancy and stillbirths)*	8.82	7.70	8.26	7.86	7.82	9.10	7.85	7.86	6.55	7.87
Terminations of pregnancy	2.60	2.83	3.10	2.75	2.58	3.14	2.65	2.62	2.44	2.67
Stillbirths	6.22	4.86	5.16	5.12	5.24	5.96	5.21	5.24	4.11	5.20
Early neonatal deaths <7 days										
Late neonatal deaths 7–27 days										
Neonatal deaths <28 days#	2.20	2.70	2.36	2.56	2.25	2.67	2.39	1.84	2.21	2.94
Perinatal mortalities+	10.44	9.81	10.31	9.82	9.35	11.48	9.73	9.45	8.03	10.19
Perinatal related mortalities^	11.00	10.38	10.60	10.40	10.05	11.75	10.23	9.68	8.74	10.79
Perinatal mortalities excluding lethal and terminated fetal abnormalities•	7.20	6.36	6.89	6.91	6.68	7.71	6.67	6.50	5.40	6.83
Perinatal related mortalities excluding lethal and terminated fetal abnormalities•	7.61	6.74	7.05	7.20	7.16	7.89	6.85	6.69	5.92	7.22

* Fetal death rate per 1,000 babies born (includes terminations and stillbirths).

Neonatal death rate per 1,000 live born babies.

+ Fetal deaths and early neonatal deaths per 1,000 babies born.

^ Fetal deaths and early and late neonatal deaths per 1,000 babies born.

• Lethal and terminated fetal abnormalities are all perinatal related deaths with Perinatal Society of Australia and New Zealand Perinatal Death Classification (PSANZ-PDC) of congenital anomaly, and neonatal deaths with PSANZ Neonatal Death Classification (PSANZ-NDC) of congenital anomaly.

Sources: Numerator: PMMRC's perinatal data extract 2009–2018; Denominator: MAT births 2009–2018.

Table 3.44: Perinatal Society of Australia and New Zealand Perinatal Death Classification (PSANZ-PDC) Version 2017 full code list

1	**Congenital anomaly**
1.1	Structural anomaly
1.11	Nervous system
1.12	Cardiovascular system
1.13	Genitourinary system
1.14	Gastrointestinal system
1.15	Musculoskeletal
1.151	Congenital diaphragmatic hernia
1.152	Gastroschisis/omphalocele
1.16	Respiratory system (includes congenital pulmonary airway malformation (CPAM))
1.17	Haematological
1.18	Multiple congenital anomaly (no chromosomal/genetic cause or not tested)
1.19	Other congenital anomaly
1.192	Idiopathic hydrops fetalis
1.193	Fetal tumour (includes sacro-coccygeal teratoma)
1.198	Other specified
1.199	Congenital anomaly, unspecified
1.2	Chromosomal anomaly
1.21	Trisomy 21 (Down syndrome)
1.22	Trisomy 18 (Edward syndrome) and Trisomy 13 (Patau syndrome)
1.23	Other trisomies and partial trisomies of the autosomes, not elsewhere classified (includes pathogenic duplications, unbalanced translocations and insertions)
1.24	Monosomies and deletions from the autosomes, not elsewhere classified (includes pathogenic deletions, eg, 22q11.2 deletion syndrome (diGeorge syndrome), Wolff-Hirschorn syndrome, Cri-du-chat syndrome)
1.25	Turner syndrome (monosomy X)
1.26	Other sex chromosome abnormalities (eg, Klinefelter syndrome)
1.28	Other chromosomal abnormalities, not elsewhere specified (includes triploidy)
1.29	Unspecified
1.3	Genetic condition
1.31	Genetic condition, specified (includes inborn errors of metabolism (eg, Tay-Sachs disease, Fragile X syndrome, imprinting syndromes) and other syndromes with demonstrated genetic mutations (eg, Kabuki syndrome, Fraser syndrome)
1.32	Syndrome/association with demonstrated chromosomal/gene anomaly
1.39	Genetic condition, unspecified
2	**Perinatal infection**
2.1	Bacterial
2.11	Group B streptococcus
2.12	E coli
2.13	Listeria monocytogenes
2.14	Spirochaetal, eg, syphilis
2.18	Other bacterial
2.19	Unspecified bacterial
2.2	Viral
2.21	Cytomegalovirus
2.22	Parvovirus
2.23	Herpes simplex virus
2.24	Rubella virus
2.25	Zika virus
2.28	Other viral
2.29	Unspecified viral
2.3	Protozoal, eg, toxoplasma
2.5	Fungal
2.8	Other specified organism
2.9	Other unspecified organism or no organism identified
3	**Hypertension**
3.1	Chronic hypertension: essential
3.2	Chronic hypertension: secondary, eg, renal disease
3.3	Chronic hypertension: unspecified
3.4	Gestational hypertension
3.5	Pre-eclampsia
3.6	Pre-eclampsia superimposed on chronic hypertension
3.9	Unspecified hypertension
4	**Antepartum haemorrhage (APH)**
4.1	Placental abruption
4.2	Placenta praevia
4.3	Vasa praevia
4.9	APH of undetermined origin
5	**Maternal conditions**
5.1	Termination of pregnancy for maternal psychosocial indications
5.2	Diabetes
5.21	Gestational diabetes
5.22	Pre-existing diabetes
5.3	Maternal injury
5.31	Accidental
5.32	Non-accidental
5.4	Maternal sepsis
5.5	Antiphospholipid syndrome
5.6	Obstetric cholestasis
5.8	Other specified maternal conditions
5.81	Maternal suicide
5.88	Other specified maternal medical or surgical conditions

6 Complications of multiple pregnancy

6.1 Monochorionic twins
- 6.11 Twin to twin transfusion syndrome (TTTS)
- 6.12 Selective fetal growth restriction (FGR) (ie, affecting only one twin)
- 6.13 Monoamniotic twins (including cord entanglement)
- 6.18 Other
- 6.19 Unknown or unspecified

6.2 Dichorionic twins
- 6.21 Early fetal death in a multiple pregnancy (<20 weeks' gestation)
- 6.22 Selective fetal growth restriction (FGR)
- 6.28 Other
- 6.29 Unknown or unspecified

6.3 Complications of higher order multiples (3 or more fetuses)
- 6.31 Twin to twin transfusion syndrome (TTTS)
- 6.32 Selective fetal growth restriction (FGR)
- 6.33 Monoamniotic multiples (including cord entanglement)
- 6.34 Early fetal death in a multiple pregnancy (<20 weeks' gestation)
- 6.38 Other
- 6.39 Unknown or unspecified

6.4 Complications where chorionicity is unknown

6.8 Other

6.9 Unspecified

7 Specific perinatal conditions

7.1 Fetomaternal haemorrhage

7.2 Antepartum cord or fetal vessel complications (excludes monochorionic twins or higher order multiples)
- 7.21 Cord vessel haemorrhage
- 7.22 Cord occlusion (true knot with evidence of occlusion or other)
- 7.28 Other cord complications
- 7.29 Unspecified cord complications

7.3 Uterine abnormalities
- 7.31 Developmental anatomical abnormalities (eg, bicornuate uterus)
- 7.38 Other
- 7.39 Unspecified

7.4 Alloimmune disease
- 7.41 Rhesus isoimmunisation
- 7.42 Other red cell antibody
- 7.43 Alloimmune thrombocytopenia
- 7.48 Other
- 7.49 Unspecified

7.5 Fetal antenatal intracranial injury
- 7.51 Subdural haematoma
- 7.52 Fetal antenatal ischaemic brain injury
- 7.53 Fetal antenatal haemorrhagic brain injury

7.6 Other specific perinatal conditions
- 7.61 Rupture of membranes after amniocentesis
- 7.62 Termination of pregnancy for suspected but unconfirmed congenital anomaly
- 7.63 Amniotic band
- 7.68 Other

7. 8 Unspecified

8 Hypoxic peripartum death

8.1 With intrapartum complications (sentinel events)
- 8.11 Uterine rupture
- 8.12 Cord prolapse
- 8.13 Shoulder dystocia
- 8.14 Complications of breech presentation
- 8.15 Birth trauma
- 8.16 Intrapartum haemorrhage
- 8.18 Other

8.2 Evidence of significant fetal compromise (excluding other complications)

8.3 No intrapartum complications and no evidence of significant fetal compromise identified

8.9 Unspecified hypoxic peripartum death

9 Placental dysfunction or causative placental pathology

9.1 Maternal vascular malperfusion

9.2 Fetal vascular malperfusion

9.3 High grade villitis of unknown etiology (VUE)

9.4 Massive perivillous fibrin deposition/maternal floor infarction

9.5 Severe chronic intervillositis (histiocytic intervillositis)

9.6 Placental hypoplasia (small for gestation placenta)

9.7 No causal placental pathology demonstrated, with antenatal evidence of poor placental function identified (such as abnormal fetal umbilical artery Doppler)

9.8 Placental pathological examination was not performed, with antenatal evidence of poor placental function was identified (such as abnormal fetal umbilical artery Doppler)

9.9 Other placental pathology (eg, multiple pathologies with evidence of loss of placental function leading to death)

10 Spontaneous preterm labour or rupture of membranes (<37 weeks' gestation)

10.1 Spontaneous preterm
- 10.11 With histological chorioamnionitis
- 10.12 Without histological chorioamnionitis
- 10.13 With clinical evidence of chorioamnionitis, no examination of placenta
- 10.17 No clinical signs of chorioamnionitis, no examination of placenta
- 10.19 Unspecified or not known whether placenta examined

10.2 Spontaneous preterm preceded by premature cervical shortening

11 Unexplained antepartum fetal death

11.1 Unexplained antepartum fetal death despite full investigation

11.2 Unclassifiable antepartum fetal death with incomplete investigation

11.3 Unclassifiable antepartum fetal death due to unknown level of investigation

12 Neonatal death without obstetric antecedent

12.1 Neonatal death with no obstetric antecedent factors despite full investigation

12.2 Neonatal death unclassifiable as to obstetric antecedent with incomplete investigation

12.3 Neonatal death unclassifiable as to obstetric antecedent due to unknown level of investigation

Table 3.45: PSANZ Neonatal Death Classification (PSANZ-NDC) Version 2017 full code list

1 Congenital anomaly

1.1 Structural anomaly

- 1.11 Nervous system
- 1.12 Cardiovascular system
- 1.13 Genitourinary system
- 1.14 Gastrointestinal system
- 1.15 Musculoskeletal
  - 1.151 Congenital diaphragmatic hernia
  - 1.152 Gastroschisis/omphalocele
- 1.16 Respiratory system (includes congenital pulmonary airway malformation (CPAM))
- 1.17 Haematological
- 1.18 Multiple congenital anomaly (no chromosomal/genetic cause or not tested)
- 1.19 Other congenital anomaly
  - 1.192 Idiopathic hydrops fetalis
  - 1.193 Fetal tumour (includes sacro-coccygeal teratoma)
  - 1.198 Other specified
  - 1.199 Congenital anomaly, unspecified

1.2 Chromosomal anomaly

- 1.21 Trisomy 21 (Down syndrome)
- 1.22 Trisomy 18 (Edward syndrome) and Trisomy 13 (Patau syndrome)
- 1.23 Other trisomies and partial trisomies of the autosomes, not elsewhere classified (includes pathogenic duplications, unbalanced translocations and insertions)
- 1.24 Monosomies and deletions from the autosomes, not elsewhere classified (includes pathogenic deletions eg, 22q11.2 deletion syndrome (diGeorge syndrome), Wolff-Hirschorn syndrome, Cri-du-chat syndrome)
- 1.25 Turner syndrome (monosomy X)
- 1.26 Other sex chromosome abnormalities (eg, Klinefelter syndrome)
- 1.28 Other chromosomal abnormalities, not elsewhere specified (includes triploidy)
- 1.29 Unspecified

1.3 Genetic condition

- 1.31 Genetic condition, specified (includes inborn errors of metabolism (eg, Tay-Sachs disease, Fragile X syndrome, imprinting syndromes) and other syndromes with demonstrated genetic mutations (eg, Kabuki syndrome, Fraser syndrome)
- 1.32 Syndrome/association with demonstrated chromosomal/gene anomaly
- 1.39 Genetic condition, unspecified

2 Periviable infants (typically <24 weeks)

2.1 Not resuscitated (including infants where there is an antenatal plan for no resuscitation at birth or in the circumstance of re-directed care)

2.2 Unsuccessful resuscitation

2.9 Unspecified or not known whether resuscitation attempted

3 Cardio-respiratory disorders

3.1 Hyaline membrane disease/Respiratory distress syndrome (RDS)

3.2 Meconium aspiration syndrome

3.3 Primary persistent pulmonary hypertension

3.4 Pulmonary hypoplasia

3.5 Pulmonary haemorrhage

3.6 Air leak syndromes

- 3.6.1 Pneumothorax
- 3.6.2 Pulmonary interstitial emphysema
- 3.6.3 Other

3.7 Patent ductus arteriosus

3.8 Chronic neonatal lung disease (typically, bronchopulmonary dysplasia)

3.9 Other

- 3.9.1 Neonatal anaemia/hypovolaemia

4 Neonatal infection

4.1 Congenital/Perinatal bacterial infection (early onset <48 hrs)

- 4.11 Blood stream infection/septicaemia
  - 4.111 Positive culture of a pathogen
  - 4.112 Clinical signs of sepsis + ancillary evidence but culture negative
- 4.12 Bacterial meningitis
- 4.13 Bacterial pneumonia
- 4.15 Multiple site bacterial infection
- 4.18 Other congenital bacterial infection eg, gastroenteritis, osteomyelitis, cerebral abscess
- 4.19 Unspecified congenital infection

4.2 Congenital/Perinatal viral infection

4.3 Congenital fungal, protozoan, parasitic infection

4.4 Acquired bacterial infection [late onset >48hrs]

- 4.41 Blood stream infection/septicaemia
  - 4.411 Positive culture of a pathogen
  - 4.412 Clinical signs of sepsis + ancillary evidence but culture negative
- 4.42 Bacterial meningitis
- 4.43 Bacterial pneumonia
- 4.48 Other acquired bacterial infection eg, gastroenteritis, osteomyelitis
- 4.49 Unspecified acquired infection

4.5 Acquired viral infection

4.6 Acquired fungal, protozoan, parasitic infection

5 Neurological

5.1 Hypoxic ischaemic encephalopathy/Perinatal asphyxia

5.2 Cranial haemorrhage

- 5.21 Intraventricular haemorrhage
- 5.22 Subgaleal haemorrhage
- 5.23 Subarachnoid haemorrhage
- 5.24 Subdural haemorrhage
- 5.28 Other intracranial haemorrhage

5.3 Post haemorrhagic hydrocephalus

5.4 Periventricular leukomalacia

5.8 Other

6 Gastrointestinal

6.1 Necrotising enterocolitis (NEC)

6.2 Short gut syndrome

6.3 Gastric or intestinal perforation (excluding NEC)

6.4 Gastrointestinal haemorrhage

6.8 Other

7 Other

7.1 Sudden unexpected death in infancy (SUDI)

- 7.11 Sudden infant death syndrome (SIDS)
  - 7.112 SIDS Category IA: Classic features of SIDS present and completely documented
  - 7.113 SIDS Category IB: Classic features of SIDS present but incompletely documented
  - 7.114 SIDS Category II: Infant deaths that meet category I except for one or more features
- 7.12 Unknown/Undetermined
- 7.13 Unclassified sudden infant death in the neonatal period
  - 7.131 Bed sharing/unsafe sleep
  - 7.132 Not bed sharing

7.2 Multisystem failure

- 7.21 Secondary to intrauterine growth restriction
- 7.28 Other specified
- 7.29 Unspecified/undetermined primary cause or trigger event

7.3 Trauma

- 7.31 Accidental
- 7.32 Non accidental
- 7.39 Unspecified

7.4 Treatment complications

- 7.41 Surgical
- 7.42 Medical

7.5 Unsuccessful resuscitation in infants of 28 weeks' gestation or more without an obvious sentinel event

7.8 Other specified

4 Neonatal encephalopathy | Te māuiui roro i ngā pēpi whānau hou

Introduction

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. The severity of the encephalopathy is measured by the Sarnat stages 1, 2 or 3 or as mild, moderate or severe.[45]

The PMMRC collects data on babies who present with moderate or severe NE in the first seven days after birth. Data have been collected on NE babies from 37 weeks' gestation onwards since 2010. In 2016, the PMMRC started collecting data on babies from 35 weeks' gestation. Over the period 2010–2018, we have collected information on a total of 620[46] NE babies, including 17 babies born before 37 weeks' gestation. Due to the small number of cases in 35–36 weeks' gestation babies collected to date, in this chapter we present only data relating to babies born at 37 weeks or later.[47] About 67 babies with moderate to severe NE in Aotearoa/New Zealand are reported each year to the PMMRC.

There are a number of risk factors for NE as identified in the peer reviewed literature. These include antenatal risk factors, such as maternal diabetes, obesity, thyroid dysfunction, pre-eclampsia and previous caesarean section, evidence of fetal growth restriction, abnormal amniotic fluid volume and abnormal fetal heart tracing before labour. Intrapartum risk factors include clinical chorioamnionitis and ominous fetal heart tracing,[48] cord prolapse, placental abruption and uterine rupture.[49] (*PMMRC 13th report*[50])

[45] Nelson KB, Leviton A. 1991. How much of neonatal encephalopathy is due to birth asphyxia? *American Journal of Diseases of Children* 145(11): 1325–31.

[46] Includes two late notifications.

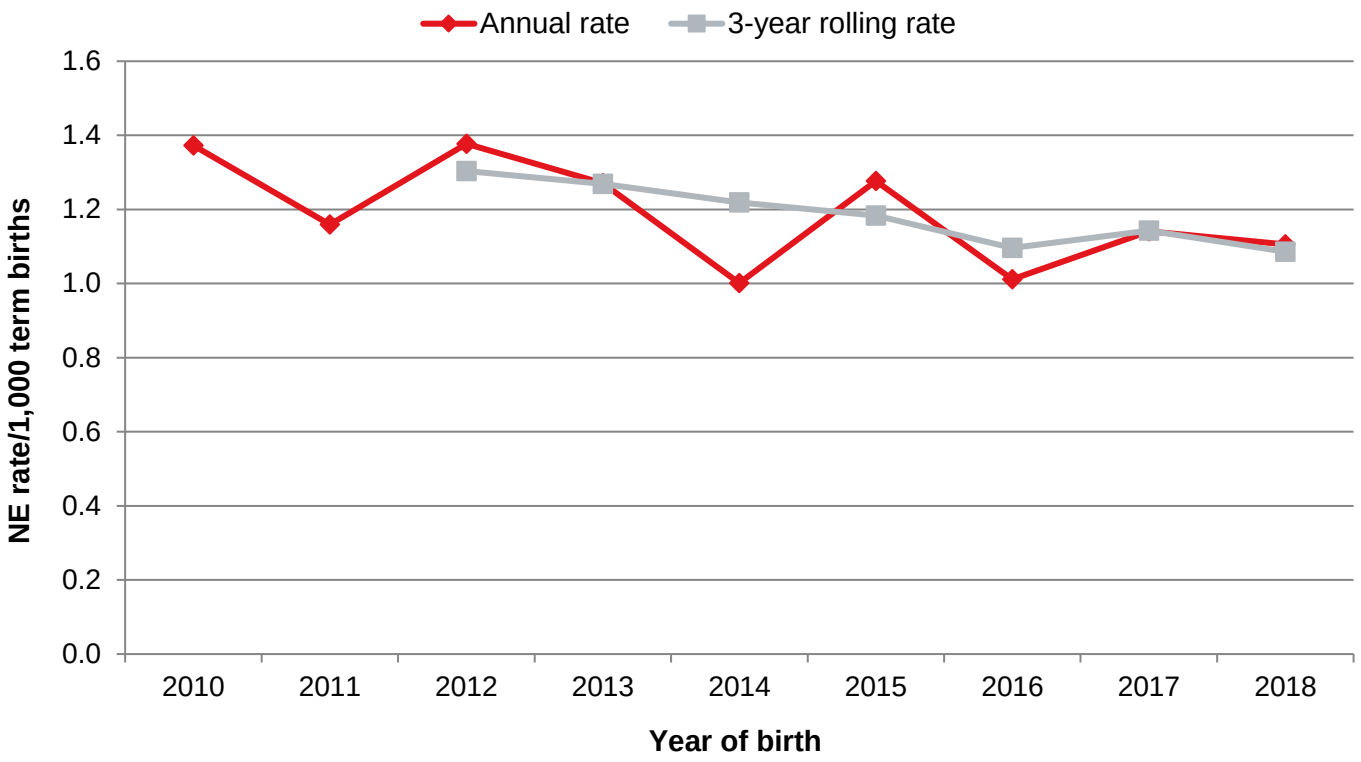
[47] Information on late notifications is not presented in the remainder of the chapter.

[48] Locatelli A, Incerti M, Paterlini G, et al. 2010. Antepartum and intrapartum risk factors for neonatal encephalopathy at term. *American Journal of Perinatology* 27(8): 649–54.

[49] Martinez-Biarge M, Madero R, González A, et al. 2012. Perinatal morbidity and risk of hypoxic-ischemic encephalopathy associated with intrapartum sentinel events. *American Journal of Obstetrics & Gynecology* 206: 148.e1–7.

[50] PMMRC. 2019. *Te Pūrongo ā-Tau Tekau mā Toru o te Komiti Arotake Mate Pēpi, Mate Whaea Hoki | Thirteenth Annual Report of the Perinatal and Maternal Mortality Review Committee: Te tuku pūrongo mō te mate me te whakamate 2017 | Reporting mortality and morbidity 2017.* Wellington: Health Quality & Safety Commission. URL: https://www.hqsc.govt.nz/assets/PMMRC/Publications/13thPMMRCreport/13thPMMRCAnnualReportWebFINAL.pdf (accessed 18 September 2020). p 87.

Figure 4.1: NE annual and three-year rolling rates* (per 1,000 term births) 2010–2018



* Rolling three-year mortality rates represented at final year of triennium.

Sources: Numerator: PMMRC's NE data extract ≥37 weeks 2010–2018; Denominator: MAT births ≥37 weeks 2010–2018.

International comparisons

It is frequently difficult to compare NE rates in New Zealand with those of other countries, due to differences in definitions of terms and in inclusion and exclusion criteria, as well as data quality issues. A previous meta-analysis estimated the NE incidence in high-income regions to be 1.6 per 1,000 live births.[51] The New Zealand rate of 1.2 per 1,000 live births over the period 2010–2018 is therefore similar to other comparable countries.

Findings

The number of NE cases ranged from 55 to 82 per year over the period 2010–2018. The rate of NE cases per 1,000 term births fluctuated from year to year, with a high of 1.38 per 1,000 live births in 2012 and a low of 1.00 in 2014. However, between the years 2010 and 2018, the rate has not shown a statistically significant trend either up or down[52] (Figure 4.1).

There was some variation in rates of NE by maternal prioritised ethnic group, with 'Other European' and 'Other Asian' mothers having the lowest rates (Figure 4.2 and Table 4.11).

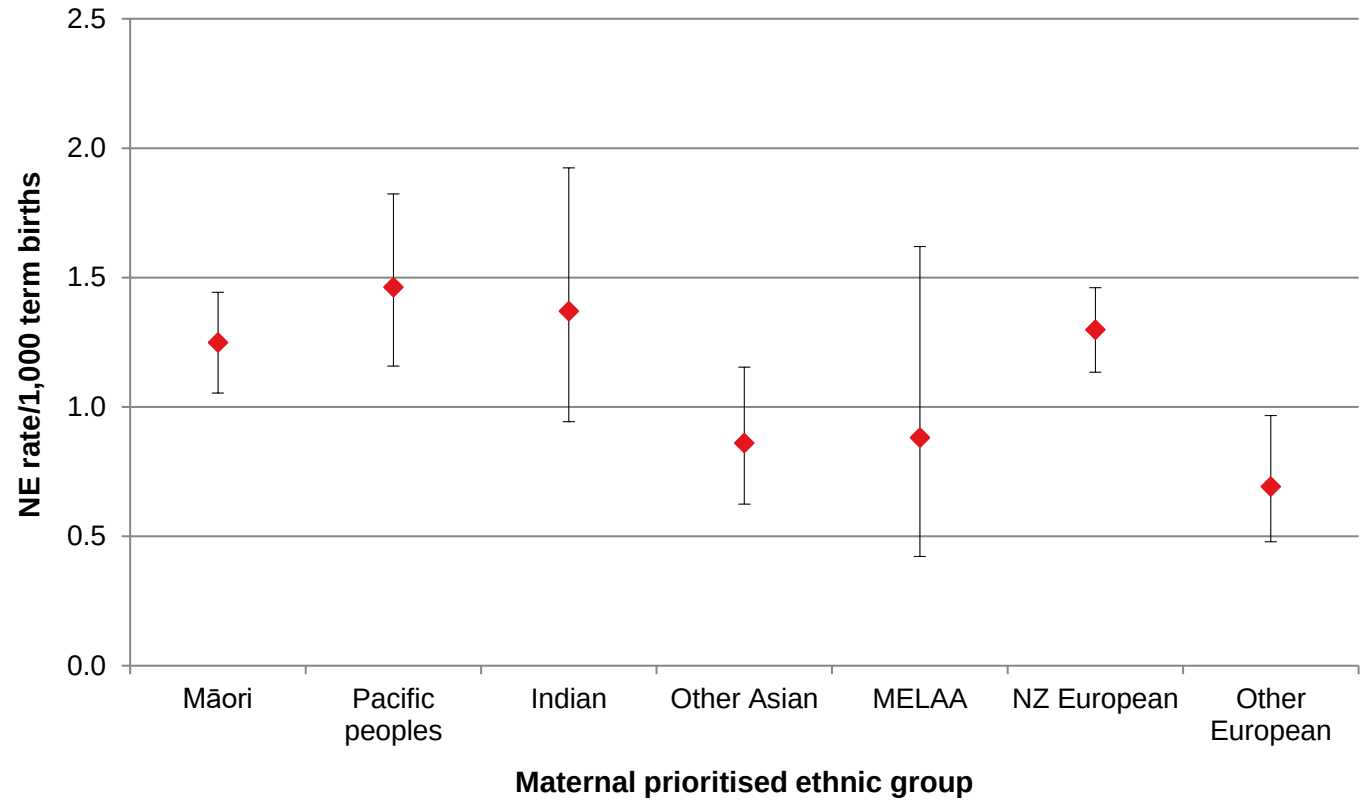
NE rates varied substantially by NZDep2013 quintile. Babies whose mothers lived in quintiles 2 to 5 were statistically significantly more likely to develop NE than those living in quintile 1[53] (Figure 4.3 and Table 4.11).

[51] Lee ACC, Kozuki N, Blencowe H, et al, 2013. Intrapartum-related neonatal encephalopathy incidence and impairment at regional and global levels for 2010 with trends from 1990. *Pediatric Research* 74(a1): 50–72.

[52] Chi-squared test for trend=2.74, p=0.10

[53] The rate ratio comparing quintile 2 with quintile 1 was 1.49 (95% CI 1.07–2.09). For quintile 4 compared with quintile 1, the rate ratio was 1.77 (95% CI 1.30–2.40).

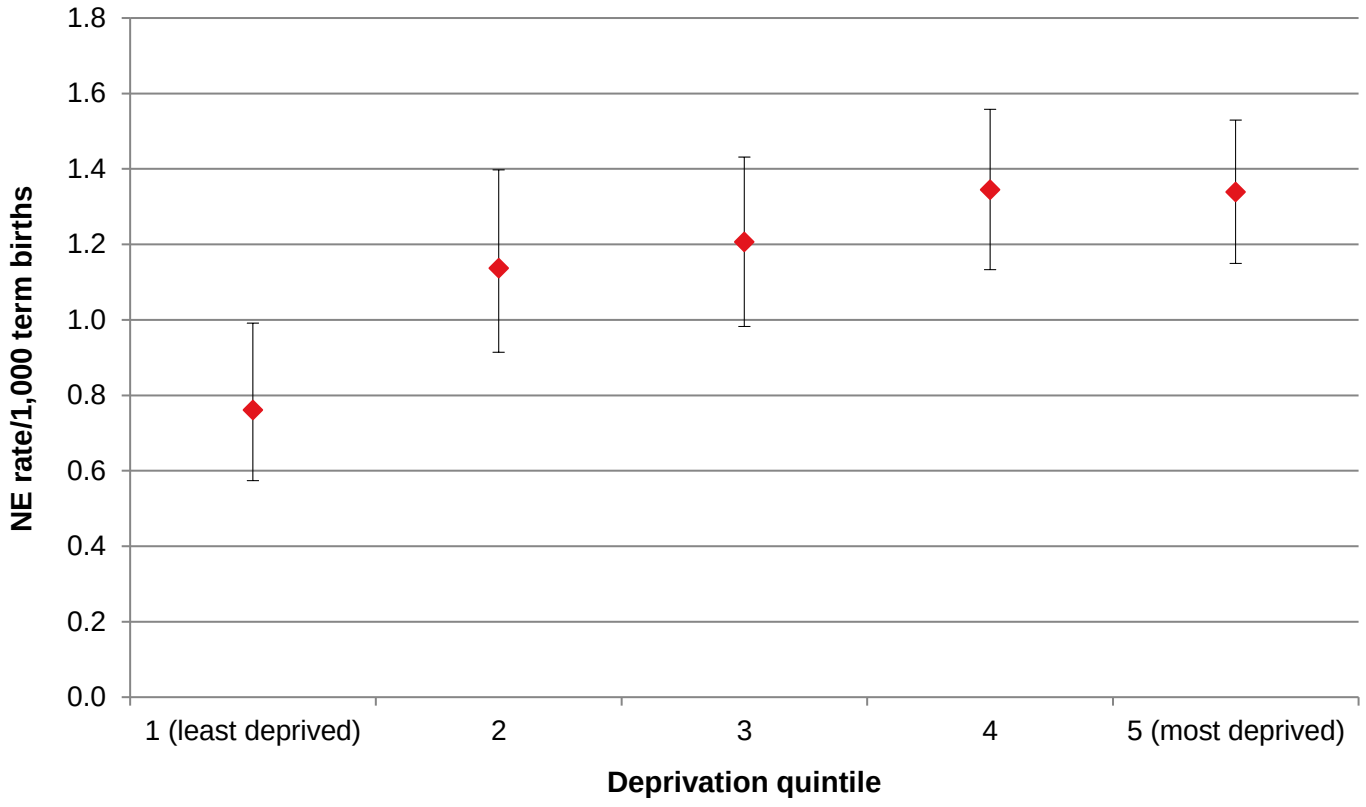
Figure 4.2: NE rates (per 1,000 term births, with 95% CIs) by maternal prioritised ethnic group 2010–2018



MELAA = Middle Eastern, Latin American, or African.

Sources: Numerator: PMMRC's NE data extract ≥37 weeks 2010–2018; Denominator: MAT births ≥37 weeks 2010–2018.

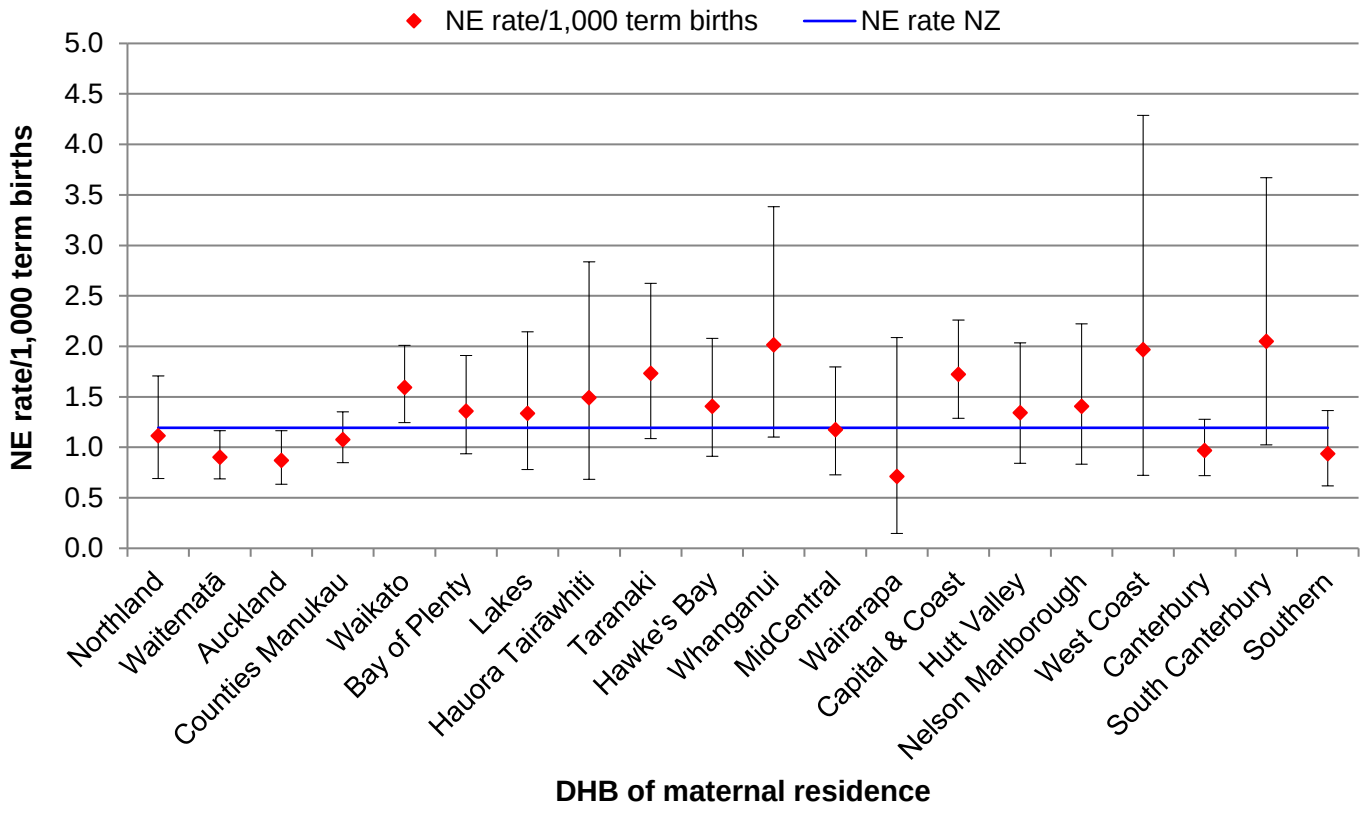
Figure 4.3: NE rates (per 1,000 term births, with 95% CIs) by NZDep quintile 2010–2018



Sources: Numerator: PMMRC's NE data extract ≥37 weeks 2010–2018; Denominator: MAT births ≥37 weeks 2010–2018.

NE rates also varied considerably by the DHB in which the mother lived. The rates in most DHBs were not statistically significantly different to the national rate of 1.19 per 1,000 term births. However, over the nine-year reporting period 2010–2018, Waitematā and Auckland DHBs had rates lower than the national average, while Capital & Coast and Waikato DHBs had rates higher than the national average (Figure 4.4 and Table 4.12). Because the frequency of cases was statistically low, it was not possible to identify any trends of an increasing or decreasing rate for individual DHBs. In future research, the Neonatal Encephalopathy Working Group will compare reporting to the Australian & New Zealand Neonatal Network and to PMMRC in terms of establishing mortality and morbidity and frequency of cases.

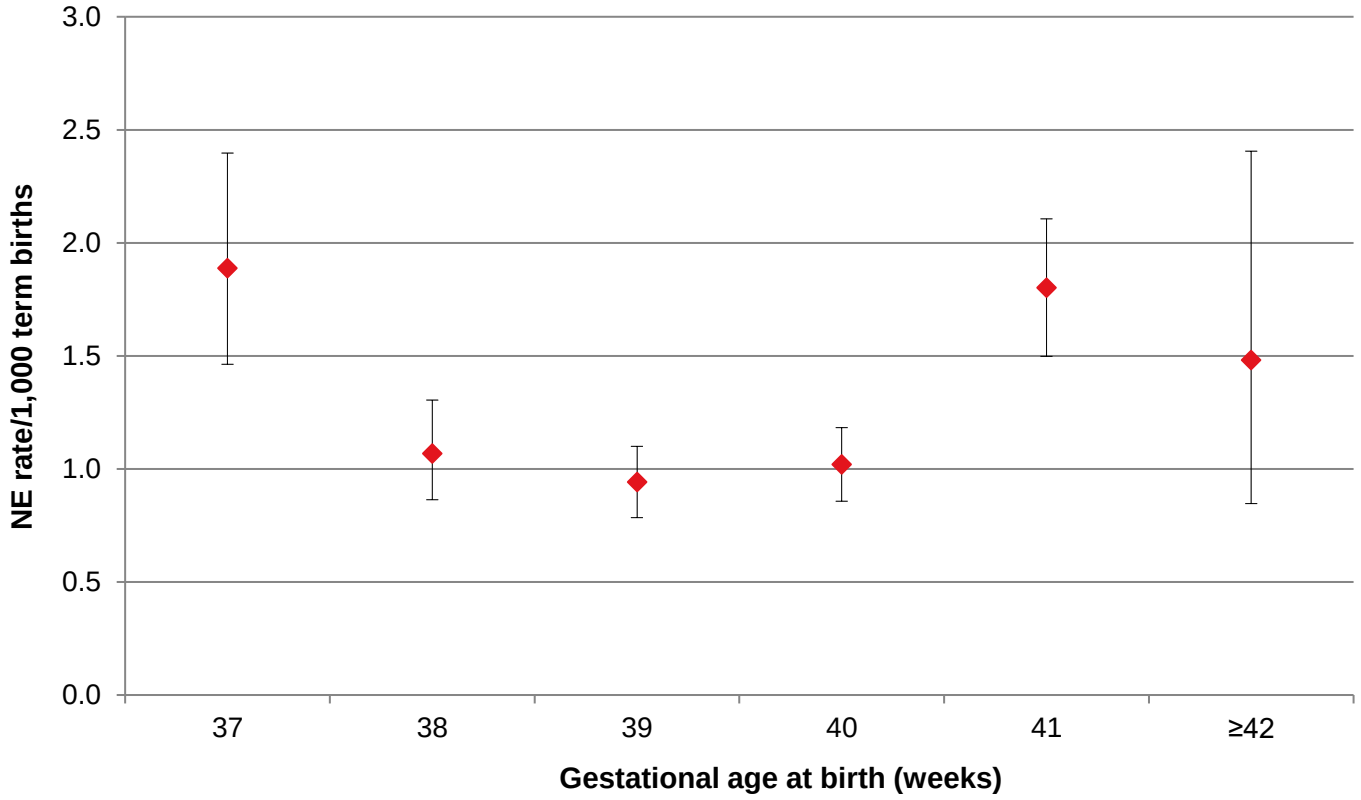
Figure 4.4: NE rates (per 1,000 term births, with 95% CIs) by DHB of maternal residence (compared with New Zealand NE rate) 2010–2018



Sources: Numerator: PMMRC's NE data extract ≥37 weeks 2010–2018; Denominator: MAT births ≥37 weeks 2010–2018.

Rates of NE varied by gestational age, with higher rates in babies at 37 weeks' and at ≥41 weeks' gestation (Table 4.1 and Figure 4.5). This finding is probably due to a number of different factors, and further case review will be required to analyse it in detail. There were no statistically significant differences by the sex of the baby. Babies with lower birthweight had higher rates of NE, with those under 2,500g having the highest rate. Babies who were multiples had an incidence rate nearly double that of singletons. However, this was not a statistically significant difference, likely due to small numbers (Table 4.1).

Figure 4.5: NE rates (per 1,000 term births) by gestational age at birth (≥37 weeks) 2010–2018



Sources: Numerator: PMMRC's NE data extract ≥37 weeks 2010–2018; Denominator: MAT births ≥37 weeks 2010–2018.

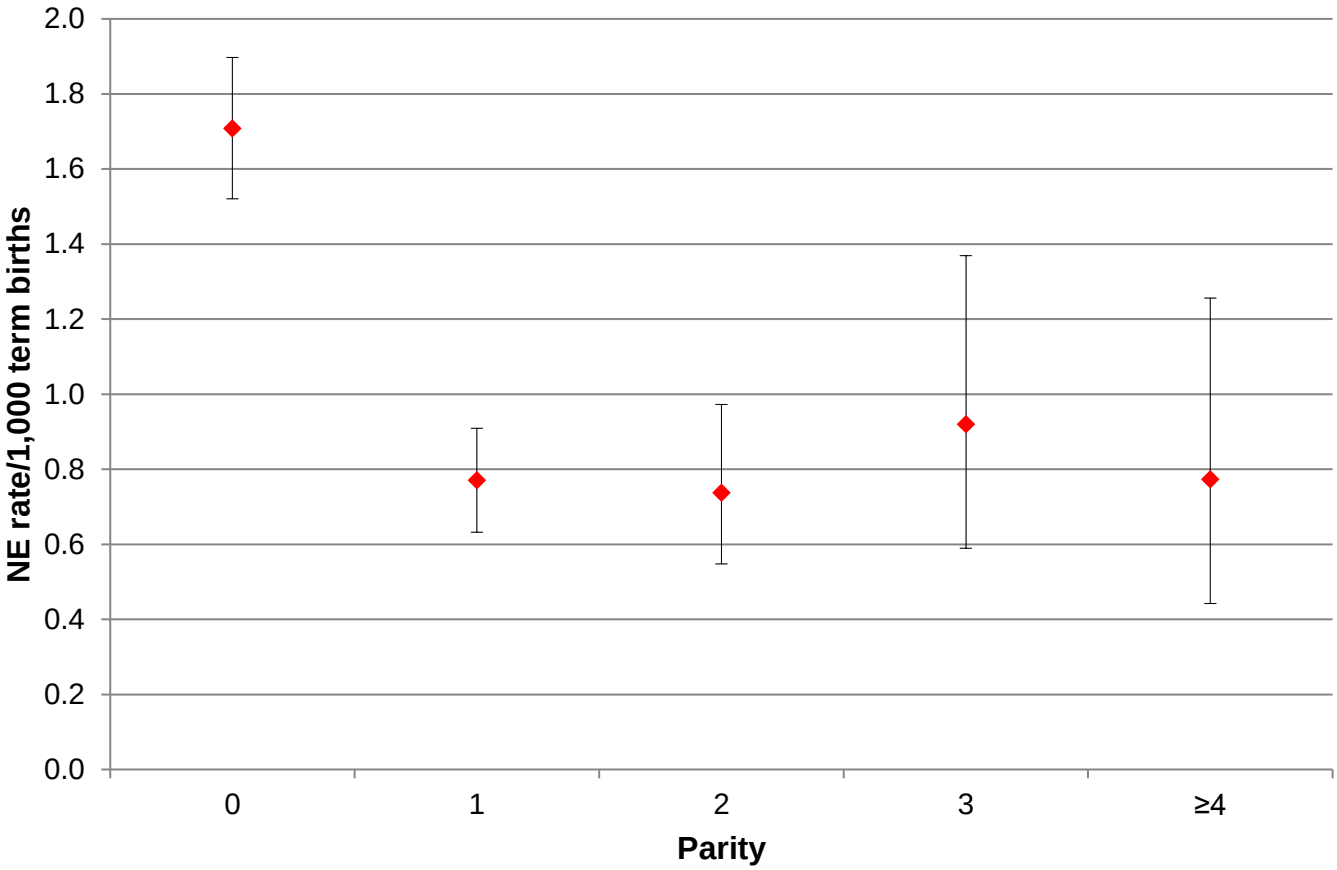
Table 4.1: NE rates (per 1,000 term births) by gestational age, sex, birthweight and plurality 2010–2018

	MAT births ≥37 weeks N=503,656		NE babies n=601		Rate (per 1,000 term births)	
	n	%	n	%	/1,000	95% CI
Gestational age at birth (weeks)						
37	35,491	7.0	67	11.1	1.89	1.46–2.40
38	88,998	17.7	95	15.8	1.07	0.86–1.30
39	145,397	28.9	137	22.8	0.94	0.78–1.10
40	148,051	29.4	151	25.1	1.02	0.86–1.18
41	74,918	14.9	135	22.5	1.80	1.50–2.11
≥42	10,801	2.1	16	2.7	1.48	0.85–2.41
Sex						
Male	257,490	51.1	323	53.7	1.25	1.12–1.39
Female	246,150	48.9	278	46.3	1.13	1.00–1.26
Undetermined/unknown	16	0.0	-	-	-	-
Birthweight (g)						
<2,500	9,340	1.9	23	3.8	2.46	1.56–3.69
2,500–3,999	396,867	78.8	498	82.9	1.25	1.14–1.37
4,000–4,499	62,134	12.3	58	9.7	0.93	0.71–1.21
≥4,500	12,576	2.5	22	3.7	1.75	1.10–2.65
Unknown	22,739	4.5	-	-	-	-
Plurality						
Singleton	495,598	98.4	589	98.0	1.19	1.09–1.28
Multiple	5,932	1.2	12	2.0	2.02	1.05–3.53
Unknown	2,126	0.4	-	-	-	-

Sources: Numerator: PMMRC's NE data extract ≥37 weeks 2010–2018; Denominator: MAT births ≥37 weeks 2010–2018.

Babies of primiparous women (women having their first baby after 20 weeks' gestation, also referred to as 'parity 0') had the highest rates of NE, which were statistically significantly higher than babies of multiparous women regardless of parity (Figure 4.6). The rate ratio for NE in babies of primiparous compared with multiparous women was 2.20 (95% CI 1.85–2.62). While women having their first baby make up 41% of the birthing population, they gave birth to 60% of babies with NE (Table 4.2 and Figure 4.6).

Figure 4.6: NE rates (per 1,000 term births) by parity prior to index birth* 2010–2018



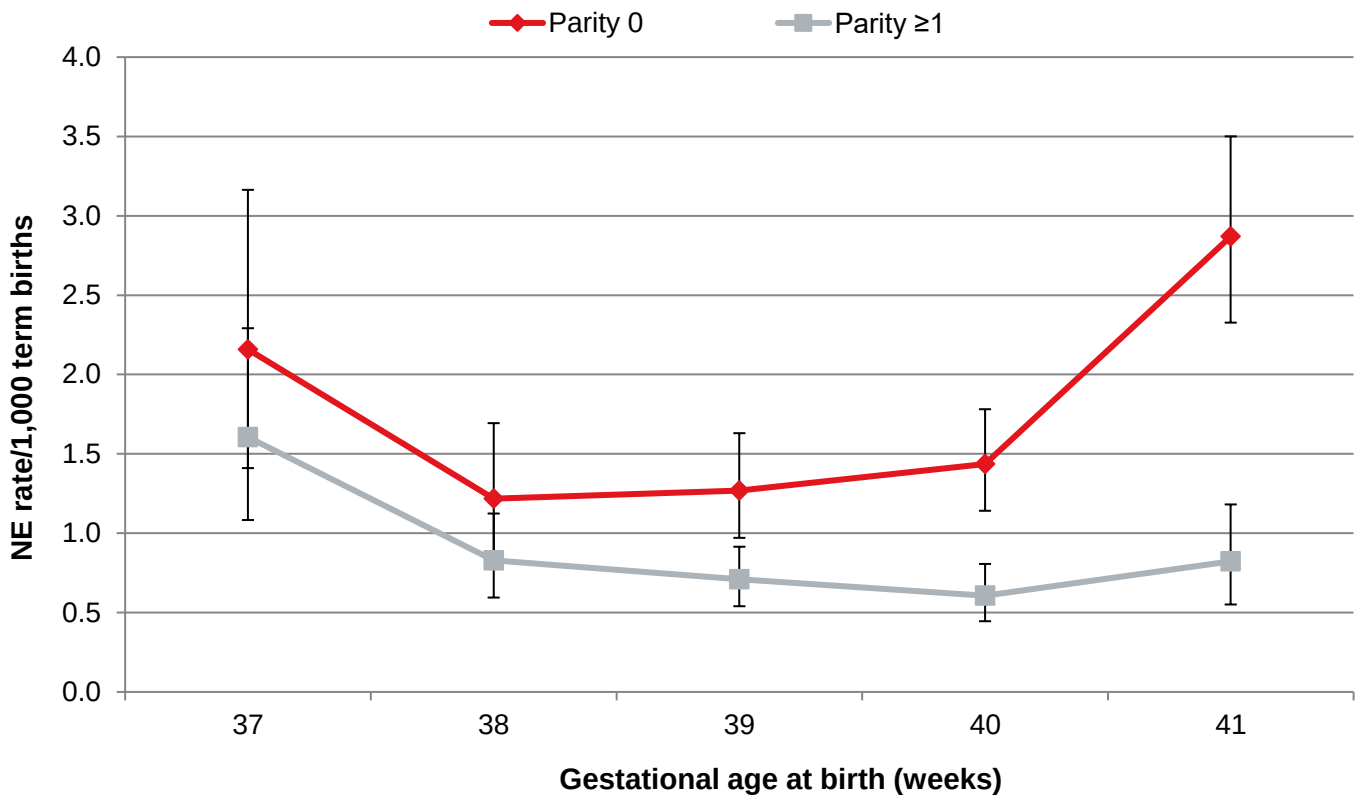
* All data limited to mothers who were registered for care with an LMC (a midwife, obstetrician or GP) claiming from the Section 88 Primary Maternity Services Notice.

Parity '0' indicates women having their first baby/babies of 20 weeks' or greater gestation.

Sources: Numerator: PMMRC's NE data extract where matched to MAT data, ≥37 weeks 2010–2018; Denominator: MAT births ≥37 weeks 2010–2018.

In analyses by both parity and gestational age, the same patterns remained. Rates of NE were higher in babies born at 37 and 41 weeks' gestation. Rates were elevated in primiparous women, regardless of gestational age, but statistically significantly higher from 39 weeks onwards (Figure 4.7).

Figure 4.7: NE rates (per 1,000 term births) by parity and gestational age* 2010–2018



* All data limited to mothers who were registered for care with an LMC (a midwife, obstetrician or GP) claiming from the Section 88 Primary Maternity Services Notice. Excludes gestational age at birth greater than 41 weeks with fewer than three cases among parity ≥1.

Sources: Numerator: PMMRC's NE data extract where matched to MAT data, ≥37 weeks 2010–2018; Denominator: MAT births ≥37 weeks 2010–2018.

During the study period, NE rates did not differ between babies of mothers who smoked and those who did not smoke. However, smoking is a risk factor for late stillbirth[54] and small for gestational age.[55] NE rates were statistically significantly higher in babies of women who had a BMI of 35 or greater, compared with women with a BMI of less than 25. This finding supports the Ministry of Health's *Guidelines for Consultation with Obstetric and Related Medical Services (Referral Guidelines)*, which state that LMCs of all women with a BMI of 35 or greater should recommend that they have an obstetric consultation.[56]

NE rates did not vary significantly by gestational age at first antenatal visit. Note, however, that 35% of mothers whose babies developed NE did not have antenatal care in the first trimester. This was similar to the percentage of all mothers who did not register with an LMC in the first trimester (32%). The PMMRC has previously recommended that the Ministry of Health, DHBs and professional colleges explore barriers to early registering with a view to increasing the number of women who register with an LMC before 10 weeks' gestation. This issue requires ongoing consideration and action. Consistent with the international literature, babies who were small for gestational age were nearly twice as likely to have moderate to severe NE compared with babies who were appropriate size for gestational age.[57]

[54] Cronin RS, Li M, Thompson JMD, et al. 2019. An individual participant data meta-analysis of maternal going-to-sleep position, interactions with fetal vulnerability, and the risk of late stillbirth. *The Lancet* 10: 49–57. doi: 10.1016/j.eclinm.2019.03.014 (accessed 15 August 2019).

[55] McCowan L, Horgan RP. 2009. Risk factors for small for gestational age infants. *Best Practice & Research: Clinical Obstetrics & Gynaecology* 23(6): 779–93.

[56] Ministry of Health. 2012. *Guidelines for Consultation with Obstetric and Related Medical Services (Referral Guidelines).* Wellington: Ministry of Health.

[57] The rate ratio for small for gestational age infants compared with appropriate for gestational age infants was 1.82 (95% CI 1.44–2.31).

As part of its NE prevention programme, the Accident Compensation Corporation (ACC) has funded the implementation of the Growth Assessment Protocol (GAP) in DHBs, which continues to be rolled out nation-wide. The Neonatal Encephalopathy Working Group has previously commended ACC on its action on this important issue and anticipates that an evaluation of the effectiveness of this programme will follow once it has been established throughout Aotearoa/New Zealand.

Table 4.2: Maternal smoking, BMI, gestational age at first antenatal visit, customised birthweight centiles and parity among NE babies* 2010–2018

	MAT births ≥37 weeks		NE cases		Rate (per 1,000 term births)	
	N=453,883		n=525			
	n	%	n	%	/1,000	95% CI
Currently smoking						
Yes	63,671	14.0	74	14.1	1.16	0.91–1.46
No	390,187	86.0	451	85.9	1.16	1.05–1.26
Unknown	25	0.0	-	-	-	-
Maternal BMI (kg/m^2)						
<18.5	12,591	2.8	7	1.3	0.56	0.22–1.15
18.5–24.9	220,333	48.5	210	40.0	0.95	0.82–1.08
25.0–29.9	117,589	25.9	149	28.4	1.27	1.06–1.47
30.0–34.9	59,965	13.2	84	16.0	1.40	1.12–1.73
35.0–39.9	27,192	6.0	47	9.0	1.73	1.27–2.30
≥40.0	15,521	3.4	28	5.3	1.80	1.20–2.61
Missing data for height and/or weight	692	0.2	-	-	-	-
Gestational age first antenatal visit (weeks)						
≤14	306,737	67.6	342	65.1	1.11	1.00–1.23
15–27	125,943	27.7	158	30.1	1.25	1.06–1.45
≥28	18,944	4.2	23	4.4	1.21	0.77–1.82
Postnatal registration	2,249	0.5	<3	x	s	s
Unknown	10	0.0	-	-	-	-
Customised birthweight centiles						
Small for gestational age	41,461	9.1	84	16.0	2.03	1.62–2.51
Appropriate for gestational age	335,977	74.0	373	71.0	1.11	1.00–1.22
Large for gestational age	53,681	11.8	68	13.0	1.27	0.98–1.61
Unknown	22,764	5.0	-	-	-	-
Parity						
0	184,917	40.7	316	60.2	1.71	1.52–1.90
1	154,399	34.0	119	22.7	0.77	0.63–0.91
2	67,771	14.9	50	9.5	0.74	0.55–0.97
3	26,083	5.7	24	4.6	0.92	0.59–1.37
≥4	20,683	4.6	16	3.0	0.77	0.44–1.26
Unknown	30	0.0	-	-	-	-

* All data limited to mothers who were registered for care with an LMC (a midwife, obstetrician or GP) claiming from the Section 88 Primary Maternity Services Notice.

'x' indicates percentage suppressed due to small numbers.

's' indicates rate suppressed due to small numbers.

BMI = body mass index.

Sources: Numerator: PMMRC's NE data extract where matched to MAT data, ≥37 weeks 2010–2018; Denominator: MAT births ≥37 weeks 2010–2018.

Women whose babies developed NE had a range of antenatal complications recorded, such as antepartum haemorrhage and hypertension, including gestational hypertension and pre-eclampsia. Both primiparous and multiparous mothers of babies with NE experienced antenatal complications. The percentages of those affected generally followed patterns that would be expected from the birthing population – that is, the numbers of multiparous women with pre-eclampsia were lower than they were for primiparous women. A number of women were induced through a variety of means and had epidural anaesthesia. Without denominator data – that is, without knowing the rates and use of these procedures during delivery of babies that did not have NE – we cannot comment on whether these factors indicated increased risk to babies. Of women whose babies developed NE, most did not themselves have significant adverse maternal outcomes. However, a number experienced an adverse outcome. Of those with an adverse outcome, 4 women died and 17 survived but with serious morbidity (Table 4.3).

Table 4.3: Antenatal complications, obstetric interventions, and maternal outcome among NE cases by parity and Sarnat stage 2010–2018

	NE cases		Primiparous#		Multiparous†		Sarnat stage			
							Moderate		Severe	
	n=601		n=351		n=248		n=413		n=188	
	n	%	n	%	n	%	n	%	n	%
Antenatal complications										
Antepartum haemorrhage (≥20 weeks vaginal bleeding)	60	10.0	33	9.4	27	10.9	39	9.4	21	11.2
Hypertension	75	12.5	54	15.4	21	8.5	56	13.6	19	10.1
Maternal trauma (antenatal)*	12	2.0	5	1.4	7	2.8	6	1.5	6	3.2
Induction/augmentation of labour										
Induction of labour	146	24.3	96	27.4	50	20.2	108	26.2	38	20.2
Induced or augmented labour (any method)	278	46.3	191	54.4	87	35.1	208	50.4	70	37.2
Oxytocin for induction or augmentation	135	22.5	99	28.2	36	14.5	105	25.4	30	16.0
Epidural anaesthesia	150	25.0	111	31.6	39	15.7	120	29.1	30	16.0
Maternal outcome										
Deceased, or alive with serious morbidity	21	3.5	8	2.3	13	5.2	12	2.9	9	4.8
Alive and well	580	96.5	343	97.7	235	94.8	401	97.1	179	95.2

* Vehicular, violent personal injury, other.

Primiparous: parity = 0 defined prior to current birth.

† Multiparous: parity ≥1 defined prior to current birth.

Source: PMMRC's NE data extract ≥37 weeks 2010–2018.

Around one quarter of babies with NE had an acute peripartum event, including abruption (7.8%) and shoulder dystocia (7.0%). Table 4.4 points to many antenatal and intrapartum factors that may indicate risk for NE for the babies. This table is not definitive in itself but indicates possible areas to focus on in the future.

Table 4.4: Peripartum complications and mode of birth among NE cases 2010–2018

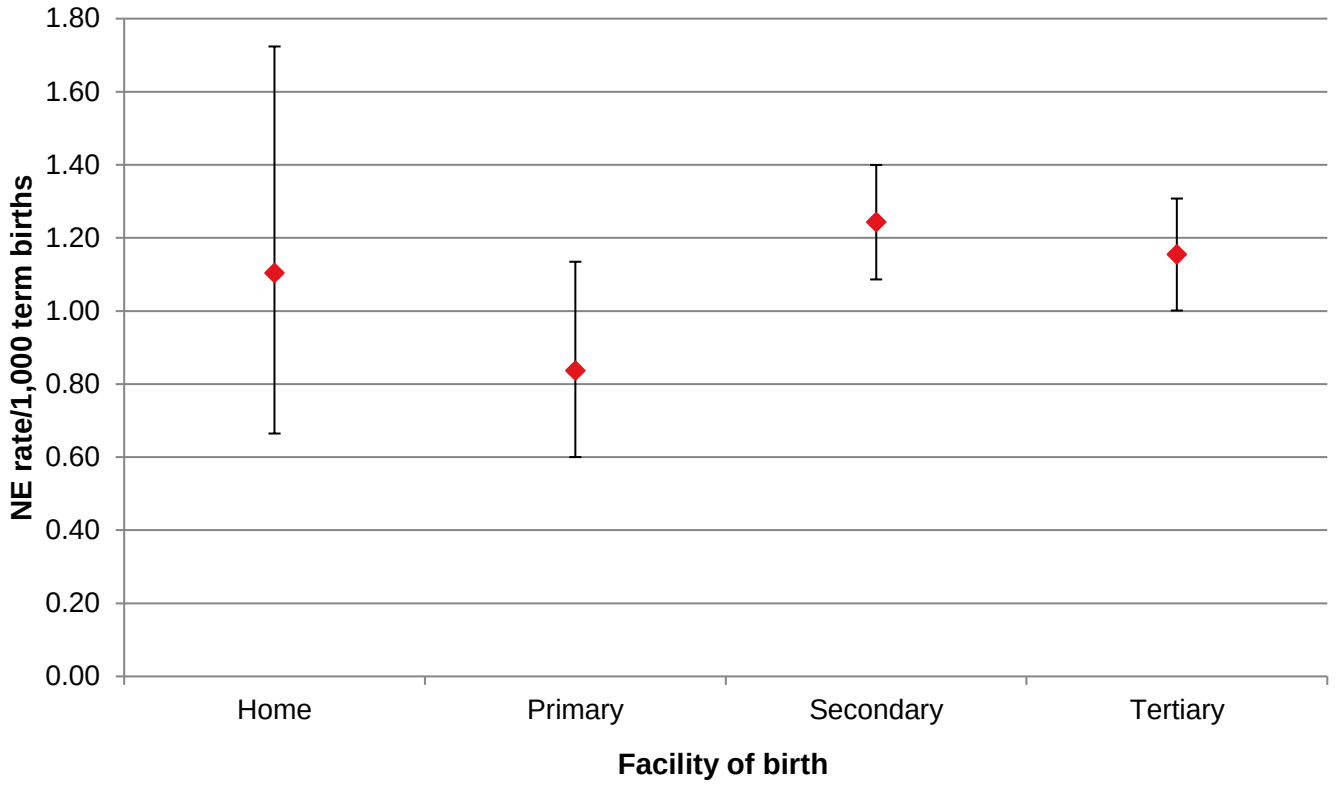
	Total NE cases n=601	
	n	%
Acute peripartum events	**154**	**25.6**
Cord prolapse	24	4.0
Abruption	47	7.8
Uterine rupture	12	2.0
Shoulder dystocia	42	7.0
Breech complication	15	2.5
Other complication	23	3.8
Liquor		
Blood stained	49	8.2
Thick meconium	136	22.6
Thin meconium	80	13.3
MODE OF BIRTH		
Normal vaginal birth	**236**	**39.3**
Operative vaginal birth	**94**	**15.6**
Forceps	38	6.3
Ventouse	54	9.0
Unknown	<3	x
Vaginal breech birth	**12**	**2.0**
Caesarean section birth	**259**	**43.1**
Elective	**11**	**1.8**
Prelabour emergency	**63**	**10.5**
Antepartum haemorrhage/Abruption	9	1.5
Suspected fetal distress	47	7.8
Other	7	1.2
In labour emergency	**185**	**30.8**
Antepartum haemorrhage/Abruption	15	2.5
Suspected fetal distress	126	21.0
Failure to progress/cephalopelvic disproportion	18	3.0
Other	26	4.3
Attempt at operative vaginal birth before caesarean	**17**	**2.8**

'x' indicates percentage suppressed due to small numbers.

Source: PMMRC's NE data extract ≥37 weeks 2010–2018.

Rates of NE varied somewhat by the facility of birth (Figure 4.8 and Table 4.5). When examining rates of NE by the facility of birth, it is important to consider other information also. This includes where the intended place of birth was and, if transferred, the stage in the pregnancy or birthing process that the transfer occurred. Also important is whether the chosen facility of birth would be recommended for each particular woman and baby. This is the subject of a proposed research project by the Neonatal Encephalopathy Working Group.

Figure 4.8: NE rates (per 1,000 term births, with 95% CIs) by place of birth* 2010–2018



* All data limited to mothers who were registered for care with an LMC (a midwife, obstetrician or GP) claiming from the Section 88 Primary Maternity Services Notice.

Sources: Numerator: PMMRC's NE data extract where matched to MAT data, ≥37 weeks 2010–2018; Denominator: MAT births ≥37 weeks 2010–2018.

Table 4.5: NE rates (per 1,000 term births) by place of birth* 2010–2018

Facility of birth	MAT births ≥37 weeks		NE cases		Rate (per 1,000 term births)	
	N=453,883		n=525			
	n	%	n	%	/1,000	95% CI
Home	17,212	3.8	19	3.6	1.10	0.66–1.72
Primary	49,018	10.8	41	7.8	0.84	0.60–1.13
Secondary	194,702	42.9	242	46.1	1.24	1.09–1.40
Tertiary	188,839	41.6	218	41.5	1.15	1.00–1.31
Unknown	4,112	0.9	5	1.0	-	-

* All data limited to mothers who were registered for care with an LMC (a midwife, obstetrician or GP) claiming from the Section 88 Primary Maternity Services Notice.

Sources: Numerator: PMMRC's NE data extract where matched to MAT data, ≥37 weeks 2010–2018; Denominator: MAT births ≥37 weeks 2010–2018.

Neonatal wellbeing just after birth, measured by Apgar scores, was consistently poor at one minute. In those babies with moderate to severe NE, 76.5% had an Apgar score less than 7 at five minutes. The percentage of babies who had cord blood gases recorded has fluctuated over the years. Overall across 2010–2018, around 18% of babies with NE did not have cord blood gases recorded. Of all babies who developed NE, 66% had abnormal gases, whereas 15% of babies with clinically significant NE had normal blood gases (Table 4.6).

Table 4.6: Immediate newborn wellbeing among NE babies by year 2010–2018

	2010		2011		2012		2013		2014		2015		2016		2017		2018		Total	
	n=82		n=67		n=79		n=70		n=55		n=70		n=56		n=63		n=59		n=601	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Apgar scores																				
Apgar score <3 at 1 minute	48	58.5	41	61.2	47	59.5	40	57.1	37	67.3	39	55.7	37	66.1	36	57.1	39	66.1	364	60.6
Apgar score <5 at 1 minute	65	79.3	54	80.6	62	78.5	58	82.9	49	89.1	51	72.9	48	85.7	50	79.4	51	86.4	488	81.2
Apgar score <7 at 1 minute	73	89.0	61	91.0	70	88.6	65	92.9	53	96.4	59	84.3	51	91.1	56	88.9	55	93.2	543	90.3
Apgar score <7 at 5 minutes	61	74.4	54	80.6	62	78.5	57	81.4	43	78.2	50	71.4	46	82.1	42	66.7	45	76.3	460	76.5
Apgar score <7 at 10 minutes	39	47.6	38	56.7	49	62.0	32	45.7	29	52.7	35	50.0	33	58.9	29	46.0	34	57.6	318	52.9
Apgar score <9 at 10 minutes	52	63.4	52	77.6	62	78.5	52	74.3	45	81.8	48	68.6	44	78.6	41	65.1	46	78.0	442	73.5
Cord blood gases: summary data																				
Normal (none of pH ≤7, BE ≤−12, lactate ≥6)	12	14.6	14	20.9	11	13.9	13	18.6	7	12.7	8	11.4	6	10.7	10	15.9	10	16.9	91	15.1
Abnormal (any of pH ≤7, BE ≤−12, lactate ≥6)	47	57.3	41	61.2	55	69.6	48	68.6	40	72.7	47	67.1	42	75.0	39	61.9	41	69.5	400	66.6
No gases reported	23	28.0	12	17.9	13	16.5	9	12.9	8	14.5	15	21.4	8	14.3	14	22.2	8	13.6	110	18.3
No gases and Apgar <7 at 1 minute	14	17.1	8	11.9	8	10.1	6	8.6	8	14.5	6	8.6	6	10.7	10	15.9	7	11.9	73	12.1
No gases and Apgar ≥7 at 1 minute	8	9.8	4	6.0	5	6.3	3	4.3	-	-	9	12.9	<3	x	3	4.8	<3	x	35	5.8
No gases and unknown Apgar	<3	x	-	-	-	-	-	-	-	-	-	-	-	-	<3	x	-	-	<3	x

BE = base excess.

'x' indicates percentage suppressed due to small numbers.

Source: PMMRC's NE data extract ≥37 weeks 2010–2018.

Table 4.7: Induced cooling therapy among NE babies by year 2010–2018

Cooling	2010		2011		2012		2013		2014		2015		2016		2017		2018		Total	
	n=82		n=67		n=79		n=70		n=55		n=70		n=56		n=63		n=59		n=601	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Yes	56	68.3	51	76.1	62	78.5	58	82.9	45	81.8	56	80.0	44	78.6	43	68.3	45	76.3	460	76.5
No	26	31.7	16	23.9	17	21.5	12	17.1	10	18.2	14	20.0	12	21.4	20	31.7	14	23.7	141	23.5
Age at cooling																				
≤6 hours	46	82.1	39	76.5	53	85.5	47	81.0	39	86.7	44	78.6	34	77.3	36	83.7	32	71.1	370	80.4
>6 hours	10	17.9	8	15.7	9	14.5	11	19.0	6	13.3	11	19.6	10	22.7	7	16.3	12	26.7	84	18.3
Unknown time	-	-	4	7.8	-	-	-	-	-	-	<3	x	-	-	-	-	<3	x	6	1.3

'x' indicates percentage suppressed due to small numbers.

Source: PMMRC's NE data extract ≥37 weeks 2010–2018.

Table 4.7 reports on cooling therapy in babies with NE by year of birth. While the number and percentage of babies who were cooled in 2017 decreased slightly, the percentage of babies cooled in 2018 is comparable with previous years.

The majority of babies with NE were resuscitated at birth (93%). Resuscitation ranged from giving oxygen only, through to cardiac massage, and adrenaline. A small percentage of babies had a positive blood culture. Around 75% of babies were given anticonvulsants (Table 4.8).

Table 4.8: Neonatal resuscitation and early neonatal management by Sarnat stage among NE babies 2010–2018

	NE babies		Sarnat stage			
			Moderate		Severe	
	n=601		n=413		n=188	
	n	%	n	%	n	%
Resuscitation at birth						
Yes	555	92.3	380	92.0	175	93.1
No	46	7.7	33	8.0	13	6.9
Type of resuscitation at birth*						
Oxygen only	9	1.5	8	1.9	<3	x
IPPV with mask	402	66.9	287	69.5	115	61.2
IPPV with ETT	310	51.6	177	42.9	133	70.7
Cardiac massage	237	39.4	123	29.8	114	60.6
Adrenaline	96	16.0	33	8.0	63	33.5
Respiratory and ventilation management						
Mechanical ventilation	465	77.4	298	72.2	167	88.8
Nitric oxide	141	23.5	87	21.1	54	28.7
Infection						
Positive blood culture	23	3.8	18	4.4	5	2.7
Antibiotics	544	90.5	386	93.5	158	84.0
Anticonvulsant therapy	427	71.0	286	69.2	141	75.0
Phenobarbitone	380	63.2	248	60.0	132	70.2
Phenytoin	128	21.3	67	16.2	61	32.4
Benzodiazepines	156	26.0	96	23.2	60	31.9
Other	98	16.3	67	16.2	31	16.5

* Categories not mutually exclusive.

IPPV = intermittent positive pressure ventilation.

ETT = endotracheal tube.

'x' indicates percentage supressed due to small numbers.

Source: PMMRC's NE data extract ≥37 weeks 2010–2018.

Overall, 77% of babies were cooled; the proportion was slightly higher for babies with moderate NE. The rates of cooling were the same for babies of Māori mothers as for those of New Zealand European mothers. Mortality was much higher in babies with severe NE at 60%, compared with 2% of babies with moderate NE (Table 4.9).

Table 4.9: Use of cooling and outcomes of encephalopathy by Sarnat stage among NE babies 2010–2018

	NE babies		Sarnat stage			
			Moderate		Severe	
	n=601		n=413		n=188	
	n	%	n	%	n	%
Induced cooling						
Yes	460	76.5	330	79.9	130	69.1
No	141	23.5	83	20.1	58	30.9
Deceased						
Yes	120	20.0	7	1.7	113	60.1
No	481	80.0	406	98.3	75	39.9

Source: PMMRC's NE data extract ≥37 weeks 2010–2018.

Of those babies with NE who survived, nearly half of those with moderate NE had a normal physical examination on discharge or transfer, compared with 16% of those with severe NE. Nearly all babies (97%) with severe NE had magnetic resonance imaging (MRI) prior to discharge (Table 4.10). The PMMRC has previously recommended that all babies with moderate and severe NE should receive an MRI scan.[58]

Table 4.10: Investigations and neonatal outcome by Sarnat stage of NE survivors 2010–2018

Investigations	Total NE survivors		Sarnat stage			
			Moderate		Severe	
	n=481		n=406		n=75	
	n	%	n	%	n	%
Examination on discharge/transfer						
Normal	210	43.7	198	48.8	12	16.0
Mild or moderate abnormality	171	35.6	142	35.0	29	38.7
Severe abnormality	35	7.3	9	2.2	26	34.7
Not examined	24	5.0	21	5.2	3	4.0
Examined but finding unknown	19	4.0	15	3.7	4	5.3
Missing data	22	4.6	21	5.2	<3	x
MRI (investigation done)	375	78.0	302	74.4	73	97.3
No MRI or Unknown	106	22.0	104	25.6	<3	x
Results of MRI*						
Moderately/Severely abnormal	141	29.3	93	22.9	48	64.0
Normal or only mildly abnormal	226	47.0	202	49.8	24	32.0
Unknown result	8	1.7	7	1.7	<3	x

MRI = magnetic resonance imaging (of the brain).

'x' indicates percentage suppressed due to small numbers.

Source: PMMRC's NE data extract ≥37 weeks 2010–2018.

[58] PMMRC. 2013. *Seventh Annual Report of the Perinatal and Maternal Mortality Review Committee: Reporting mortality 2011*. Wellington: Health Safety & Quality Commission. URL: https://www.hqsc.govt.nz/assets/PMMRC/Publications/Seventh-PMMRC-Report-FINAL-June-2013.pdf (accessed 1 December 2020).

Neonatal encephalopathy appended tables

Table 4.11: NE rates (per 1,000 term births) by maternal prioritised ethnic group, maternal age and NZDep quintile 2010–2018

	MAT births ≥37 weeks		NE cases		Rate (per 1,000 term births)	
	N=503,656*		N=601			
	n	%	n	%	/1,000	95% CI
Maternal prioritised ethnic group						
Māori	126,555	25.1	158	26.3	1.25	1.05–1.44
Pacific peoples	54,010	10.7	79	13.1	1.46	1.16–1.82
Asian	75,276	14.9	77	12.8	1.02	0.81–1.28
Indian	24,092	4.8	33	5.5	1.37	0.94–1.92
Other Asian	51,184	10.2	44	7.3	0.86	0.62–1.15
MELAA	11,354	2.3	10	1.7	0.88	0.42–1.62
European	236,438	46.9	277	46.1	1.17	1.03–1.31
NZ European	187,282	37.2	243	40.4	1.30	1.13–1.46
Other European	49,156	9.8	34	5.7	0.69	0.48–0.97
Other	-	-	-	-	-	-
Maternal age (years)						
<20	25,988	5.2	35	5.8	1.35	0.94–1.87
20–34	372,119	73.9	452	75.2	1.21	1.10–1.33
35–39	85,188	16.9	92	15.3	1.08	0.87–1.32
≥40	20,336	4.0	22	3.7	1.08	0.68–1.64
Unknown	25	0.0	-	-	-	-
Deprivation quintile						
1 (least deprived)	72,204	14.3	55	9.2	0.76	0.57–0.99
2	79,159	15.7	90	15.0	1.14	0.91–1.40
3	91,958	18.3	111	18.5	1.21	0.98–1.43
4	114,448	22.7	154	25.6	1.35	1.13–1.56
5 (most deprived)	142,576	28.3	191	31.8	1.34	1.15–1.53
Unknown	3,311	0.7	-	-	-	-

* Includes 23 unknown maternal ethnicity among MAT births.

MELAA = Middle Eastern, Latin American, or African.

Sources: Numerator: PMMRC's NE data extract ≥37 weeks 2010–2018; Denominator: MAT births ≥37 weeks 2010–2018.

Table 4.12: NE rates (per 1,000 term births) by DHB of maternal residence 2010–2018

DHB of maternal residence	MAT births ≥37 weeks	Total NE cases	Rate (per 1,000 term births)	
	N=503,656	n=601		
	n	n	/1,000	95% CI
Northland	18,812	21	1.12	0.69–1.71
Waitematā	65,356	59	0.90	0.69–1.16
Auckland	51,711	45	0.87	0.63–1.16
Counties Manukau	69,577	75	1.08	0.85–1.35
Waikato	44,557	71	1.59	1.24–2.01
Bay of Plenty	24,272	33	1.36	0.94–1.91
Lakes	12,698	17	1.34	0.78–2.14
Hauora Tairāwhiti	6,023	9	1.49	0.68–2.84
Taranaki	12,692	22	1.73	1.09–2.62
Hawke's Bay	17,749	25	1.41	0.91–2.08
Whanganui	6,944	14	2.02	1.10–3.38
MidCentral	17,877	21	1.17	0.73–1.80
Wairarapa	4,201	3	0.71	0.15–2.09
Capital & Coast	30,161	52	1.72	1.29–2.26
Hutt Valley	16,375	22	1.34	0.84–2.03
Nelson Marlborough	12,801	18	1.41	0.83–2.22
West Coast	3,046	6	1.97	0.72–4.29
Canterbury	51,579	50	0.97	0.72–1.28
South Canterbury	5,363	11	2.05	1.02–3.67
Southern	28,800	27	0.94	0.62–1.36
Other*	3,062	-	-	-

* Other includes Overseas, Unknown and Other.

Sources: Numerator: PMMRC's NE data extract ≥37 weeks 2010–2018; Denominator: MAT births ≥37 weeks 2010–2018.

5 Maternal mortality | Te mate o ngā whaea

Definitions

Maternal death is the death of a woman while pregnant or within 42 days of termination 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.[59]

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*.[60]

- **Direct maternal deaths**: those resulting from obstetric complications of the pregnant state (pregnancy, labour or puerperium) from interventions, omissions, incorrect treatment or from a chain of events resulting from the above. In 2018, the PMMRC adopted the World Health Organization (WHO) revision to include deaths by suicide with direct maternal deaths. We then applied it 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.

Over the period 2006–2018, the PMMRC has collected information on a total of 154 maternal deaths during pregnancy or within 42 days postpartum, including 28 coincidental deaths. Unless stated otherwise, this analysis excludes data relating to coincidental maternal deaths.

Findings

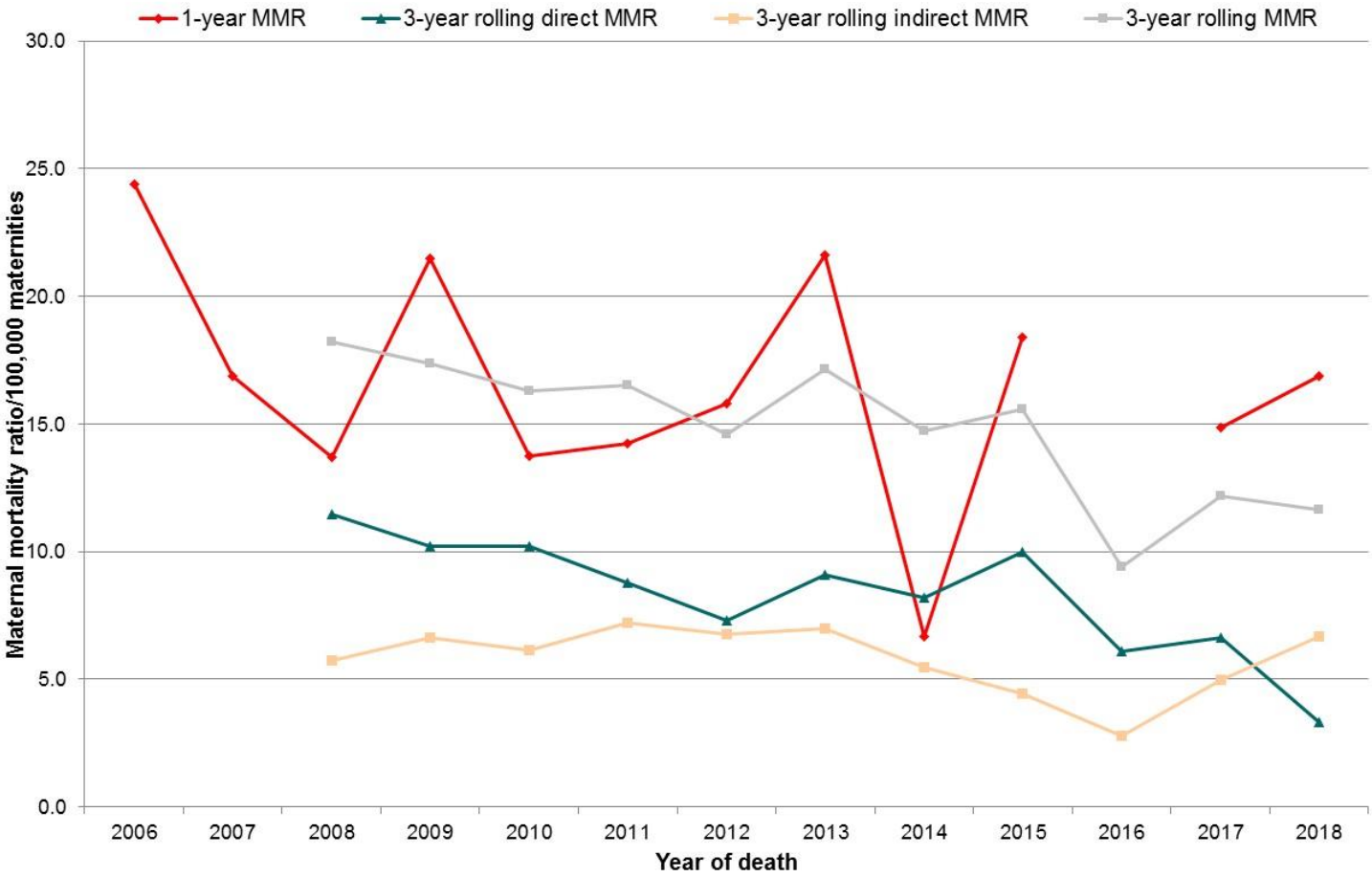
The number of maternal deaths has varied substantially over the period 2006–2018. The annual maternal mortality ratio has fluctuated from being too small to meaningfully calculate[61] up to 24.4 deaths per 100,000 maternities. Although the trend is not statistically significant, the total number of maternal deaths followed a general downward pattern over the period (Figure 5.1 and Table 5.1).

[59] World Health Organization. nd. Number of maternal deaths. URL: https://www.who.int/data/gho/data/indicators/indicator-details/GHO/number-of-maternal-deaths (accessed 15 December 2020).

[60] World Health Organization. 2012. *The WHO Application of ICD-10 to Deaths during Pregnancy, Childbirth and the Puerperium: ICD-MM*. Geneva: World Health Organization. URL: https://apps.who.int/iris/bitstream/handle/10665/70929/9789241548458_eng.pdf;jsessionid=CC029155D5B4A0E7BB4AE0129A0A6CEB?sequence=1 (accessed 1 December 2020).

[61] Where the numerator is fewer than three deaths.

Figure 5.1: Maternal mortality ratios (per 100,000 maternities) (rolling one-year and three-year)* 2006–2018



Note: the number of deaths in 2016 was too small to calculate a reliable rate for this year.

* Rolling three-year maternal mortality ratio represented at final year of triennium.

MMR = maternal mortality ratio.

Sources: Numerator: PMMRC's maternal mortality data extract 2006–2018; Denominator: MAT data 2006–2018.

Table 5.1: Single-year and three-year rolling maternal mortality ratios (per 100,000 maternities) 2006–2018

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2006–2018	Chi-squared test for trend (p)
	n	n	n	n	n	n	n	n	n	n	n	n	n	Cause specific ratio /100,000 maternities	
Total maternal deaths	**15**	**11**	**9**	**14**	**9**	**9**	**10**	**13**	**4**	**11**	**<3**	**9**	**10**	**15.56**	
Single-year MMR	24.40	16.87	13.71	21.47	13.75	14.23	15.80	21.62	6.66	18.40	s	14.88	16.88	-	0.097
Three-year rolling MMR	**-**	**-**	**06–08**	**07–09**	**08–10**	**09–11**	**10–12**	**11–13**	**12–14**	**13–15**	**14–16**	**15–17**	**16–18**	-	
			18.20	17.34	16.30	16.50	14.59	17.14	14.71	15.56	9.42	12.16	11.64	-	

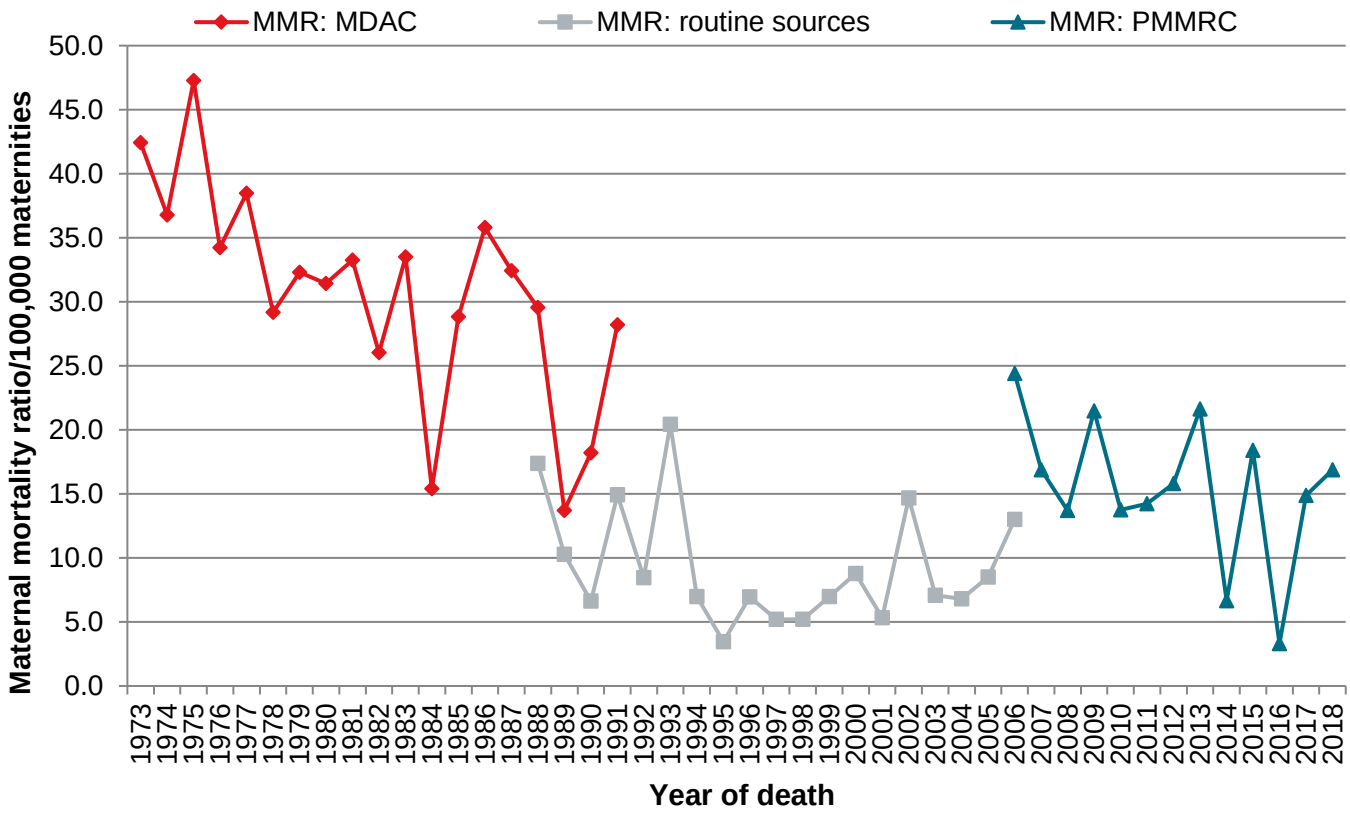
MMR = maternal mortality ratio.

‘s’ indicates rate not calculated due to small numbers.

Sources: Numerator: PMMRC’s maternal mortality data extract 2006–2018; Denominator: MAT data 2006–2018.

Substantial gains have been made in lowering the rate of maternal death since the 1970s. Figure 5.2 shows the maternal mortality ratio over time, and by the different data sources that were available at various time periods. As well as demonstrating an overall reduction in deaths over time, this figure shows that in the past, routine data sets are unlikely to have detected all maternal deaths, and active review of cases has greatly improved reliability in identifying maternal deaths.

Figure 5.2: New Zealand maternal mortality ratio (per 100,000 maternities) by mortality data source 1973–2018



MMR = maternal mortality ratio.

MDAC = Maternal Deaths Assessment Committee.

Sources:

MMR: MDAC: Data from the MDAC, including maternal deaths to three months postpartum.

MMR: routine sources: Data from routine New Zealand data sets (ie, the Births, Deaths and Marriages (BDM) Mortality Collection and the National Minimum Dataset), including maternal deaths to six weeks postpartum.

MMR: PMMRC: PMMRC's maternal mortality data extract 2006–2018, including maternal deaths to six weeks postpartum; Denominator: MAT data 2006–2018.

The incidence of maternal death increased with age, with those aged 40 years and over having the highest rate (39.2 per 100,000 maternities). In an analysis by prioritised ethnic group, Māori and Pacific women had the highest rates, with 23.5 and 22.2 deaths per 100,000 maternities respectively. The mortality rate for wāhine Māori was statistically significantly higher than the rate for New Zealand European women (Table 5.2).

Our analysis also examined the rate of maternal deaths by NZDep2013 quintile. There was a general pattern of increasing mortality with increasing deprivation. However, this was not statistically significant (p=0.11) (Table 5.2).

Table 5.2: Demographic characteristics among maternal deaths 2006–2018

	Maternities		Maternal mortality 2006–2018					
	N=809,831		n=126		Maternal mortality ratio /100,000 maternities	95% CI	RR	95% CI
	n	%	n	%				
Maternal age (years)								
<20	48,848	6.0	6	4.8	12.28	4.51–26.73	0.94	0.39–2.25
20–24	141,745	17.5	17	13.5	11.99	6.99–19.20	0.92	0.51–1.65
25–29	208,859	25.8	33	26.2	15.80	10.88–22.19	1.21	0.74–1.97
30–34	236,748	29.2	31	24.6	13.09	8.90–18.59	1.00	-
35–39	140,187	17.3	26	20.6	18.55	12.12–27.18	1.42	0.84–2.39
≥40	33,156	4.1	13	10.3	39.21	20.88–67.05	2.99	1.57–5.72
Unknown	288	0.0	-	-	-	-	-	-
Maternal prioritised ethnic group								
Māori	208,724	25.8	49	38.9	23.48	17.37–31.04	1.78	1.18–2.70
Pacific peoples	89,964	11.1	20	15.9	22.23	13.58–34.33	1.69	0.99–2.88
Asian	105,481	13.0	13	10.3	12.32	6.56–21.08		
Indian	33,922	4.2	5	4.0	14.74	4.79–34.40	1.12	0.44–2.83
Other Asian	71,559	8.8	8	6.3	11.18	4.83–22.03	0.85	0.40–1.81
MELAA	16,656	2.1	-	-	-	-	-	-
European	388,512	48.0	44	34.9	11.33	8.23–15.20		
NZ European	310,878	38.4	41	32.5	13.19	9.46–17.89	1.00	-
Other European	77,634	9.6	3	2.4	3.86	0.80–11.29	0.29	0.09–0.95
Other	-	-	-	-	-	-	-	-
Unknown	494	0.1	-	-	-	-	-	-
Deprivation quintile								
1 (least deprived)	114,222	14.1	12	9.5	10.51	5.43–18.35	1.00	-
2	123,856	15.3	12	9.5	9.69	5.01–16.92	0.92	0.41–2.05
3	146,518	18.1	23	18.3	15.70	9.95–23.55	1.49	0.74–3.00
4	185,680	22.9	35	27.8	18.85	13.13–26.22	1.79	0.93–3.46
5 (most deprived)	232,068	28.7	44	34.9	18.96	13.78–25.45	1.80	0.95–3.42
Unknown	7,487	0.9	-	-	-	-	-	-

MELAA = Middle Eastern, Latin American, or African.

Sources: Numerator: PMMRC's maternal mortality data extract 2006–2018; Denominator: MAT data 2006–2018.

Parity was unknown in 66,000 women over this period, therefore it is not possible to comment on how parity might be associated with maternal death (Table 5.3). This gap is largely due to a technical issue in the MAT data set. While the Ministry of Health is working to rectify this issue, it still requires urgent resolution.

The literature recognises that high maternal BMI is associated with adverse outcomes for both the mother[62] and baby.[63] However, again our records have substantial amounts of missing data. In nearly 169,000 records (21%) for the entire period, either height or weight data were incomplete or inaccurately recorded. The proportion of records with missing height or weight data did decrease over time, from over 85% in 2006 and 2007 down to 3.6% in 2014. However, since then the proportion of records with incomplete or inaccurate height and weight information has remained at around 5%. This is of concern given the significance of body mass as a risk factor (Table 5.3).

[62] McCall SJ, Li Z, Kurinczuk JJ, et al. 2017. Binational cohort study comparing the management and outcomes of pregnant women with a BMI >50–59.9 kg/m^2 and those with a BMI ≥60 kg/m^2. *British Medical Journal Open* 8:e021055. doi: 10.1136/bmjopen-2017-021055 (accessed 1 December 2020).

[63] PMMRC. 2018. *Twelfth Annual Report of the Perinatal and Maternal Mortality Review Committee: Reporting mortality 2016*. Wellington: Health Safety & Quality Commission. URL: https://www.hqsc.govt.nz/assets/PMMRC/Publications/12th-PMMRC-report-final.pdf (accessed 1 December 2020).

Table 5.3: Characteristics among maternal deaths, by parity and BMI 2006–2018

	Maternities		Maternal mortality	
	N=809,831		n=126	
	N	%	n	%
Parity*				
0	295,607	36.5	33	26.2
1–3	408,353	50.4	62	49.2
4+	39,606	4.9	28	22.2
Unknown	66,265	8.2	3	2.4
Maternal BMI (kg/m^2)#				
<18.5	17,668	2.2	3	2.4
18.5–24.9	310,122	38.3	41	32.5
25.0–29.9	165,866	20.5	21	16.7
30.0–34.9	85,322	10.5	23	18.3
35.0–39.9	39,010	4.8	16	12.7
≥40.0	22,858	2.8	17	13.5
Missing data for height and/or weight	168,985	20.9	5	4.0

* Mortality rates by parity not calculated as denominator data unreliable.

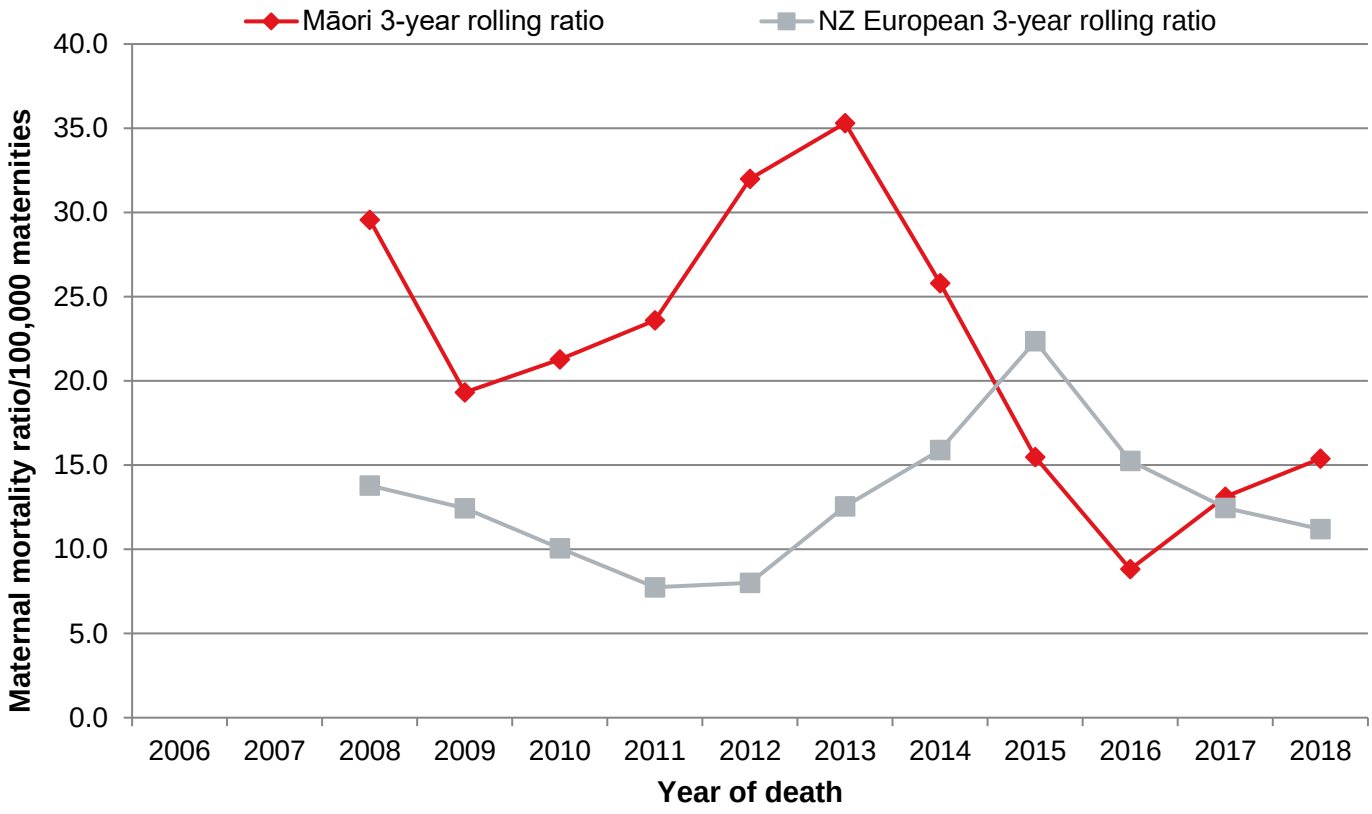
Mortality rates by BMI not calculated as denominator data unreliable.

BMI = body mass index.

Sources: Numerator: PMMRC's maternal mortality data extract 2006–2018; Denominator: MAT data 2006–2018.

In an analysis by prioritised ethnic group, wāhine Māori, until recently, had higher mortality rates than New Zealand European women. Over the period 2006–2018, no statistically significant change occurred for wāhine Māori or for New Zealand European women (Figure 5.3).

Figure 5.3: Maternal three-year rolling mortality ratios (per 100,000 maternities) by prioritised ethnic group (Māori and New Zealand European) and year 2006–2018



Sources: Numerator: PMMRC's maternal mortality data extract 2006–2018; Denominator: MAT data 2006–2018.

Table 5.4: Maternal mortality ratios (per 100,000 maternities) and cause of maternal death* 2006–2018

	2006–2018		2006–2018
	n=126		Cause specific ratio
	n	%	/100,000 maternities
Maternities	**809,831**		
Direct maternal death	**68**	**54.0**	**8.40**
Suicide	30	23.8	3.70
Pregnancies with abortive outcome (ectopic and miscarriage)#	3	2.4	0.37
Hypertensive disorders	4	3.2	0.49
Obstetric haemorrhage	4	3.2	0.49
Pregnancy-related infection	6	4.8	0.74
Other obstetric complications	21	16.7	2.59
Amniotic fluid embolism	14	11.1	1.73
Venous thrombo-embolism	6	4.8	0.74
Indirect maternal death	**50**	**39.7**	**6.17**
Cardiac	13	10.3	1.61
Neurological	13	10.3	1.61
Infections not a direct result of pregnancy	9	7.1	1.11
Other non-obstetric complications	14	11.1	1.73
Unknown/undetermined	**8**	**6.3**	**0.99**

* Other causes with small numbers have been suppressed.

This is the WHO category that includes first trimester pregnancy complications such as miscarriages and ectopic pregnancy.

Sources: Numerator: PMMRC's maternal mortality data extract 2006–2018; Denominator: MAT data 2006–2018.

There were 68 direct maternal and 50 indirect maternal deaths over the study period 2006–2018 inclusive. The single largest cause of maternal death in Aotearoa/New Zealand was suicide, accounting for 30 deaths during this time (23.8%).

The second most common cause was amniotic fluid embolism (AFE), which caused 14 deaths (11.1%) (Table 5.4). The mortality rate from AFE has reduced from nine maternal deaths for 2008–2010 to fewer than three in 2016–2018 (data not shown). A recent study, which included New Zealand data, identified 'having an obstetrician and/or anaesthetist present at the time of the event and the use of interventions to correct blood clotting abnormalities' was associated with lower mortality.[64] Massive transfusion protocols have been established throughout Aotearoa/New Zealand; they recognise the importance of prompt resuscitation and managing large blood loss with blood products and medications to support haemostasis. Regardless of whether the cause of a postpartum haemorrhage is AFE or another cause, where the bleeding is ongoing and uncontrolled the New Zealand national postpartum haemorrhage guidelines recommend using tranexamic acid to promote coagulation.[65]

Maternal suicide

While 56% of maternal deaths occurred during the postpartum period, around 41% of deaths occurred during pregnancy,[66] mostly before 20 weeks' gestation (data not shown). This finding shows that, in contrast to previous thinking, pregnancy is not necessarily protective of death by suicide. For a detailed review of maternal deaths due to suicide, see the PMMRC's 11th report.

Suicide deaths particularly affect wāhine Māori, who have both the largest number of deaths and the highest rate, compared with other ethnic groups. Wāhine Māori were 3.35 times more likely to die by suicide, mostly involving self-injury rather than self-poisoning means, than New Zealand European women (Table 5.5). A previous review of maternal suicide in wāhine Māori highlighted that nearly half of the women

[64] Fitzpatrick KE, van den Akker T, Bloemenkamp KWM, et al. 2019. Risk factors, management, and outcomes of amniotic fluid embolism: A multicountry, population-based cohort and nested case-control study. *PLOS Medicine* 16(11):e1002962. doi: 10.1371/journal.pmed.1002962 (accessed 1 December 2020).

[65] Ministry of Health. 2013. *National Consensus Guideline for Treatment of Postpartum Haemorrhage*. Wellington: Ministry of Health. URL: https://www.health.govt.nz/publication/national-consensus-guideline-treatment-postpartum-haemorrhage (accessed: 30 June 2020).

[66] Three percent of maternal deaths occurred during the intrapartum period or the timing was unknown.

who died by suicide had engaged in self-harm or made a suicide attempt during their pregnancy, and were known to be exposed to significant other stressors. The review made a number of recommendations around early recognition of risk factors, comprehensive assessment and active follow-up.[67] In addition, suicide prevention needs to be considered in the wider context of the structural drivers of suicide.[68]

Table 5.5: Maternal suicide by prioritised ethnic group* 2006–2018

Ethnicity (prioritised)	N	n	Rate	RR	95% CI
Māori	208,724	18	8.62	3.35	1.46–7.71
NZ European	310,878	8	2.57	1.00	-

* Excludes four cases that were in Pacific and 'Other Asian' ethnic groups. There were no deaths due to suicide in Indian; Middle Eastern, Latin American, or African (MELAA); Other European; or other ethnic groups.

Sources: Numerator: PMMRC's maternal mortality data extract 2006–2018; Denominator: MAT data 2006–2018.

Figure 5.4 shows that rates of maternal death in Aotearoa/New Zealand are generally higher than those in the United Kingdom, and the higher rate of direct deaths is statistically significant. For most individual causes there were no statistically significant differences between rates in Aotearoa/New Zealand and the UK, except for suicide, where the rate in Aotearoa/New Zealand was substantially higher.

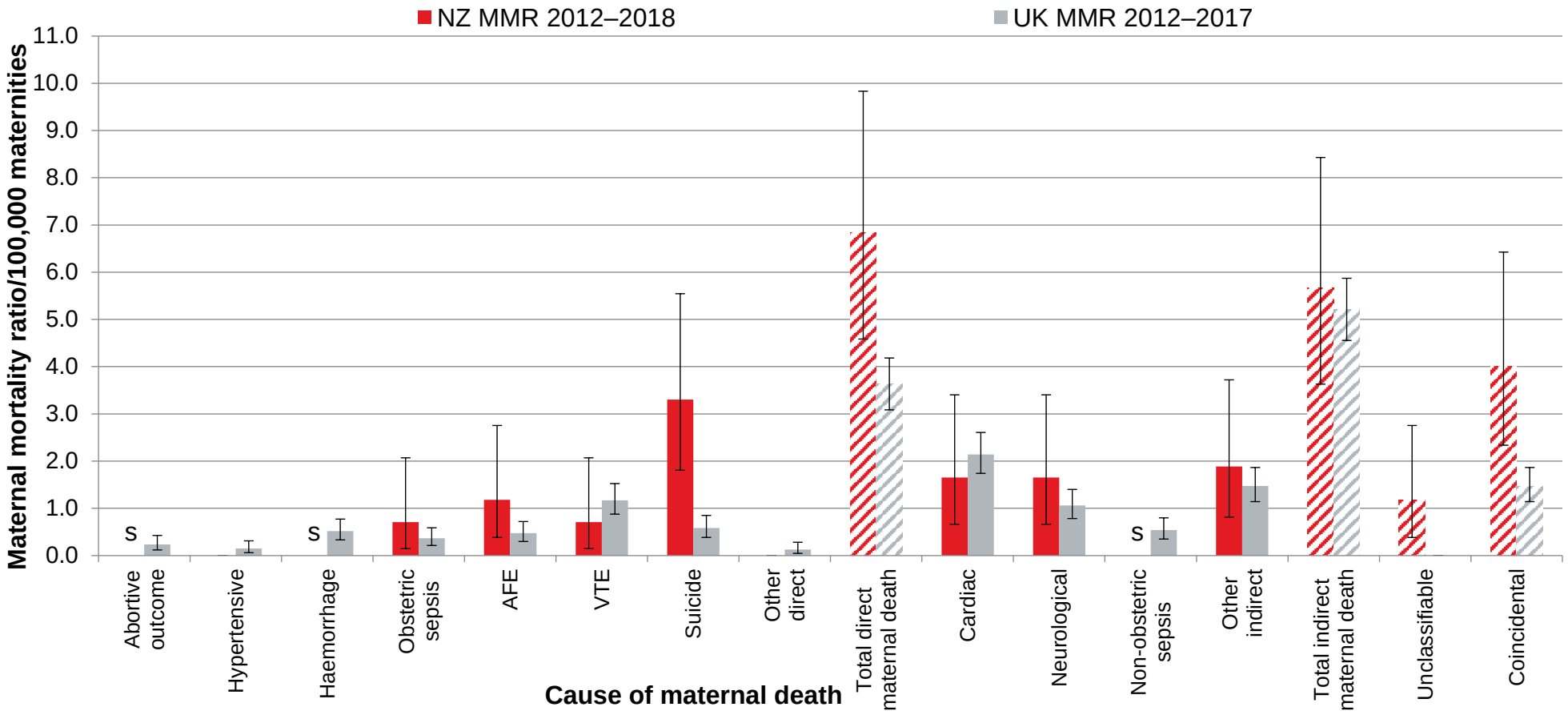
While both suicide prevention and mental wellbeing are topical, no governmental budget has been provided specifically to reduce maternal suicide deaths, and investment in maternal wellbeing is limited. In contrast, the UK has a proportionately lower maternal mortality from suicide and in July 2019 the NHS England invested significant funding (£239 million) over the five years 2019/20–2023/24 towards specialist and community-based services for improving maternal and perinatal mental health.[69] The Maternal Mortality Review Working Group recommends making targeted investment in maternal mental health a key priority for funding by the Ministry of Health. Maternal wellbeing, the development of culturally appropriate maternal screening tools and treatment for women and their babies continue to be areas in urgent need of investment, alongside addressing the wider societal drivers of suicide. Investment should prioritise populations who would benefit the most, such as ngā māma Māori, and be informed by research findings about when that support is most needed.

[67] PMMRC. 2017. *Eleventh Annual Report of the Perinatal and Maternal Mortality Review Committee: Reporting mortality 2015*. Wellington: Health Safety & Quality Commission. URL: https://www.hqsc.govt.nz/assets/PMMRC/Publications/2017_PMMRC_Eleventh_Annual_Report.pdf (accessed 1 December 2020).

[68] Ngā Pou Arawhenua, Child and Youth Mortality Review Committee, Suicide Mortality Review Committee. 2020. *Te Mauri – the Life Force: Rangatahi suicide report – Te pūrongo mō te mate whakamomori o te rangatahi.* Wellington: Health Quality & Safety Commission. URL: https://www.hqsc.govt.nz/assets/SUMRC/PR/TeMauriTheLifeForce_final.pdf (accessed 1 December 2020).

[69] NHS. 2019. *NHS Mental Health Implementation Plan 2019/20–2023/24*. URL: https://www.longtermplan.nhs.uk/wp-content/uploads/2019/07/nhs-mental-health-implementation-plan-2019-20-2023-24.pdf (accessed 1 July 2020).

Figure 5.4: Cause-specific maternal mortality ratios* (per 100,000 maternities, with 95% CIs) in New Zealand 2012–2018 and the UK 2012–2017



* Includes coincidental deaths.

MMR = maternal mortality ratio. AFE = amniotic fluid embolism. VTE = venous thromboembolism.

's' indicates rate not calculated due to small numbers.

'Other direct' includes cardiomyopathy.

'Other indirect' includes endocrine, respiratory, neoplasm, other pre-existing medical.

'Coincidental' includes motor vehicle accident, external causes of accidental injury, assault, malignancy not related to pregnancy.

The shaded bars represent total of direct, indirect, unclassifiable and coincidental deaths.

Sources: NZ MMR: Numerator: PMMRC's maternal mortality data extract 2012–2018; Denominator: MAT data 2012–2018. UK MMR: Numerator: Maternal Deaths and Morbidity, includes surveillance data on women who died during or up to one year after pregnancy 2012–2017 in the UK; Denominator: The number of pregnancies that result in a live birth at any gestation or stillbirths occurring at or after 24 completed weeks of gestation, supplied by organisations such as the Office for National Statistics, the Scotland General Registrar Office, Northern Ireland Statistical Research Agency and Hospital Episode Statistics 2012–2017. UK MMR: Mothers and Babies: Reducing Risk through Audits and Confidential Enquiries across the UK (MBRRACE-UK) November 2019, 'Saving Lives, Improving Mothers' Care: Lessons learned to inform maternity care from the UK and Ireland Confidential Enquiries into Maternal Deaths and Morbidity 2015–17', Maternal, Newborn and Infant Clinical Outcome Review Programme.

Appendix A: Maternal morbidity in Aotearoa/New Zealand | Te manaaki i te whaea matemate i Aotearoa

While most women are healthy throughout their pregnancy, a small number experience severe acute maternal morbidity, also known as maternal 'near miss mortality'. One way of describing this is when a pregnant or recently pregnant woman became so unwell that she 'would have died had it not been luck or good care was on her side'.[70]
Rates of severe maternal morbidity can be used alongside maternal mortality as a measure of the quality of maternity care that can help to address health and disability system failures, with the goal of improving maternity care. Research shows that nearly all maternity intensive care unit (ICU) admissions are cases of severe morbidity (ie, high specificity) and make up more than three quarters of all severe acute maternal morbidity (ie, high sensitivity).[71,72]
Research shows there are significant health inequities in maternity in Aotearoa/New Zealand. The impact of these inequities is particularly evident for Māori and Pacific peoples.

Oversight of maternal morbidity

In January 2020, the PMMRC committed to providing direct oversight of the maternal morbidity collection and reporting, beginning retrospectively from 1 July 2019. Previously, the Maternal Morbidity Working Group (MMWG) had received funding for three years to oversee and provide advice on maternal morbidity review, which ended on 30 June 2019. The PMMRC acknowledges the dedication and expertise of the MMWG in working towards the goal of improving outcomes for mothers in Aotearoa/New Zealand. It has made this contribution in particular through its woman-centred maternal morbidity reviews. Offering women the opportunity to describe their experiences has been extraordinarily valuable to inform case reviews, panel findings and recommendations. In addition, the MMWG has developed successful quality improvement initiatives, including the sepsis pathways and bundles, the maternity early warning system (MEWS) and the maternal morbidity review toolkit. It also collaborated in the development of the Severity Assessment Code (SAC) to provide guidance around reporting of adverse events in maternity services.
The PMMRC aims to provide and maintain a sustainable maternal morbidity review function and plans to include maternal morbidity findings in its annual reports. The Chair of the PMMRC and the co-Chairs of the MMWG agree that work in this area is important and should continue.

However, in taking on this important role the PMMRC has identified some key areas of data quality and reporting that require dedicated focus and resource to meet our responsibilities to Te Tiriti o Waitangi and to achieve equitable maternal outcomes that benefit all mothers and babies in Aotearoa/New Zealand.

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[70] Mantel GD, Buchmann E, Rees H, et al. 1998. Severe acute maternal morbidity: a pilot study of a definition for a near-miss. *BJOG: An International Journal of Obstetrics and Gynaecology* 105(9): 985–90. doi: 10.1111/j.1471-0528.1998.tb10262.x (accessed 30 December 2020).

[71] Geller S, Rosenberg D, Cox S, et al. 2004. A scoring system identified near-miss maternal morbidity during pregnancy. *Journal of Clinical Epidemiology* 57(7): 716–20. doi: 10.1016/j.jclinepi.2004.01.003 (accessed 30 December 2020).

[72] You W, Chandrasekaran S, Sullivan J, et al. 2013. Validation of a scoring system to identify women with near-miss maternal morbidity. *American Journal of Perinatology* 30(1): 21–4. doi: 10.1055/s-0032-1321493 (accessed 30 December 2020).

Key focus areas to improve maternal morbidity review and reporting

Engage with hospitals and district health boards to improve ethnicity data to better align with the *Principles of Māori Data Sovereignty*[73] and the guidelines set out in *Health Information Standards Organisation (HISO) 10001:2017 Ethnicity Data Protocols* (Ministry of Health 2017).[74]

Review the maternal morbidity notification form to contribute to a robust approach to collecting data.

Explore ways to improve case ascertainment[75] in order to analyse maternal morbidity more accurately in Aotearoa New Zealand.

Te manaaki i te whaea matemate i Aotearoa – Maternal morbidity in Aotearoa/New Zealand

Ngā whakamōhiotanga - data quality

The PMMRC recognises the desperate need for a robust approach to ethnicity data collection to allow accurate and thorough analysis. Through such analysis, we aim to address systemic factors, such as racism and the ongoing effects of colonisation, that contribute to more severe illness.

The PMMRC acknowledges that the data currently collected on maternal morbidity require significant review to better align with our commitment to the *Principles of Māori Data Sovereignty*[73] and the guidelines set out in *HISO 10001:2017 Ethnicity Data Protocols* (Ministry of Health 2017).[74]

Part of best practice is for ethnicity data collection to be self-identified; people should be able to identify with more than one ethnic group (multiple ethnicities) and information systems must be capable of recording up to six responses.[74] However, the approach to collecting the ethnicity data that are in the maternal morbidity notification database falls well short of best practice: the data come from the ethnicity recorded on the patient's clinical file; only one ethnicity can be selected even though the maternal morbidity notification form has six options of ethnicity to choose from; and ICU or high dependency unit (HDU) staff fill out the form.

Ngā whakamōhiotanga – reporting

Reporting cases of maternal morbidity in Aotearoa/New Zealand is recommended and requested, yet it is not required. If we are to effectively analyse maternal morbidity trends, it

[73] Te Mana Rauranga. 2018. *Principles of Māori Data Sovereignty.* URL: https://static1.squarespace.com/static/58e9b10f9de4bb8d1fb5ebbc/t/5bda208b4ae237cd89ee16e9/1541021836126/TMR+Ma%CC%84ori+Data+Sovereignty+Principles+Oct+2018.pdf (accessed 30 December 2020).

[74] Ministry of Health. 2017. *HISO 10001:2017 Ethnicity Data Protocols*. Wellington: Ministry of Health. URL: https://www.health.govt.nz/publication/hiso-100012017-ethnicity-data-protocols (accessed 30 December 2020).

[75] Case ascertainment refers to the completeness and accuracy of information collected

is important to have full case ascertainment, which requires robust, self-identified ethnicity data.
Inconsistent reporting across hospitals and district health boards will lead to an underestimate of the incidence of maternal morbidity. This is particularly concerning for Māori, Pacific peoples and those with multiple risk factors.

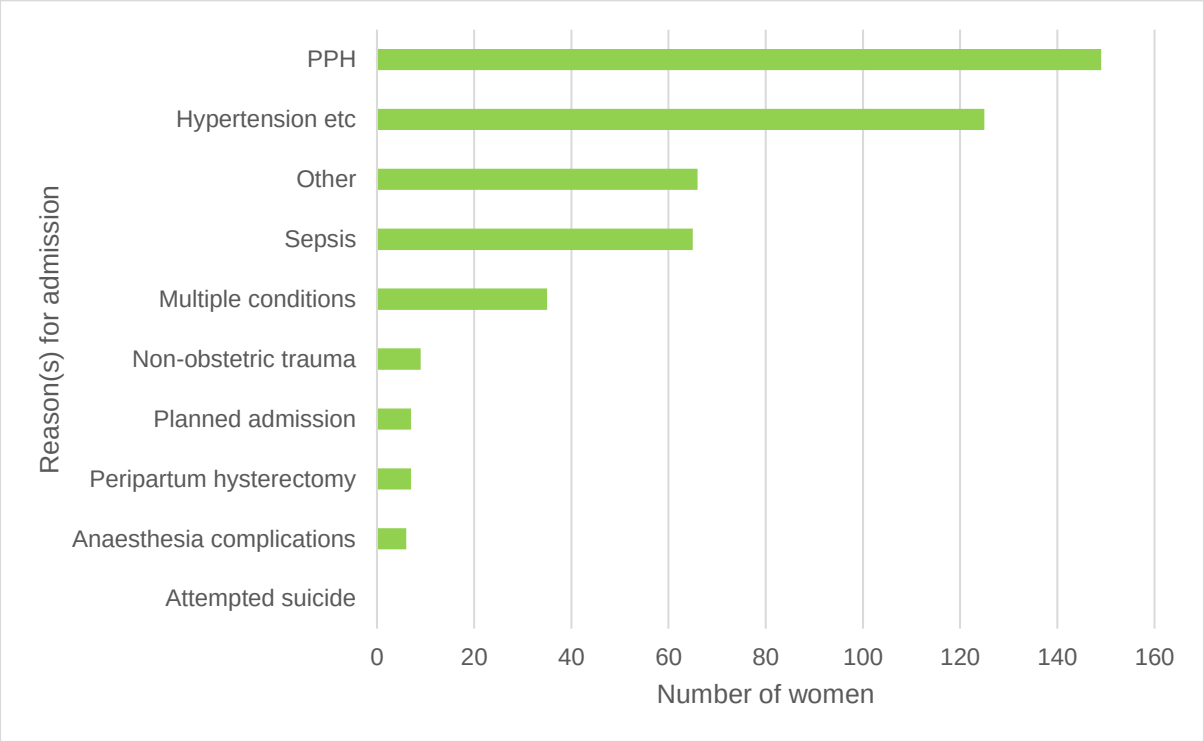
For this reason, this year the PMMRC has agreed to not report on the maternal morbidity data at the same level of detail as previous years. Although the trends they reveal can be useful, analysis and comparisons of specific rates are of limited value due to the variations in reporting and do not meet our commitment to improve ethnicity data. Reporting of these current data may lead some readers to misinterpret them and may not fully represent any existing inequities or the realities of the experiences of the women and babies involved.

Ngā whakamōhiotanga – notifications

Health providers send maternal morbidity notifications to the Commission for women who have been admitted to an HDU or ICU while pregnant, or within 42 days of the end of the pregnancy. These notifications include demographics, the reason for admission and the treatment the women received. Some women who experience severe maternal morbidity receive specialised care in other areas of hospitals, such as birthing/delivery suites. The maternal morbidity notification database does not include these women. While data collection for these cases is not yet robust, it does not discount or diminish the experiences of those women, their whānau or the people who care for them.

Between 1 September 2018 and 31 August 2019, there were 421 notifications of 401 women admitted to an HDU or ICU. The leading reason for admission was postpartum haemorrhage, which accounted for 37.1% of cases (Figure A1). This was followed by hypertensive disorders (31.2%) and sepsis (14%).

Figure A1: Number of pregnant or recently pregnant women admitted to an HDU or ICU by reason(s) for admission 1 September 2018–31 August 2019



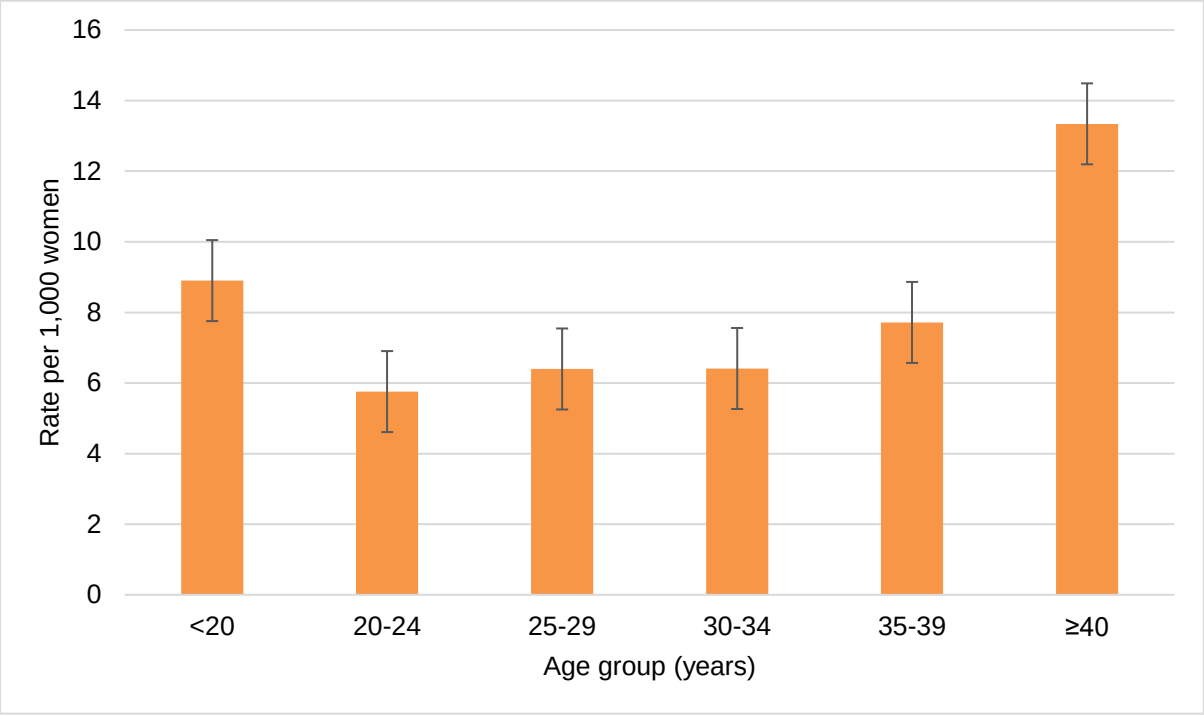
Note: 'Other' includes a wide range of other conditions or causes for admission, including but not limited to cardiac issues, anaphylaxis and chronic co-morbidities. 'Multiple conditions' includes all women who were admitted with more than one diagnosis; these women are counted in the data collection multiple times.

PPH = postpartum haemorrhage.

Source: MMWG Notifications Database: Admissions to an HDU or ICU during or within 42 days of pregnancy.

As Figure A2 shows, women aged over 40 years made up the highest admission rate (13.3:1,000 women giving birth) followed by those aged under 20 years (8.9:1,000 women giving birth).

Figure A2: Rate per 1,000 women giving birth with an HDU or ICU notification by age
1 September 2018–31 August 2019



Sources: Numerator: MMWG notification database: Admissions to an HDU or ICU during or within 42 days of pregnancy; Denominator: MAT: Women who had babies born ≥20 weeks, average between 2017 and 2018.

The notifications suggest the rate of maternal morbidity in Aotearoa/New Zealand during this reporting period was 6.69 per 1,000 women giving birth. This rate is in line with other high-income countries, where the maternal morbidity incidence rate is suggested to range from 3.8 (95% CI 3.3–4.4) to 12 (95% CI 11.2–13.2) per 1,000 births.[76]

Note that the classification of maternal morbidity varies internationally. The rate in this report reflects notifications in Aotearoa/New Zealand of women who were severely unwell and received HDU and/or ICU care; it does not include women who were very unwell and received care in other areas.

Numerator data for notifications

The numerator data come from the MMWG notification database on admissions to an HDU or ICU during or within 42 days of pregnancy.

The Commission provides all HDUs and ICUs in Aotearoa/New Zealand with a maternal morbidity notification form. The form gives the following instructions: ‘Please fill in the details

[76] van Roosmalen J, Zwart J. 2009. Severe acute maternal morbidity in high-income countries. *Best Practice & Research Clinical Obstetrics Gynaecology* 23(3): 297–304.

below for each woman admitted to HDU and/or ICU who was pregnant or had delivered within 42 days prior to admission.'

After a pregnant or recently pregnant woman is admitted to an HDU or ICU, organisations are responsible for returning the completed notification form to the Commission. All notification data presented in this report came from the MMWG's notification database, which is managed by the Commission.

Denominator data for notifications

The denominator data for notifications come from MAT data on women who had babies born ≥20 weeks, averaged between 2017 and 2018. See *Methods and definitions for Perinatal and Maternal Mortality Review Committee (PMMRC) reporting* document, available at: www.hqsc.govt.nz/our-programmes/mrc/pmmrc/publications-and-resources/publication/4210.

Maternal morbidity review toolkit for maternity services | Te kete arotake mate whakawhānau mō ngā ratonga whakawhānau

The PMMRC and the MMWG continue to recommend using the *Maternal Morbidity Review Toolkit* (the toolkit) for maternity services to guide local DHB review of maternal morbidity.

In 2018 the MMWG released this toolkit to provide a sustainable reviewing method of maternal morbidity. It intended that this practice would become business as usual from July 2019.

The purpose of the toolkit is to provide maternity services with clear, easy-to-use, evidence-based guidance and resources for implementing a consistent process for reviewing cases of significant maternal morbidity.

Appendix B: PMMRC recommendations for government departments and agencies 2007–2019

The table below is a subset of recommendations yet to be implemented and made by the PMMRC since its first report in 2007. The recommendations are aimed at government departments and agencies. The reports referenced in the third column are all available on the Health Quality & Safety Commission's website at: www.hqsc.govt.nz/our-programmes/mrc/pmmrc/publications-and-resources.

It is vital that government ensures adequate funding and infrastructure to enable DHBs and clinicians to implement PMMRC recommendations. While there has been significant work towards implementing recommendations, further priority must be given to them because a number of preventable deaths continue to occur.

This table is one of five (see also Appendices C–F), each directed towards different areas of maternity services and governing bodies. Government departments and agencies need to view the recommendations below alongside the other tables.

Importantly, we must all continue to support the work of our colleagues and organisations in owning these responsibilities. Together, we can make the greatest and most valuable impact towards changing the outcomes of women and their babies, families and whānau.

		PMMRC recommendations yet to be fully implemented
Perinatal mortality	Antenatal care/screening	**URGENT RECOMMENDATION**: All women should commence maternity care before 10 weeks, for the following reasons: • opportunity to offer screening for congenital abnormalities, sexualy transmitted infections, family violence, and maternal mental health: and to refer as appropriate • education around nutrition (including appropriate weight gain), smoking, alcohol and drug use, and other at risk behaviours • recognition of underlying medical conditions with referral for secondary care as appropriate • identification of vunerable women at increase risk of perinatal related mortality. *(Fifth Annual Report, 2011)*
		As smoking is a significant modifiable risk factor for both stillbirth and neonatal death, every effort must be made to encourage women to engage in effecttive smoking cessation programmes prior to, during and after pregnancy *(Eighth Annual Report, 2014)*

		URGENT RECOMMENDATION: We strongly recommend to the Government/Ministry for Primary Industries that folic acid fortification of bread be mandatory to reduce both mortality and serious morbidity from neural tube defects *(Thirteenth Annual Report, 2013)*
		Strategies to improve awareness of antenatal care services and increase access among women who are isolated for social, economic, cultural or language reasons should be developed *(Third Annual Report, 2009)*
	Guidelines	The PMMRC recommends a review of epilepsy in the Guidelines for Consultation with Obstetric and Related Medical Services (Referral Guidelines). *(Ninth Annual Report, 2015)*
	Data collection	The Ministry of Health should continue to support and fund DHBs and lead maternity carers (LMCs) in their collection of complete perinatal mortality statistics*. (Third Annual Report, 2009)*
		As a matter of urgency, the Ministry of Health update the National Maternity Collection (MAT), including the ethnicity data as identified by the parents in the birth registration process *(Eleventh Annual Report, 2017 and Ninth Annual Report, 2015)*
		The national Maternity Collection (MAT), linked to birth registration ethnicity data, be available for use by the mortality review committees. Access to these data would allow PMMRC to report the independent associations between ethnicity, maternal age, socioeconomic status and perinatal related death, adjusting for smoking and maternal body mass index *(Seventh Annual Report, 2013)*
		The PMMRC recommend the Ministry of Health: • urgently require DHBs to provide complete and accurate registration data to the MAT dataset (as required of LMCs providing services to pregnant women in order to receive funding for those services). Specifically, this should include women who present for birthing at DHB facilities without previous antenatal LMC registration and women who are provided primary maternity care by DHB maternity services • require that the MAT dataset include complete registration and antenatal data on live and stillborn babies from 20 weeks gestation (including terminations for pregnancy). *(Eleventh Annual Report, 2011)*
	Mothers less than 20 years	Maternity and primary care providers need to be aware of the increasing risk of perinatal mortality for mothers under 20 years of age in New Zealand. Inequity in perinatal mortality for babies born to mothers under 20 years of age needs to be actively addressed. The PMMRC recommends the Ministry of Health and DHBs: • develop, in consultation with young mothers, acceptable and safe methods for mothers under 20 years of age to access and engage with care in order to achieve equitable health outcomes

		• identify and adequately resource evidence-based solutions to address risks for mothers under 20 years of age, paying attention to smoking cessation, screening and treatment for infections, screening for fetal growth restriction, and providing adequate information about the causes and symptoms of preterm labour • consider how they can support LMCs caring for mothers aged under 20 years. *(Twelfth Annual Report, 2018)*
	Preterm birth	The PMMRC recommends the Ministry of Health establish a multidisciplinary working group to review current evidence for implementation of a preterm birth prevention program such as that implemented in Western Australia, taking care to: • identify and adequately resource evidence-based solutions • ensure equitable access to screening and/or treatment for priority populations • ensure that priority populations have a voice in the development of health policy, process and practice in order to achieve equitable health outcomes • ensure that the outcomes of any implemented program, including equity of access, are evaluated. *(Twelfth Annual Report, 2018)*

		Birth in a tertiary centre is associated with improved outcomes for preterm babies at the lower limits of viability (prior to 25 weeks gestation). The PMMRC recommends the Ministry of Health leads the development of a national consensus pathway for the care of women in preterm labour or requiring delivery prior to 25 weeks gestation. The PMMRC recommends this pathway includes:
		• ensuring that all groups of women (irrespective of ethnicity, age, socioeconomic status or place of residence) are offered and provided the same level of care
		• strategies for secondary units for management of women in threatened or early preterm labour, or who require delivery, prior to 25 weeks gestation. Including:
		  ○ administration of corticosteroids and magnesium sulphate
		  ○ timely transfer from primary and secondary units to tertiary units
		  ○ management of babies inadvertently born in their units at the lower limits of viability
		• ensuring that priority populations have a voice in the development of health policy, process and practice in order to achieve equitable health outcomes
		• guidance on monitoring that care provision is equitable by ethnicity, age, socioeconomic status and place of residence. *(Twelfth Annual Report, 2018)*

		URGENT RECOMMENDATION: There is a need to recognise the independent impact of socioeconomic deprivation on perinatal death, specifically on preterm birth, which after congenital abnormality is the leading cause of perinatal death. Addressing the impact of poverty requires wider societal commitment as has been highlighted in the recent

		health select committee report on improving child health outcomes. The PMMRC supports the implementation of the recommendations. The report can be found at https://www.parliament.nz/en/pb/sc/reports/document/50DBSCH_SCR6007_1/inquiry-into-improving-child-health-outcomes-and-preventing *(Eight Annual Report, 2014)*
	SUDI prevention	The PMMRC recommends that the Ministry of Health and DHBs have a responsibility to ensure that midwifery staffing ratios and staffing acuity tools: • enable active observation of mothers and babies who are undertaking skin-to-skin contact in the postnatal inpatient period • allow for the identification of, and additional needs of, mothers who have increased risk factors for sudden unexpected death in infancy (SUDI). *(Twelfth Annual Report, 2018)*
Neonatal encephalopathy		The Neonatal Encephalopathy Working Group (NEWG) and PMMRC support the development of a guideline for the investigation and management of neonatal encephalopathy *(Eighth Annual Report, 2014)*
Maternal mortality	Maternal mental health	**URGENT RECOMMENDATION:** The PMMRC recommends that a Maternal and Infant Mental Health Network is funded by the Ministry of Health and that the network then determine an achievable work stream by the end of 2018 detailing work to be completed by the end of 2020, to include as potential areas of priority: a. a stocktake of current mental health services available across New Zealand for pregnant and recently pregnant women to identify both the strengths of services and gaps or inequity in current services and skills in the workforce b. a national pathway for accessing maternal mental health services, including: • cultural appropriateness to ensure of service access and provision • appropriate screening • care for women with a history of mental illness • communication and coordination. *(Twelfth Annual Report, 2018)*
		That a Perinatal and Infant Mental Health Network be established to provide an interdisciplinary and national forum to discuss perinatal mental health issues *(Tenth Annual Report, 2016)*
		A comprehensive perinatal and infant mental health service should include: • screening and assessment • timely interventions including case management, transition planning and referrals • access to respite care and specialist inpatient care for mothers and babies

		• consultaiton and liaison services within the health system and with other agencies for example, primary care and termination of pregnancy services. *(Sixth Annual Report, 2012)*
	Mortality review committees Māori caucus relating to maternal mental health	Improve awareness and responsiveness to the increased risk for Māori women. *(Eleventh Annual Report, 2017)*
Support for parents, families and whānau		**URGENT RECOMMENDATION:** The Ministry of Health should resource, support and facilitate the development of a national perinatal bereavement pathway with key stakeholders, including governmental and non-governmental organisations, to ensure high-quality, appropriate and equitable care for all. *(Thirteenth Annual Report, 2019)*
		Develop and improve the provision of perinatal pathology services with regards to accessibility, training and appropriateness and ensure quality and equitable services are available across the country. *(First Annual Report, 2007 and Second Annual Report, 2008)*

Appendix C: PMMRC recommendations for district health boards 2007–2019

The table below is a subset of recommendations yet to be implemented made by the PMMRC since its first report in 2007. These recommendations are aimed towards district health boards (DHBs). The reports referenced in the third column are all available on the Health Quality & Safety Commission's website at: www.hqsc.govt.nz/our-programmes/mrc/pmmrc/publications-and-resources.

While there has been significant work towards implementing recommendations, further priority must be given to them because a number of preventable deaths continue to occur.

This table is one of five (see also Appendices A and D–F), each directed towards different areas of maternity services and governing bodies. It is important that DHBs view the below recommendations alongside Appendix E recommendations for health practitioners. This is to ensure that DHBs, through good systems and processes, can effectively support clinicians to implement PMMRC recommendations.

Importantly, we must all continue to support the work of our colleagues and organisations in owning these responsibilities. Together, we can make the greatest and most valuable impact towards changing the outcomes of women and their babies, families and whānau.

		PMMRC recommendations yet to be fully implemented
		DHBs should demonstate that they have co-developed and implemented models of care that meet the needs of mothers of Indian ethnicity. *(Thirteenth Annual Report, 2019)*
		That all maternity care providers identify women with modifiable risk factors for perinatal related death and work individually and collectivley to address these strategies to address modifiable risk factors include: • Improving update of periconceptual folate • Pre-pregnancy care for known medical disease such as diabetes • Access to antenatal care • Accurate height and weight measurement in pregnancy with advice on ideal weight gain • Prevention and appropriate management of multiple pregnancy • Smoking cessation • Antenatal recognition and management of threatened preterm labour • Following evidence based recommendations for indications for induction of labour • Advice to women and appropriate management of decreased fetal movements.

		All DHBs should report the availablitiy and uptake of relevant services in their annual clinical report to ensure that these strategies are embedded and to identify areas for improvements. *(Ninth Annual Report, 2015)*
		URGENT RECOMMENDATION: There is a need to recognise the independent impact of socioeconomic deprivation on perinatal death, specifically on preterm birth, which after congenital abnormality is the leading cause of perinatal death. Addressing the impact of poverty requires wider societal commitment as has been highlighted in the recent health select committee report on improving child health outcomes. The PMMRC supports the implementation of the recommendations. The report can be found at https://www.parliament.nz/en/pb/sc/reports/document/50DBSCH_SCR6007_1/inquiry-into-improving-child-health-outcomes-and-preventing *(Eighth Annual Report, 2014)*
		For the management of suspected ectopic pregnancies, the PMMRC recommends DHB gynaecology services have: • Clear pathways/processess for primary care regarding early pregnancy management. Clear hospital guidelines for assessment of the collapsed woman of reproductive age that include the differential diagnosis of ectopic pregnancy. Collapse due to ectopic pregnancy requires rapid assessment and surgical management. *(Thirteenth Annual Report, 2019)*
		Strategies to improve awareness of antenatal care services and increase access among women who are isolated for social, economic, cultural or language reasons should be developed. *(Third Annual Report, 2009)*
	Communication and coordination	Pregnant women who are admitted to hospital for medical conditions not related to pregnancy need to have specific referral pathways for perinatal care *(Fifth Annual Report, 2011)*
	Education	**URGENT RECOMMENDATION:** The PMMRC recommends that regulatory bodies require cultural competency training of all individuals working across all areas of the maternity and neonatal workforce. Training should address awareness of, and strategies to reduce and minimise the impact of, implicit bias and racism. *(Twelfth Annual Report, 2018)*
		The PMMRC recommends that DHBs provide free interdisciplinary fetal surveillance education for all clinicians involved in intrapartum care on a triennial basis. This is to be provided free for staff and at no cost to LMCs. The PMMRC encourages the Midwifery Council, the New Zealand College of Midwives (NZCOM) and Royal Australian and New Zealand College of Obstetricians and Gynaecologists (RANZCOG) to work with DHBs in the implementation of this recommendation:

		• this education includes risk assessment for babies throughout pregnancy as well as intrapartum observations. The aims include strengthening of supervision and support to promote professional judgement, interdisciplinary conversations and reflective practice. *(Thirteenth Annual Report, 2019 and Ninth Annual Report, 2015)*
		Offer education to all clinicians so they are proficient at screening women, and are aware of local services and pathways to care for the following: • family violence • smoking • alcohol and other substance use. *(Ninth Annual Report, 2015)*
		All clinicians involved in the care of pregnant women should undertake regular multidisciplinary training in management of obstetric emergencies. *(Tenth Annual Report, 2016 and Fifth Annual Report, 2011)*
		Maternity and primary care providers need to be aware of the increasing risk of perinatal mortality for mothers under 20 years of age in New Zealand. Inequity in perinatal mortality for babies born to mothers under 20 years of age needs to be actively addressed. The PMMRC recommends the Ministry of Health and DHBs: • develop, in consultation with young mothers, acceptable and safe methods for mothers under 20 years of age to access and engage with care in order to achieve equitable health outcomes • identify and adequately resource evidence-based solutions to address risks for mothers under 20 years of age, paying attention to smoking cessation, screening and treatment for infections, screening for fetal growth restriction, and providing adequate information about the causes and symptoms of preterm labour consider how they can support LMCs caring for mothers aged under 20 years. *(Twelfth Annual Report, 2018)*
	Mothers less than 20 years	Maternity services for teenage mothers need to address this increased risk by the provision of services that specifically meet their needs, paying attention to: • Commencing maternity care before 10 weeks • Smoking cessation prevention of preterm birth (including smoking cessation, sexually transmitted infection screening and treatment, urinary tract infection screening and treatment) and screening for fetal growth restricition using regular fundal height measurement on customised growth charts

		• Providing appropriate antenatal education *(Fifth Annual Report, 2011)*
		DHBs make available appropriate information, including appropriate counselling for parents, families and whānau about birth outcomes prior to 25 weeks gestation to enable shared decision making and planning of active care or palliative care options. *(Twelfth Annual Report, 2018)*
	Preterm birth	DHB maternity services audit the rates of antenatal corticosteroid administration, including repeat doses when indicated, to mothers of neonates live born at less than 34 weeks gestation, including autditing whether administation is equitable by ethnicity, DHB of residence, and maternal age. *(Twelfth Annual Report, 2018)*
		The PMMRC recommends that LMCs and DHBs ensure that every baby will have access to a safe sleep place on discharge from the hospital or birth unit, or at home, that is their own place of sleep, on their back and with no pillow. If they do not have access to a safe sleep place, then a wahakura or Pēpi-Pod must be made available for the baby's use prior to discharge from hospital. *(Twelfth Annual Report, 2018)*
	SUDI prevention	The PMMRC recommends that DHBs have a responsibility to ensure that midwifery staffing ratios and staffing acuity tools: • Enable active observation of mothers and babies who are undertaking skin-to-skin contact in the postnatal inpatient period. Allow for the identification of, and additional needs of, mothers who have increased risk factors for sudden unexpected death in infancy (SUDI). *(Twelfth Annual Report, 2018)*
		Clinicans and LMCs should be encouraged to collect accurate ethnicity details at the time of booking. *(Fourth Annual Report, 2010)*
	Data collection	It is recommended that mothers who experience Intrapartum stillbirth, Intrapartum deaths of babies at term without obvious congenital abnormality are encouraged to have full investigation, including a post-mortem examination *(Third Annual Report, 2009)*
	Post-mortem	All neonatal encephalopathy (NE) cases need to be considered for a Severity Assessment Code (SAC) rating. Neonatal hypoxic brain injury resulting in permanent brain damage (or permanent and severe loss of function) should be rated as SAC 1. Those who received cooling with as yet undetermined outcome should be rated as SAC 3*. (Thirteenth Annual Report, 2019)*
		All babies with NE, regardless of severity, should have a multidisciplinary discussion about whether to refer to the Accident Compensation Corporation (ACC) for consideration for cover as a treatment injury, using

Neonatal encephalopathy		ACC's Treatment Injury Claim Lodgement Guide. Parents should be advised that not all treatment claims are accepted. All clinicians involved in the care of pregnant women should undertake regular multidisciplinary training in management of obstetric emergencies. *(Tenth Annual Report, 2016 and Fifth Annual Report, 2011)*
		DHBs with rates of neonatal encephalopathy significantly higher than the national rate review or continue to review, the higher rate of neonatal encephalopathy in their area and identify areas for improvement. *(Twelfth Annual Report, 2018 and Eleventh Annual Report, 2017 and Tenth Annual Report, 2016)*
		URGENT RECOMMENDATION: Widespread multidiscipinary education is required on the recognition of neonatal encephalopathy with a particular emphasis on babies with evidence of neonatal asphyxia (eg, babies who required resuscitation) for all providers of care for babies in the immediate postpartum period. This should include: • Recognition of babies at increased risk by their history • Signs suggestive of encephalopathy Knowledge of clinical pathways to induce cooling if required *(Ninth Annual Report, 2015)*
		All DHBs should undertake local review of cases of neonatal encephalopathy to identify area for improvement in care including adequacy of resuscitation and cooling. *(Eighth Annual Report, 2014)*
		Women with pre-existing medical conditions (such as epilepsy, hypertension or mental health) should have individualised pre-conceptual counselling about their condition and the medication they are taking. Health professionals providing care to these women need to communicate the importance of continuing their medication in pregnancy, if appropriate, and to advise women to seek early medical review. *(Seventh Annual Report, 2013)*
Maternal mortality	Antenatal care/screening	Women with complex medical conditions require a multidisciplinary approach to care, often across more than one DHB. Each woman requiring such care should be assigned a key clinician to facilitate her care. *(Third Annual Report, 2009)*
		Women who are unstable or clinically unwell should be cared for in the most appropriate place within each unit in order for close observation to occur. When observations are abnormal, clear documentation, early review by a senior clinican and development of a detailed management plan are required. *(Eighth Annual Report, 2014)*

	Communication and coordination	Pregnant women who are admitted to hospital for medical conditions that are not related to pregnancy need to have specific referral pathways for perinatal care. *(Fifth Annual Report, 2011)*
		Women with serious pre-existing medical conditions require a multidisciplinary management plan for the pregnancy, birth and postpartum period. This plan must be communicated to all relevant caregivers. *(Eighth Annual Report, 2014)*
		A comprehensive perinatal and infant mental health service includes: • Screening and assessment • Timely interventions including case management, transition planning and referrals • Access to respite care and specialist inpatient care for mothers and babies. Consultation and liaison services within the health system and with other agencies for example, primary care and termination of pregnancy services. *(Sixth Annual Report, 2012)*
	Maternal mental health	Termination of pregnancy services should undertake holistic screening for maternal mental health and family violence and provide appropriate support and referral. *(Sixth Annual Report, 2012)*
		At first contact with services women should be asked: • Are you currently receiving, or have you ever received treatment for a serious mental illness such as severe depression, bipolar disorder, schizophrenia or psychosis? • Have you ever had treatment from a psychiatrist or specialist mental health team in the past? • Do you have a family history of mental illness including perinatal mental illness? Women with a previous history of serious affective disorder or other psychoses should be referred in pregnancy for psychiatric assessment and management even if they are well. Regular monitoring and support is recommended for at least three months following delivery. *(Fifth Annual Report, 2011)*
		Improve awareness and responsiveness to the increased risk for Māori women. *(Eleventh Annual Report, 2017)*
	Mortality review committees Māori caucus relating to maternal mental health	All providers of maternity, obstetric, mental health and maternal mental health services should improve their systems, guidelines and professional development to ensure that they are responsive to the identified increased risk for Māori women. *(Eleventh Annual Report, 2017)*
		Māori women who have a history of serious mental illness and are currently well should be referred to specialist mental health services for a mental health birth plan, and monitored closely by their maternity care provider +/- mental health services. Where such a woman has a miscarriage, the GP should be notified

		immediately and an explicity process for early follow up that includes a review of mental health status agreed with GP. *(Eleventh Annual Report, 2017)*
		Where Māori women exhibit symptoms suggesting serious mental illness or distress, an urgent mental health assessment, including consultant psychiatrist review and consultation with perinatal mental health services, on the same day these symptoms are first noted should be undertaken. *(Eleventh Annual Report, 2017)*
		Primary care (GPs, FPA), LMCs, TOP services, alcohol and drug services, and secondary and tertiary providers of maternity, obstetric, mental health, and maternal mental health services should improve their systems, guidelines and professional development to ensure that they are responsive to the identified increased risk for Māori women. *(Eleventh Annual Report, 2017)*
		Communication and coordination between primary care (GPs, FPA), LMCs, TOP services, alcohol and drug services, and secondary providers of maternity, obstetric, mental health, and maternal mental health services should be improved and enhanced using a variety of means including but not limited to case management, integrated notes systems, and electronic transfer of information. *(Eleventh Annual Report, 2017)*
		The PMMRC recommends that DHBs with rates of perinatal related mortality and neonatal encephalopathy significantly higher than the national rate review, or continue to review, the higher rater of mortality in their area and idenitfy areas for improvement. *(Twelfth Annual Report, 2018 and Eleventh Annual Report, 2017 and Tenth Annual Report, 2016)*
Auditing		**URGENT RECOMMENDATION:** DHBs should monitor key maternity indicators by ethnic group to identify variations in outcomes. They should then improve areas where there are differences in outcome. *(Thirteenth Annual Report, 2019)*
		Further research is warranted to understand the higher rate of perinatal related mortality in the Counties Manukau region. *(Third Annual Report, 2009)*

Appendix D: PMMRC recommendations for health organisations, colleges and regulatory bodies 2007–2019

The table below is a subset of recommendations yet to be implemented made by the PMMRC since its first report in 2007. These recommendations are aimed towards health organisations, colleges and regulatory bodies. The reports referenced in the third column are all available on the Health Quality & Safety Commission's website at: www.hqsc.govt.nz/our-programmes/mrc/pmmrc/publications-and-resources.

While there has been significant work towards implementing recommendations, further priority must be given to them because a number of preventable deaths continue to occur.

This table is one of five (see also Appendices A–C and E–F), each directed towards different areas of maternity services and governing bodies. It is important that health organisations view the below recommendations alongside Appendix E recommendations for health practitioners. This is to ensure that health organisations, through good systems and education, can effectively support clinicians to implement PMMRC recommendations.

Importantly, we must all continue to support the work of our colleagues and organisations in owning these responsibilities. Together, we can make the greatest and most valuable impact towards changing the outcomes of women and their babies, families and whānau.

		PMMRC recommendations yet to be fully implemented
Perinatal mortality	*Antenatal care/screening*	The PMMRC recommends that DHBs provide free interdisciplinary fetal surveillance education for all clinicians involved in intrapartum care on a triennial basis. This is to be provided free for staff and at no cost to LMCs. The PMMRC encourages the Midwifery Council, the New Zealand College of Midwives (NZCOM) and Royal Australian and New Zealand College of Obstetricians and Gynaecologists (RANZCOG) to work with DHBs in the implementation of this recommendation: • This education includes risk assessment for babies throughout pregnancy as well as intrapartum observations. • The aims include strengthening of supervision and support to promote professional judgement, interdisciplinary conversations and reflective practice. *(Thirteenth Annual Report, 2019 and Ninth Annual Report, 2015)*
		The PMMRC endorses all recommendations of the audit of congenital abnormalities. Key recomendations from the audit include: • all primary care providers (if first contact of a pregnant woman with the health service) should offer first trimester screening and facilitate expeditious registration • achieving optimal use of preconceptual folate by young women in New Zealand requires a policy for foritification of bread • the National Screening Unit review the cost benefit of the current algorithms in the first and second trimester screening programme, so they are calibrated for maximal sensitivitiy for all chromosomal abnormalities • the National Screening Unit review false negative screening tests • the New Zealand National Maternal Fetal Medicine Network regularly audit time from referral to review to ensure that the majority of women are seen within seven days as recommended. *(Seventh Annual Report, 2013)*
	Education	**URGENT RECOMMENDATION:** The PMMRC recommends that regulatory bodies require cultural competency training of all individuals working across all areas of the maternity and neonatal workforce. Training should address awareness of, and strategies to reduce and minimise the impact of, implicit bias and racism. *(Twelfth Annual Report, 2018)*
Neonatal encephalopathy		**URGENT RECOMMENDATION:** Widespread multidiscipinary education is required on the recognition of neonatal encephalopathy with a particular emphasis on babies with evidence of neonatal asphyxia (eg. babies who required resuscitation) for all providers of care for babies in the immediate postpartum period. This should include: • Recognition of babies at increased risk by their history • Signs suggestive of encephalopathy

		• Knowledge of clinical pathways to induce cooling if required. *(Ninth Annual Report, 2015)*
		The Neonatal Encephalopathy Working Group (NEWG) and PMMRC support the development of a guideline for the investigation and management of neonatal encephalopathy *(Eighth Annual Report, 2014)*
Maternal mortality	*Mortality review committees Māori caucus relating to maternal mental health*	**URGENT RECOMMENDATION:** Improved awareness and responsiveness to the increased risk for Māori women *(Eleventh Annual Report, 2017)*
		URGENT RECOMMENDATION: Primary care (GPs, FPA), LMCs, TOP services, alcohol and drug services, and secondary and tertiary providers of maternity, obstetric, mental health, and maternal mental health services should improve their systems, guidelines and professional development to ensure that they are responsive to the identified increased risk for Māori women. *(Eleventh Annual Report, 2017)*

Appendix E: PMMRC recommendations for health practitioners involved in care of pregnant women 2007–2019

The table below is a subset of recommendations yet to be implemented made by the PMMRC since its first report in 2007. These recommendations are aimed towards health practitioners involved in the care of pregnant women. The reports referenced in the third column are all available on the Health Quality & Safety Commission's website at: www.hqsc.govt.nz/our-programmes/mrc/pmmrc/publications-and-resources.

While there has been significant work towards implementing recommendations, further priority must be given to them because a number of preventable deaths continue to occur.

This table is one of five (see also Appendices A–D and F), each directed towards different areas of maternity services and governing bodies. It is important that government departments, agencies and DHBs fund, develop and maintain effective systems and processes to enable health practitioners to implement these recommendations.

Importantly, we must all continue to support the work of our colleagues and organisations in owning these responsibilities. Together, we can make the greatest and most valuable impact towards changing the outcomes of women and their babies, families and whānau.

		PMMRC recommendations yet to be fully implemented
Perinatal mortality	Antenatal care/ screening	That all maternity care providers identify women with modifiable risk factors for perinatal related death and work individually and collectively to address these. Strategies to address modifiable risk factors include: • Improving update of periconceptual folate • Pre-pregnancy care for known medical disease such as diabetes • Access to antenatal care • Accurate height and weight measurement in pregnancy with advice on ideal weight gain • Prevention and appropriate management of multiple pregnancy • Smoking cessation • Antenatal recognition and management of threatened preterm labour • Following evidence based recommendations for indications for induction of labour

		• Advice to women and appropriate management of decreased fetal movements. All DHBs should report the availability and uptake of relevant services in their annual clinical report to ensure that these strategies are embedded and to identify areas for improvements. *(Ninth Annual Report, 2015)*
		URGENT RECOMMENDATION: All women should commence maternity care before 10 weeks, for the following reasons: • Opportunity to offer screening for congenital abnormalities, sexualy transmitted infections, family violence, and maternal mental health: and to refer as appropriate • Education around nutrition (including appropriate weight gain), smoking, alcohol and drug use, and other at risk behaviours • Recognition of underlying medical conditions with referral for secondary care as appropriate • Identification of vunerable women at increase risk of perinatal related mortality. *(Fifth Annual Report, 2011)*
		If small for gestational age (SGA) is confirmed by ultrasound at term, timely delivery is recommended. *(Sixth Annual Report, 2012)*
		Pregnant women should consult their midwife, general practitioner or specialist services as soon as symptoms of influenza like illness develop or if other family members are unwell to allow: • Referral to hospital for assessment if there are symptoms of respiratory compromise due to influenza that is, worsening shortness of breath, espeically at rest, productive cough, pleuritic chest pain, haemoptysis • Prescription of antiviral medication. *(Fifth Annual Report, 2011*)
	Communication and coordination	Pregnant women who are admitted to hospital for medical conditions not related to pregnancy need to have specific referral pathways for perinatal care. *(Fifth Annual Report, 2011)*
	Data collection	Clinicans and LMCs should be encourage to collect accurate ethnicity details at the time of booking. *(Fourth Annual Report, 2010)*
	Education	All clinicians involved in the care of pregnant women should undertake regular multidisciplinary training in management of obstetric emergencies and resuscitation. *(Tenth Annual Report, 2016 and Fifth Annual Report, 2011)*
		Maternity services for teenage mothers need to address this increased risk by the provision of services that specifically meet their needs, paying attention to: • Commencing maternity care before 10 weeks

		• Smoking cessation prevention of preterm birth (including smoking cessation, sexually transmitted infection screening and treatment, urinary tract infection screening and treatment) and screening for fetal growth restricition using regular fundal height measurement on customised growth charts • Providing appropriate antenatal education. *(Fifth Annual Report, 2011)*
	SUDI prevention	The PMMRC recommends that LMCs and DHBs ensure that every baby will have access to a safe sleep place on discharge from the hospital or birth unit, or at home, that is their own place of sleep, on their back and with no pillow. If they do not have access to a safe sleep place, then a wahakura or Pēpi-Pod must be made available for the baby's use prior to discharge from hospital. *(Twelfth Annual Report, 2018)*
Neonatal encephalopathy		All neonatal encephalopathy (NE) cases need to be considered for a Severity Assessment Code (SAC) rating. Neonatal hypoxic brain injury resulting in permanent brain damage (or permanent and severe loss of function should be rated as SAC 1. Those who received cooling with as yet undermined outcome should be rated as SAC 3. *(Thirteenth Annual Report, 2019)*
		For all babies diagnosed with NE a multidisciplinary discussion about whether to refer to the Accident Compensation Corporation (ACC) for consideration for cover as a treatment injury, using ACC's Treatment Injury Claim Lodgement Guide, should be arranged. Parents should be advised that not all treatment claims are accepted. *(Thirteenth Annual Report, 2019)*
		If neonatal encephalopathy is clinically suspected in the immediate hours after birth, early consultation with a neonatal paediatrician is recommended in order to avoid a delay in commencing cooling. *(Sixth Annual Report, 2012)*
		Cord gases should be performed on all babies born with an Apgar 7 at one minute. *(Sixth Annual Report, 2012)*
Maternal mortality	Antenatal care/screening	Women with serious pre-existing medical conditions require a multidisciplinary management plan for the pregnancy, birth and postpartum period. This plan must be communicated to all relevant caregivers. *(Eighth Annual Report, 2014)*
		Women who are unstable or clinically unwell should be cared for in the most appropriate place within each unit in order for close observation to occur. When observations are abnormal, clear documentation, early review by a senior clinican and development of a detailed management plan are required. *(Eighth Annual Report, 2014)*
		Women with pre-existing medical conditions (such as epilepsy, hypertension or mental health) should have individualised pre-conceptual counselling about their condition and the medication they are taking. Health

		professionals providing care to these women need to communicate the importance of continuing their medication in pregnancy, if appropriate, and to advise women to seek early medical review. *(Seventh Annual Report, 2013)*
		Pregnant women who are admitted to hospital for medical conditions not related to pregnancy need to have specific referral pathways for perinatal care *(Fifth Annual Report, 2011)*
	Communication and coordination	Women with complex medical conditions require a multidisciplinary approach to care, often across more than one DHB. Each woman requiring such care should be assigned a key clinician to facilitate her care. *(Third Annual Report, 2009)*
	Maternal mental health	A comprehensive perinatal and infant mental health service should include: • Screening and assessment • Timely interventions including case management, transition planning and referrals • Access to respite care and specialist inpatient care for mothers and babies. Consultation and liaison services within the health system and with other agencies for example, primary care and termination of pregnancy services. *(Sixth Annual Report, 2012)*
		Termination of pregnancy services should undertake holistic screening for maternal mental health and family violence and provide appropriate support and referral. *(Sixth Annual Report, 2012)*
		At first contact with services women should be asked: • Are you currently receiving, or have you ever received treatment for a serious mental illness such as severe depression, bipolar disorder, schizophrenia or psychosis • Have you ever had treatment from a psychiatrist or specialist mental health team in the the past? • Do you have a family history of mental illness including perinatal mental illness? Women with a previous history of serious affective disorder or other psychoses should be referred in pregnancy for psychiatric assessment and management even if they are well. Regular monitoring and support is recommended for at least three months following delivery. *(Fifth Annual Report, 2011)*
	Mortality review committees Māori caucus relating to	Improved awareness and responsiveness to the increased risk for Māori women. *(Eleventh Annual Report, 2017)*
		Communication and coordination between primary care (GPs, FPA), LMC's TOP services, alcohol and drug services, and secondary providers of maternity, obstetric, mental health and maternal mental health services should be improved and enhanced using a variety of means including but not limited to case management, integrated notes systems, and electronic transfer to information. *(Eleventh Annual Report, 2017)*

	maternal mental health	Primary care (GPs, PA) LMCs, TOP services, alcohol and drug services and secondary and tertiary providers of maternity, obstetric, mental health and maternal mental health services should improve their systems, guidelines and professional development to ensure that they are responsive to the identified increased risk for Māori women. *(Eleventh Annual Report, 2017)*
		Where Māori women exhibit symptoms suggesting serious mental illness or distress, an urgent mental health assessment, including consultant psychiatrist review and consultation with perinatal mental health services, on the same day these symptoms are first noted should be undertaken. *(Eleventh Annual Report, 2017)*
		Comprehensive assessment of risk factors for all Māori women, including those seeking a TOP, should be undertaken at diagnosis of pregnancy and/or on first presentation for antenatal care. *(Eleventh Annual Report, 2017)*
		Māori women who have a history of serious mental illness and are currently well should be referred to specialist mental health services for a mental health birth plan, and monitored closely by their maternity care provider +/- mental health services. Where such a woman has a miscarriage, the GP should be notified immediately and an explicit process for early follow up that includes a review of mental health status agreed with GP. *(Eleventh Annual Report, 2017)*
		The referring doctor of women who undergo a TOP is expected to provide a free post-TOP follow up consultation 10–14 days after the procedure. The referring doctor should actively follow up Māori women referred for TOP to ensure this consultation is completed and review mental health status during this consultation *(Eleventh Annual Report, 2017)*
		Clinicans are reminded that mental illness can deteriorate very rapidly in pregnancy and the postnatal period, and that suicide is the most common cause of maternal death in New Zealand at this time *(Fifth Annual Report, 2011)*

Appendix F: PMMRC recommendations for researchers 2007–2019

The table below is a subset of recommendations yet to be implemented made by the PMMRC since its first report in 2007. These recommendations are aimed towards researchers. The reports referenced in the third column are all available on the Health Quality & Safety Commission's website at: www.hqsc.govt.nz/our-programmes/mrc/pmmrc/publications-and-resources.

While there has been significant work towards implementing recommendations, further priority must be given to them because a number of preventable deaths continue to occur.

This table is one of five (see also Appendices A–E), each directed towards different areas of maternity services and governing bodies. While the below recommendations have been made directly to researchers, there are many recommendations included in Appendices B–E, where barriers to implementation could generate valuable research. It is worthwhile viewing the below recommendations alongside the other appendices.

Importantly, we must all continue to support the work of our colleagues and organisations in owning these responsibilities. Together, we can make the greatest and most valuable impact towards changing the outcomes of women and their babies, families and whānau.

PMMRC recommendations relating to research
Collectively, we need to increase our understanding of the reasons for adverse outcomes in certain groups. For example, within Aotearoa/New Zealand and internationally, we have an incomplete understanding of what puts women and babies of Indian ethnicity at increased risk. *(Thirteenth Annual Report, 2019)*
Research on the best model of care for teenage pregnant mothers in New Zealand should be undertaken with a view to reducing stillbirth and neonatal death. *(Fifth Annual Report, 2011)*
Key stakeholders in provision of health and social services to women at risk should work together to identify existing research on: • Reasons for barriers to engagement with maternity care • Interventions to address barriers to engagement with maternity care. *(Fifth Annual Report, 2011)*

Possible causes for the increase in perinatal-related death of babies born to Pacific women, Māori women, women under the age of 20 and over the age of 40, and women who live in areas of high socioeconomic deprivation should be researched. This information is necessary in order to develop appropriate strategies to reduce these possibly preventable deaths. *(Fourth Annual Report, 2010)*
Strategies to improve awareness of antenatal care services and increase access among women who are isolated for social, economic, cultural or language reasons should be developed. *(Third Annual Report, 2009)*