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

Eighth Annual Report of the Perinatal and Maternal Mortality Review Committee

Reporting mortality 2012

Fourth Report to the Health Quality & Safety Commission New Zealand

JUNE 2014

"He mate nga ohorere, he wairua uiui, wairua mutunga-kore. The grief of a sudden, untimely death will never be forgotten."

PMMRC. 2014. *Eighth Annual Report of the Perinatal and Maternal Mortality Review Committee: Reporting mortality 2012.* Wellington: Health Quality & Safety Commission.

Published in June 2014 by the Perinatal and Maternal Mortality Review Committee, PO Box 25496, Wellington 6146, New Zealand

ISBN 978-0-478-38578-6 (Print)
ISBN 978-0-478-38579-3 (Online)

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

Acknowledgements

The Perinatal and Maternal Mortality Review Committee (PMMRC) is grateful to the following groups and individuals for their assistance in the production of this report.

- The lead maternity carers and district health board (DHB) clinicians throughout New Zealand and the local coordinators within each DHB who completed the rapid reporting and classification forms that provided the data within this report.
- The PMMRC National Coordination Service, managed by Professor Cindy Farquhar.
- Vicki Masson, the national coordinator of the PMMRC, who ensured the sets of mothers and infants were complete and that the dataset was as complete and accurate as possible.
- Dr Lynn Sadler, epidemiologist at Auckland DHB and the University of Auckland, who designed the analysis and prepared drafts of the perinatal and maternal mortality and neonatal encephalopathy reports.
- The staff at Analytical Services, of the Ministry of Health, who provided denominator data for the births in 2012.
- The staff at the University of Otago's Mortality Review Data Group, who established and maintain the perinatal and maternal mortality website and collated the data and produced the tables and figures in the perinatal and maternal mortality and neonatal encephalopathy sections.
- The members of the PMMRC, who provided advice and guidance for the analysis, determined the recommendations and assisted with editing of the final report.
- The members of the Maternal Mortality Review Working Group (MMRWG), who worked on the maternal mortality report.
- The members of the Neonatal Encephalopathy Working Group (NEWG), who worked on the neonatal encephalopathy report.
- The members of the Australasian Maternity Outcomes Surveillance Systems Working Group (AMOSSWG) and the University of New South Wales, who provided the maternal morbidity data and report.
- Dr Kate Bartlett, perinatal pathologist, Auckland DHB, and Dr Jane Zuccollo, perinatal pathologist, for providing advice on audit of pathology reports and of placental pathology.
- Dr Nicola Austin, Dr Lesley Dixon, Dr Chris Wilkinson and Dr Deborah Turnbull, who provided peer review on an earlier version of the report. This final report does not necessarily reflect their views.
- The Health Quality & Safety Commission, which has been involved in all stages of the development of this report and, in particular, Deon York.

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Perinatal and Maternal Mortality Review Committee

The Perinatal and Maternal Mortality Review Committee (PMMRC) members in 2014 are:

- Dr Sue Belgrave (Chair), obstetrician, Waitemata DHB
- Dr Sue Crengle, Māori health researcher, GP, public health physician, Waitemata and Southern DHBs
- Ms Alison Eddy, midwife, Christchurch
- Ms Gail McIver, midwife, Counties Manukau DHB
- Dr Maggie Meeks, neonatologist, Canterbury DHB
- Ms Linda Penlington, Sands New Zealand, Wairarapa.

Maternal Mortality Review Working Group

The Maternal Mortality Review Working Group (MMRWG) members in 2014 are:

- Dr Graham Sharpe (Chair), anaesthetist, Capital & Coast DHB
- Dr Sue Belgrave (Chair PMMRC)
- Ms Alison Eddy, midwife, Christchurch
- Dr Alec Ekeroma, obstetrician, Counties Manukau DHB
- Dr Lesley Dixon, midwife, Christchurch
- Dr Liz MacDonald, perinatal psychiatrist, Canterbury DHB
- Dr Claire McLintock, obstetric physician and haematologist, Auckland DHB
- Dr John Walker, anaesthetist, Auckland DHB
- Dr Kate White, pathologist, MidCentral DHB.

Neonatal Encephalopathy Working Group

The Neonatal Encephalopathy Working Group (NEWG) members in 2014 are:

- Dr Malcolm Battin (Chair), neonatal paediatrician, Auckland DHB
- Dr Astrid Budden, obstetrician and gynaecologist, Auckland DHB
- Professor Cynthia Farquhar, obstetrician and gynaecologist, and clinical epidemiologist, the University of Auckland
- Ms Anja Hale, neonatal nurse practitioner, Waikato DHB
- Dr Deborah Harris, neonatal nurse practitioner, Waikato DHB
- Ms Gail McIver, midwife, Counties Manukau DHB
- Ms Suzanne Miller, midwife, Wellington
- Dr Thorsten Stanley, paediatrician, Capital & Coast DHB
- Ms Rachel Taylor, team manager, Accident Compensation Corporation
- Dr Alex Wallace, paediatrician, the University of Auckland.

Australasian Maternity Outcomes Surveillance System Working Group

The Australasian Maternity Outcomes Surveillance System Working Group (AMOSSWG) members in 2014 are:

- Dr Claire McLintock (Chair), obstetric physician and haematologist, Auckland DHB
- Dr Sarah Wadsworth, obstetrician and gynaecologist, Counties Manukau DHB
- Ms Alison Eddy, midwife, Christchurch
- Professor Cynthia Farquhar, obstetrician and gynaecologist, and clinical epidemiologist, the University of Auckland
- Dr Ted Hughes, anaesthetist and intensive care unit consultant, Waitemata DHB
- Ms Jo McMullan, midwife and local coordinator, Hutt Valley DHB
- Ms Estelle Mulligan, midwife, Counties Manukau DHB
- Ms Kathleen Williamson, midwife, Hawke's Bay DHB.

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Foreword

The Health Quality & Safety Commission (the Commission) welcomes the eighth report of the Perinatal and Maternal Mortality Review Committee (PMMRC). The report represents a large body of data, analysed carefully with clear recommendations on how further improvements to the quality and safety of New Zealand's maternity system can be made.

This report details perinatal and maternal deaths from 1 January to 31 December 2012, and analyses six years of perinatal mortality data from 2007 to 2012 and seven years of maternal mortality data from 2006 to 2012. Data are also included on babies with moderate and severe neonatal encephalopathy from 2010 to 2012 and mothers with selected morbidities for the same time period. Part of the neonatal encephalopathy review work is jointly funded by the Accident Compensation Corporation (ACC) and the Commission; both agencies recognise the high human cost of morbidity in neonates.

The perinatal related mortality rate, using the New Zealand definition, has been stable during the years 2007–2012. As noted in the report, the rate in 2012 was 10.7/1000 births, equivalent to one baby dying in pregnancy or during the first month of life for every 100 babies born. Interestingly, if the World Health Organization's recommended international definition for perinatal death is used, there has been a significant reduction in the perinatal death rate. The three-year average maternal mortality ratio for 2010–2012 was 14.7 per 100,000 maternities.

While these results are encouraging, 19 percent of perinatal deaths in 2012 were identified by local review as potentially avoidable. Common contributory factors include caregivers not offering or following recommended best practice, infrequent antenatal care and lack of recognition by patients and their family of the complexity or seriousness of their condition.

During seven years of maternal mortality review, one-third of maternal deaths were thought by the Maternal Mortality Review Working Group (MMRWG) to be potentially avoidable. In 2012, 10 mothers died from direct or indirect obstetric causes and a further five coincidental deaths were reported to the PMMRC. There is clearly still work to be done to improve the safety of our maternity services.

This report would not be possible without the substantial contribution of a dedicated team of people: the local coordinators across the country who provided these data; Dr Sue Belgrave and the PMMRC; National Coordination Services based at the University of Auckland; and the Mortality Review Committee staff at the Commission.

On behalf of the Commission, I sincerely thank Dr Belgrave for leading this committee's important work.

Professor Alan Merry, ONZM

Chair, Health Quality & Safety Commission

Chair's Introduction

This is the eighth annual report of the Perinatal and Maternal Mortality Review Committee (PMMRC) and the first annual report with myself as Chair.

I congratulate Professor Cindy Farquhar for her work as founding chair, and for her oversight of the development of a comprehensive reporting system, a network of coordinators throughout the country and a framework for assessing cases for contributory and potentially avoidable factors with the aim of progressively improving care. We now have a wealth of data to help guide clinical practice in maternity. Much of this information has come from the families and whānau who have faced the distressing loss of babies and mothers. With the teams of professionals who worked with them, they have told their stories in the hope that other families and whānau will be spared their distress in the future. The stories of individual women and their families and whānau give us focus in our overview of New Zealand's perinatal and maternal mortality.

The PMMRC reports to the Health Quality & Safety Commission and is part of the broader quality framework that is gaining momentum throughout the country.

In the eighth report we are reporting perinatal deaths from 2007 to 2012, maternal deaths from 2006 to 2012 and babies with neonatal encephalopathy from 2010 to 2012. It is encouraging that although the overall perinatal mortality rate has been stable over this time period, there has been a significant reduction in stillbirths, specifically in unexplained stillbirths and deaths due to hypoxia in labour.

This year we have been able to undertake a multivariate analysis for the women booked under a lead maternity carer. In this analysis, evidence of the association of smoking to stillbirth and neonatal death and obesity to stillbirth has become stronger. For the first time we have been able to demonstrate that these are independent risk factors. Socioeconomic deprivation is also independently associated with neonatal death and we hope this informs policy to help address some of these inequalities. The independent risk of stillbirth for women of Indian ethnicity is also statistically significant and we will need to give this greater attention in the future.

We continue to report on barriers to access and/or engagement with care. One of the challenges is to improve access for women to maternity services, recognising that many of these women have social and financial stresses, which prevent them from accessing care. This is a priority of the Maternity Quality and Safety Programmes within DHBs and we would like to see improvement in these factors over time. The risk of maternal death for women living in the most deprived 20 percent of residential areas is 2.5 times that of those in the least deprived 40 percent. This difference is highly statistically significant. Analysis of maternal deaths also indicates that Māori and Pacific mothers are three times more likely to die of direct and indirect causes in pregnancy or in the 42 days following the birth. These are worrying findings with implications for policy makers and New Zealand society generally, as well as for the providers of maternity services.

This report includes an analysis of perinatal deaths around the time of labour and our review highlights the need for all DHBs to investigate these deaths, to allow for incremental improvements in these mortality rates. The report also includes an analysis of those stillbirths at term classified as 'unexplained', using the criteria adopted by the Perinatal Society of New Zealand and Australia (PSANZ). We hope to undertake a review of the PSANZ classification system because we consider that some of these deaths can be explained by the placental pathology. While these deaths may not currently be prevented, families and whānau need to be informed of the cause of their child's death, and even more importantly, to understand the recurrent risk in any subsequent pregnancies.

There is much to do and the challenge is to improve outcomes but also improve the care and support we provide to families.

Dr Sue Belgrave

Chair of the Perinatal and Maternal Mortality Review Committee

Executive Summary and Recommendations

Terms of Reference and Mortality Definitions

- The Perinatal and Maternal Mortality Review Committee (PMMRC) is responsible for reviewing maternal deaths and all deaths of infants born from 20 weeks gestation to 28 completed days after birth, or weighing at least 400g if gestation is unknown.
- A maternal death is the death of a woman while pregnant or within 42 days of termination of pregnancy, 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.
- Maternities are all live births and all fetal deaths at 20 weeks or beyond or weighing at least 400g if gestation was unknown. The maternal mortality ratio is calculated per 100,000 maternities.
- Perinatal mortality is fetal and early neonatal deaths from 20 weeks gestation until less than seven days of age or weighing at least 400g if gestation was unknown.
- The perinatal related mortality rate is fetal deaths (including terminations of pregnancy and stillbirths) and neonatal deaths (up to 28 days) per 1000 total babies born at 20 weeks or beyond, or weighing at least 400g if gestation is unknown.
- Neonatal mortality is all infant deaths from live birth to 27 days of age inclusive.

Key Findings 2014 Report (Data 2012)

Perinatal related mortality

1. There has been a significant reduction in stillbirth from 2007 to 2012, which is independent of demographic changes (5.6/1000; 5.8/1000; 6.1/1000; 5.3/1000; 5.3/1000; and 5.1/1000 births in 2007–2012 respectively).
    a) There has been a significant reduction in unexplained antepartum stillbirth and hypoxic peripartum stillbirth, which contribute to the observed reduction.
    b) The following women are at increased risk of stillbirth:
        - women who have a high body mass index (BMI) – as the BMI increases over 25, the risk increases
        - women who smoke during pregnancy
        - women of Indian ethnicity
        - women having their first birth.

    (Each of these risk factors is independent of the others and of age and socioeconomic deprivation.)

2. The following women are at increased risk of neonatal death of babies born at 20–27 weeks gestation:
    - women of Māori and Pacific ethnicity
    - women who smoke during pregnancy
    - women living in areas of high socioeconomic deprivation
    - women having their first birth.

    (Each of these risk factors is independent of the others and of age and socioeconomic deprivation.)

3. Women who smoke during pregnancy are also at increased risk of neonatal death of babies born from 28 weeks gestation, independent of ethnicity, socioeconomic deprivation, age, parity and body mass index.

Maternal mortality

4. The maternal mortality ratio in New Zealand was 16.0/100,000 maternities (95 percent confidence interval 8.7–29.5/100,000) for the year 2012. The three-year average maternal mortality ratio for 2010–2012 was 14.7/100,000 maternities (95 percent confidence interval 10.2–21.3/100,000).

5. Older mothers (≥40 years) and mothers of Māori and Pacific ethnicity are at increased risk of maternal mortality, and there is increasing risk of maternal mortality with increasing socioeconomic deprivation.

6. Pre-existing medical disease and suicide are the most frequent causes of maternal mortality in New Zealand in 2006–2012.

Neonatal encephalopathy

7. The incidence of neonatal encephalopathy is significantly higher among Pacific mothers than among New Zealand European mothers, and the incidence increases with increasing socioeconomic deprivation.

8. In 2012, 78 percent of babies with moderate and severe neonatal encephalopathy received induced cooling, as recommended, to reduce morbidity.

Recommendations

These recommendations should be considered alongside previous recommendations from the PMMRC (Appendix B on page 199 and 'Summary of Key PMMRC 2013 Report Recommendations and Progress' on page 12.)

Perinatal related mortality

1. 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 effective smoking cessation programmes prior to, during and after pregnancy.

2. As high body mass index (BMI) at booking is an independent risk factor for stillbirth, public health initiatives to prevent obesity prior to pregnancy should be supported. Optimal weight gain according to BMI should be emphasised and encouraged during pregnancy.

3. 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. This report can be found at: *http://www.parliament.nz/resource/en-nz/50DBSCH_SCR6007_1/3fe7522067fdab6c601fb31fe0fd24eb6befae4a*

4. Maternity workforce education programmes and DHB guidelines should incorporate the third edition of the Royal Australian and New Zealand College of Obstetricians and Gynaecologists (RANZCOG) fetal surveillance guidelines (which are supported by the New Zealand College of Midwives). These are available at: *http://www.ranzcog.edu.au/college-statements-guidelines.html*

5. The PMMRC recommends that Northland, Tairawhiti and South Canterbury DHBs review all cases of intrapartum related death at term in their area to identify opportunities for improvement.

Maternal mortality

6. 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 clinician and development of a detailed management plan are required.

7. 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.

Neonatal encephalopathy

8. All DHBs should undertake local review of cases of neonatal encephalopathy to identify areas for improvement in care including adequacy of resuscitation and cooling.

9. The Neonatal Encephalopathy Working Group (NEWG) and PMMRC support the development of a guideline for the investigation and management of neonatal encephalopathy.

Overview of the 2014 Report of the PMMRC

Introduction

This, the eighth report of the PMMRC, includes data on babies who died in New Zealand between 2007 and 2012, and mothers who died from 2006 to 2012. It includes data on babies with moderate and severe hypoxic ischaemic encephalopathy in 2010–2012, and mothers with selected morbidities from 2010 to 2012.

For the first time, it includes a multivariate analysis using the national maternity dataset, which investigates whether ethnicity, age, socioeconomic status, body mass index (BMI), parity and smoking are associated with stillbirth and neonatal death.

It includes two special topic analyses, as planned in the seventh report, on term unexplained stillbirth and term intrapartum related perinatal death.

Term unexplained stillbirths were studied because these contribute the largest proportion of perinatal deaths at term. This analysis includes babies who died in utero prior to labour from 37 weeks gestation.

The term intrapartum related death analysis includes babies dying at term in labour of any cause other than congenital abnormality and babies dying in the first month of life where the cause was thought to be peripartum asphyxia. This group was chosen as it has been found to have a higher rate of potentially avoidable deaths than other causes of death, both by the PMMRC review process and in other published reports (Gardosi 2010).

Perinatal related mortality rates

In New Zealand perinatal related mortality is defined as fetal and neonatal death of babies born from 20 weeks gestation who die in utero, or within the first 27 days of life, of any cause.

The perinatal related mortality rate, using the New Zealand definition, has overall been stable over the years 2007–2012. In 2012 the perinatal related mortality rate was 10.7/1000 births which is the equivalent of one baby dying in pregnancy or during the first month of life for every 100 babies born.

However, using the World Health Organization recommended international definition for perinatal mortality, there has been a significant reduction in perinatal mortality from 2007 to 2012. The international definition includes death of a baby of 1000g or more (or from 28 weeks of pregnancy) and up to one month of age. This decrease began in 2010 and has continued. The decrease is due to a decrease in stillbirths. Among stillbirths there has been a significant reduction in unexplained stillbirths and in deaths due to hypoxia in labour.

International comparisons

New Zealand perinatal mortality rates can be compared to 2011 rates in Australia and the United Kingdom and to 2012 rates in England and Wales. New Zealand perinatal mortality rates are not significantly different to perinatal mortality rates in Australia or the United Kingdom.

As New Zealand and some jurisdictions of Australia (Queensland, West Australia, South Australia, Tasmania) are using the same Perinatal Society of New Zealand and Australia perinatal death classification (PSANZ-PDC) system, we compared the causes of death between the two countries for 2011. There was a higher rate of deaths without antecedent cause, most often due to sudden unexpected death in infancy (SUDI), in New Zealand. There was a higher rate of death due to preterm birth in Australia and a higher rate of death due to antepartum haemorrhage in New Zealand. It is likely that this difference is due to different application of the classification system between Australia and New Zealand rather than any real difference as antepartum haemorrhage and preterm birth most often occur together. There was also a higher rate of deaths due to specific perinatal conditions in New Zealand. These deaths are due to twin–twin transfusion syndrome, fetomaternal haemorrhage, antenatal cord complications, maternal uterine abnormalities and other less common conditions.

Causes of perinatal death

The most common cause of perinatal death in New Zealand is congenital abnormality, which accounts for 30 percent of deaths. Congenital abnormality accounts for 75 percent of terminations of pregnancy from 20 weeks. The second most common cause of death is spontaneous preterm birth which accounts for 15 percent of all perinatal deaths and is the cause of a third of neonatal deaths.

Stillbirth is most often unexplained (27 percent) and for this reason unexplained stillbirth at term is the subject of further analysis in this year's report. Some deaths in this category have a placental cause of death and the New Zealand PMMRC would like to see this category revised to correctly identify these as explained deaths. An audit of unexplained deaths in 2011 showed that not all babies received the full set of recommended blood tests, microbiological tests and pathology.

Timing of perinatal death

The highest risk of perinatal death among ongoing pregnancies is from 20–23 weeks gestation. Perinatal deaths from 20–23 weeks are most commonly due to termination of pregnancy for congenital abnormalities. Antepartum haemorrhage and spontaneous preterm birth are the next most common causes of death from 20–23 weeks gestation, and these events often occur together. The risk of perinatal death from 20–23 weeks gestation has increased significantly from 2007 to 2012. This is because of an increase in termination of pregnancy at 20–23 weeks gestation, specifically of termination of pregnancy for reasons other than congenital abnormality, such as perinatal infection, hypertension, antepartum haemorrhage, maternal conditions, specific perinatal conditions, fetal growth restriction and spontaneous preterm birth sequelae.

Independent associations between demographic and clinical factors and stillbirth

This is the first year that it has been possible to undertake an analysis to determine the separate effects of the known predictors of stillbirth and neonatal death. This is because this year it was possible to use the National Maternity Collection (MAT) dataset, which is a compilation of data collected by lead maternity caregivers and from public hospital discharge data. This dataset, however, does not currently include early pregnancy data (specifically BMI and smoking at registration) for mothers whose primary maternity care is provided by hospital employed midwives. These women therefore had to be excluded from the analysis and the findings of the analysis may not apply to them.

The analysis identified the predictors of stillbirth in singleton pregnancies excluding deaths from congenital abnormalities, after accounting for mother's ethnicity, mother's age, number of previous births (parity), mother's socioeconomic status as measured by area of residence, smoking in pregnancy and BMI. The significant predictors were:

- women of Indian ethnicity
- smoking in pregnancy
- BMI greater than 25, with an increase in risk with increasing BMI
- women having their first baby.

Women of Indian ethnicity

Perinatal deaths among Indian mothers are more often due to spontaneous preterm birth and fetal growth restriction than among New Zealand European mothers. There may also be an increased rate of death from maternal conditions (mostly diabetes) and hypertension, but these differences are not statistically significant.

Smoking in pregnancy

Published studies consistently demonstrate that smoking is associated with preterm and small for gestational age (SGA) birth, placental abruption, stillbirth and perinatal mortality. As smoking is a modifiable risk factor for both stillbirth and neonatal death, every effort must be made to encourage women to engage in effective smoking cessation programmes prior to, during and after pregnancy.

Best practice notes for helping women and whānau quit smoking are provided on page 55.

Body mass index

Both overweight (BMI 25–29) and obesity (BMI 30 and over) at the start of pregnancy (which was used in the analysis presented in this report) and excess weight gain during pregnancy have been reported to increase maternal and perinatal risk in pregnancy.

Recommendations for weight gain during pregnancy, by pre-pregnancy BMI and good practice notes on helping women achieve ideal weight gain in pregnancy are included on page 53.

Independent associations between demographic and clinical factors and neonatal death

The analysis of predictors of neonatal death of babies born from 20–27 weeks gestation in singleton pregnancies excluding deaths from congenital abnormalities found that the following were significant independent predictors, meaning they are predictors in their own right, not because they are associated with any of mother's age, ethnicity, socioeconomic status, number of previous births, smoking and BMI:

- women of Māori and Pacific ethnicity
- women who smoke in pregnancy
- women living in areas with higher socioeconomic deprivation
- women having their first baby.

Because neonatal deaths of babies born from 20–27 weeks gestation are most often due to consequences of spontaneous preterm birth, this is the same as saying that these factors are predictors of death from spontaneous preterm birth. These deaths might be reduced by helping women to stop smoking in pregnancy and by reducing the numbers of women who are living in poverty during their reproductive years.

The only predictor of neonatal death of babies born from 28 weeks until term was smoking in pregnancy.

Alcohol and substance use in pregnancy

Analyses using the PMMRC database have shown that alcohol and marijuana are associated with death due to spontaneous preterm birth and to SUDI death. Mothers whose babies died and who reported alcohol and marijuana use were also more likely to be Māori, smokers, from socioeconomically deprived areas and aged under 25 years. These demographic factors are also associated with death from spontaneous preterm birth and SUDI. Marijuana and alcohol abuse may be some of the underlying reasons why these social factors are associated with perinatal death.

The true rate of use of alcohol and substances in pregnancy may be under-reported. The PMMRC would like to see further investigation to estimate the impact of alcohol and substance use as additional services tailored to pregnant women may need to be developed.

Stillbirth

There has been a reduction in stillbirth from 2007 to 2012. This reduction is significant for deaths at 41 weeks gestation and over. At the same time, there has been a significant reduction in the proportion of births in New Zealand at 41 or more weeks gestation. This might be due to higher rates of induction of labour in pregnancies at 41 or more weeks gestation. There has also been a decrease in stillbirths at term (37–40 weeks gestation) but this reduction was not statistically significant so may be due to chance.

Unexplained antepartum death (stillbirth) at term

This special topic was identified for further analysis this year because 26 percent of all stillbirths and 37 percent of stillbirths at term are unexplained. The analysis included all babies who died in utero at or beyond 37 weeks and where the cause of death was unexplained. The rate of unexplained stillbirth as a proportion of ongoing pregnancies is highest at term. At 40 weeks, the risk of unexplained stillbirth is approximately 1 in 5000 ongoing pregnancies, and at 42 weeks, it is approximately 1 in 3500 ongoing pregnancies.

Unexplained stillbirth at term has reduced significantly from 2007 to 2012. It is unlikely that the reduction in unexplained stillbirth at term is due to improved classification over time as there has been no coincidental increase in any other PSANZ-PDC category over the same time period.

Unexplained term stillbirths were less likely to have been fully investigated than other term stillbirths. Only 39 percent of term unexplained stillbirths were optimally investigated, and 18 percent did not have placental pathology performed.

Placental examination has been shown to be even more valuable than post-mortem with one study finding cause of death could be explained in 48 percent of perinatal deaths by placental examination alone (Manning et al 2013).

Some placental pathologies explain stillbirth and have high rates of recurrence. These include perivillous fibrin deposition and severe histiocytic intervillositis. Other significant placental causes of stillbirth include severe chronic villitis (also known as villitis of unknown etiology), fetal thrombotic vasculopathy, decidual vasculopathy, extensive placental infarction and severe chorioamnionitis.

An audit of 32 term unexplained stillbirths in 2011 found that the uptake of perinatal death related investigations among unexplained stillbirths was generally high, but there is potential for improvement in sending a specimen for chromosomal analysis (karyotype), formal ultrasound assessment of the amniotic fluid volume and for fetal anomaly prior to birth, and taking clinical photographs of the baby.

Term intrapartum related death

Term intrapartum related deaths were also chosen for specific analysis in 2012. These deaths were chosen for extra analysis as they have been found by the PMMRC and in other published reports to have a high rate of potentially avoidable deaths. In previous years numbers have been inadequate for in-depth analysis.

This analysis includes deaths in labour at term and hypoxic peripartum deaths (PSANZ-PDC 7). Hypoxic peripartum deaths are deaths that were thought to be due to hypoxia in labour, whether the baby died intrapartum or as a neonate, and whether or not there were additional risk factors identified (that is, additional PDC codes).

Approximately half of the 211 babies studied were stillbirths and half were neonatal deaths. This represents 5 percent of all perinatal deaths and 22 percent of deaths of babies born at term.

There has been a reduction in these deaths from 2007 to 2012. The reduction in the proportion of births in the New Zealand population at 41 or more weeks from 2007 to 2012 might explain some of the reduction in term peripartum related deaths (for example, due to a higher tendency to induce post term), as these babies are more vulnerable in labour.

Twenty-nine percent of intrapartum related deaths were associated with an acute serious event in labour, most commonly placental abruption or cord prolapse.

Only half of intrapartum related deaths were optimally investigated. Among the 23 intrapartum related deaths in 2011 whose clinical records were audited this year, mothers were infrequently offered the recommended maternal investigations suggesting a possible lack of awareness of the importance of these tests.

More than half of the intrapartum related deaths were thought to be potentially avoidable at local review, with a third associated with each of organisation and management, personnel and barriers to access and/or engagement with care factors. Organisation and management factors were most often related to delays in emergency response or in procedures such as caesarean section, inadequate policies, protocols and guidelines, and inadequate education and training. The most common issue around personnel was failure to follow recommended best practice. Local review identified the need for frequent and repeated assessment of the health and wellbeing of mother and baby prior to and during labour. The most common identified barrier to access and/or engagement with care was environmental issues such as labouring in an isolated location and the need for a long transfer for secondary or tertiary care when required.

Maternal mortality

Maternal mortality is death of a mother at any time in pregnancy or in the first six weeks after pregnancy, whatever the gestation, from a pregnancy related disease or a disease aggravated by pregnancy but not from accidental or incidental causes.

In 2012, 10 mothers died from direct or indirect obstetric causes and a further five coincidental deaths were reported to the PMMRC.

The maternal mortality ratio for the three years 2010–2012 was 14.7/100,000 births from 20 weeks gestation. This is higher than the maternal mortality ratio reported from the UK for 2006–2008 of 11.4/100,000. As the UK has a similar process of ascertainment of maternal deaths to that in New Zealand, this is a reliable comparison. Australia does not currently have a system of mandatory reporting and so published rates are likely to underestimate the true rate.

Over the years 2006–2012 that the Maternal Mortality Review Working Group (MMRWG) has been reviewing maternal deaths, the most common causes of maternal death have been suicide and pre-existing medical conditions. These are both considered indirect causes of maternal death (diseases aggravated by pregnancy). The most common pregnancy related disease to cause maternal death in New Zealand is amniotic fluid embolism.

Maternal mortality is higher among mothers of Māori and Pacific ethnicity, mothers 40 years of age and older, and mothers living in areas of greater socioeconomic deprivation. Although there are no national data for alcohol and substance use in pregnancy in New Zealand, there appeared to be a high rate of alcohol and substance use by mothers who died in pregnancy.

One-third of mothers who die, die while pregnant, and one-third of mothers die outside of hospital.

Contributory factors and potentially avoidable perinatal and maternal deaths

In 2012, 19 percent of perinatal deaths were identified by local review to be potentially avoidable. Common contributory factors include failure of caregivers to offer or follow recommended best practice, infrequent antenatal care and lack of recognition by patients and their family of the complexity or seriousness of their condition.

During the seven years of maternal mortality review, one-third of maternal deaths were identified by the MMRWG to be potentially avoidable. This was fairly similar for direct and indirect maternal deaths, but barriers to access and/or engagement with care were seldom identified among direct deaths but identified in half of indirect deaths.

Summary of Key PMMRC 2013 Report Recommendations and Progress

The following summarises progress made against recommendations published in last year's report (June 2013).

Recommendations (June 2013)	Progress to date (June 2014)
Audit of congenital abnormalities *The PMMRC endorses all recommendations of the audit of congenital abnormalities.**	
All primary care providers (if first contact of a pregnant woman with the health service) should offer first trimester screening and facilitate expeditious registration.	The importance of timely registration has been continuously promoted through the Ministry of Health's Maternity Quality and Safety Programme. All DHBs are required in their 2013–14 Annual Plans to identify actions they will take to increase the number of women accessing primary maternity services in their first trimester. The National Maternity Monitoring Group, established as an advisory group to the Director General of Health, has identified timely registration with maternity services as one of their five priority areas, and has undertaken a number of actions to raise the profile of the importance of early booking and to identify and share good practice examples and initiatives being undertaken by DHBs. Many DHBs have initiated media and social media campaigns, and recently the New Zealand College of Midwives, supported by the Ministry of Health, launched the 'Find Your Midwife' website which further supports women to find and book with a lead maternity carer (LMC). The TAHA Well Pacific Mother & Infant Service have launched a smart phone app with information on pregnancy and parenting. This can be accessed at: *www.tapuaki.org.nz* The Ministry of Health is in the process of revising the DHB funded Pregnancy and Parenting Education service specifications to focus on providing information for pregnancy and parenting as well as education for targeted groups.
Achieving optimal use of periconceptual folate by young women in New Zealand requires a policy for fortification of bread.	This recommendation will be carried forward as it is not a current policy priority. There is general agreement for this policy in principle.
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 sensitivity for all chromosomal abnormalities.	Awaiting response from National Screening Unit.
The National Screening Unit review false negative screening tests.	As above.
The 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.	The New Zealand Maternal Fetal Medicine Network has completed an audit of fetal cardiac referrals and identified areas for improvement for access to a cardiology opinion. Paediatric cardiology and fetal medicine video consultation has been established to address this issue.

* These recommendations can be viewed at *http://www.hqsc.govt.nz/assets/Other-Topics/QS-challenge-reports/Detecting-abnormalities-earlier-in-pregnancy-Final-Report.pdf*

Recommendations (June 2013)	Progress to date (June 2014)
Perinatal related mortality	
In order to reduce perinatal related mortality associated with multiple pregnancy, the following is advised. • All women undergoing assisted reproduction be offered single embryo transfer. • The use of clomiphene for fertility treatment requires monitoring of hormonal response with ultrasound to determine the number of follicles. • LMCs note that the referral guidelines recommend transfer of clinical responsibility for care of all women with multiple pregnancies to obstetrician-led care. *http://www.health.govt.nz/system/files/documents/publications/referral-glines-jan12.pdf*	These recommendations have been promoted through the Ministry of Health's Maternity Quality and Safety Programme and the Health Quality & Safety Commission.
Neonatal encephalopathy	
Strategies to reduce neonatal encephalopathy include: • continually improving the standard of neonatal resuscitation by all health professionals involved in providing peripartum care • local review of the apparent higher neonatal encephalopathy rate in Waikato DHB.	Waikato DHB advised they have reviewed the babies diagnosed with neonatal encephalopathy 2010–2011, and that they plan to review any further cases.
In cases of neonatal encephalopathy: • all babies with encephalopathy should undergo investigation to predict prognosis including formal neurological examination, cerebral magnetic resonance imaging (MRI) and, if available, formal electroencephalography (EEG) • all parents of an affected child should have a formal discussion with the neonatologist/paediatrician providing care in order to review the prognosis and ongoing care of their child.	These recommendations have been promoted through the Health Quality & Safety Commission.
Maternal mortality	
In maternal deaths, where the coroner declines jurisdiction, post-mortem should be offered as part of full investigation of cause of death.	This message has been disseminated at the annual conference of the PMMRC.
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.	These messages have been promoted at the annual conference of the PMMRC.
Recommendation for Ministry of Health	
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 the PMMRC to report the independent associations between ethnicity, maternal age, socioeconomic status and perinatal related death, adjusting for smoking and maternal body mass index.	This dataset has been made available to the PMMRC for the current report.

Parents, Families, Whānau

Compiled by Linda Penlington

This section of the report is designed for parents, families and whānau of the babies who died during the 2012 year.

This report is the eighth report from the PMMRC, but is not like all other reports. As time has gone on, the previous seven years have taught us that clear, accurate data are the only valuable and relevant data, thus we can now begin to form some ideas as to how to minimise the 'potentially avoidable' deaths in our country. Sadly, there will always be a large proportion of perinatal and maternal deaths that are not avoidable, and as ever, the role of this group is to determine, in a given period (in this report 2012 deaths), which of those may have been avoidable, with hindsight.

Of course, that is easier said than done. There are many contributory factors, and given our small population we have statistically lower numbers of perinatal and maternal deaths compared to other larger nations in the First World. That means that it is difficult to spot trends, or see any obvious reasons as to why these deaths occur, until we have a few years of data. In our eighth year of this review process, we are beginning to be able to rely on the quality of the data collected and have enough numbers to start to form the questions that need to be asked.

It needs to be mentioned that there are many people who contribute to this report, not just the PMMRC or the families who have suffered tragedy. Your lead maternity carer (LMC) has been involved from the beginning, the DHB in which you live has had your case under review, there is a national review process, and then finally at the PMMRC level, there is a review of trends and patterns. One of the obvious outcomes has been the need to form other specialist working groups to identify and 'drill down' for more detail in certain areas. Some examples of this are the Maternal Mortality Review Working Group (MMRWG), the Neonatal Encephalopathy Working Group (NEWG), the Australasian Maternity Outcomes Surveillance System (known as AMOSS as it has both Australia and New Zealand involved) and the Bereaved Mothers Survey 2011, which is soon to be repeated in 2014. These groups have all been formed as a result of realisation of the need to look into tiny details of cases to try to find a common link, and therefore a possible opportunity to change some outcomes for some families.

Of course, not all of the reviewing process is about biology. The PMMRC also looks at systems and procedures, training for medical and midwifery staff and policies for each DHB to adopt. In other words, every aspect of your loss is looked at, with a very clear and objective view. It's simply a question of doing whatever it takes to ensure safety and best practice for babies and their mothers.

Focusing on the perinatal deaths, one of the things that has become apparent is the value of the information gained from post-mortem of both the placenta and the baby. The pathology (data gained) from both is one of the crucial keys to understanding what has happened in many cases. Many families are happy to send the placenta for examination, but less are willing to send the baby for the same. There is so very much learning that can be derived from having both reviewed, and in many cases the placenta without the baby is a jar of information half empty. Your children are treated with dignity and respect. Their short but precious lives are valuable to medicine, to the safety of future pregnancies of yours and other families, and to the overall understanding as to why these little lives are gone far too soon. The post-mortem process is not nearly as invasive as you might think, and the answers to your concerns about 'Did I do something wrong?' and 'Will it happen again?' are best answered when the results of a post-mortem come through. Whilst it may seem like an enormous decision at the time, I can honestly say that with all the years I have worked with families through their losses, no family (mine included) has ever regretted their decision to have more information through post-mortem.

In conclusion, whilst this report may seem daunting, it contains accurate and valuable information about the losses New Zealand suffered during 2012, why they occurred, and what it is that those precious lives have triggered in terms of research, analysis and of course, the search for avoidability of the same. The children and mothers that you have lost have not been in vain: their lives and their deaths have been noted, are important and form a crucial part of our understanding of the bigger picture of how to prevent future losses. Their lives have been important, and will not be forgotten.

From the PMMRC to you, thank you for your bravery and candour, and know that you have our support.

1 Perinatal Mortality 2012

1.1 Introduction

In New Zealand, maternity care is funded by the Ministry of Health (the Ministry). Maternity care is provided by 20 district health boards (DHBs) nationally and by lead maternity carers (LMCs), who receive funding from the Ministry. LMCs may be self-employed midwives, general practitioners (GPs), private obstetricians or hospital-based midwives and obstetricians. Their services are free for eligible women, except in the case of private obstetricians, who have the right to charge co-payments for their services.

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

The obstetric and related medical services referral guidelines (2012) provide information about referring pregnant women, transferring clinical responsibility and transferring care in emergencies *(http://www.health.govt.nz/publication/guidelines-consultation-obstetric-and-related-medical-services-referral-guidelines)* (Ministry of Health 2012b).

1.2 Methodology

Data sources

The perinatal deaths presented in this report occurred between 1 January and 31 December 2012. For fetal deaths, the date of birth is used in place of the date of death. For neonatal deaths, the actual date of death is used.

An expanded description of data collection methods for this report is available in the first Perinatal and Maternal Mortality Review Committee (PMMRC) report (PMMRC 2007). After the PMMRC was established in 2005 and following consultation with stakeholders, it was agreed that a review of all perinatal deaths would require the assistance of LMCs and the DHBs to collect detailed clinical information on each perinatal death.

The PMMRC approached all the DHBs, requesting their help to establish a network of local PMMRC coordinators. Individual coordinators within each DHB identify perinatal deaths and oversee the collection of the required data. These data are submitted to the Mortality Review Data Group at the University of Otago. The coordinators are also responsible for initiating local clinical reviews of each case, including assigning classification codes, determining contributory factors and potentially avoidable deaths and ensuring appropriate, timely follow-up with parents.

The dataset of perinatal deaths is a compilation of data submitted by the local coordinators, death notifications and some additional data from Births, Deaths and Marriages (BDM). A website commissioned by the PMMRC and run by the University of Otago enables web-based data entry. LMCs and/or local coordinators are required to complete rapid reporting forms within 48 hours of a perinatal death.

One form contains information on the mother (for example, her past medical and obstetric history and details of the birth), and the other form contains information on the baby. The questions are reviewed and adjusted annually to ensure the data collection remains relevant and robust.

After local review, the local coordinator completes the PMMRC classification form. The classification system that has been adopted is the Perinatal Society of Australia and New Zealand (PSANZ) system of classification of cause of perinatal death (PSANZ 2009). This system includes both perinatal and neonatal classifications (listed in Appendix C). The local coordinator also submits the post-mortem and histology reports with the classification form.

Contributory factors and potentially avoidable mortality

An assessment of contributory factors and potentially avoidable perinatal related death is completed by the PMMRC local coordinators following local review and submitted along with the PSANZ classification of perinatal death. The PMMRC contributory factors and potential avoidable perinatal related death form was adapted to include questions that identify contributory factors related to organisation and management, personnel, technology and equipment, environment and barriers to accessing/engaging with care. In 2012, the form was modified, and technology, equipment and environment factors were incorporated into the remaining categories where appropriate. A death is considered potentially avoidable if the absence of the contributory factors may have prevented the death. From 2011, local coordinators were also asked to indicate the main contributory factor(s) in identifying the death as potentially avoidable. A copy of the form can be found in Appendix D.

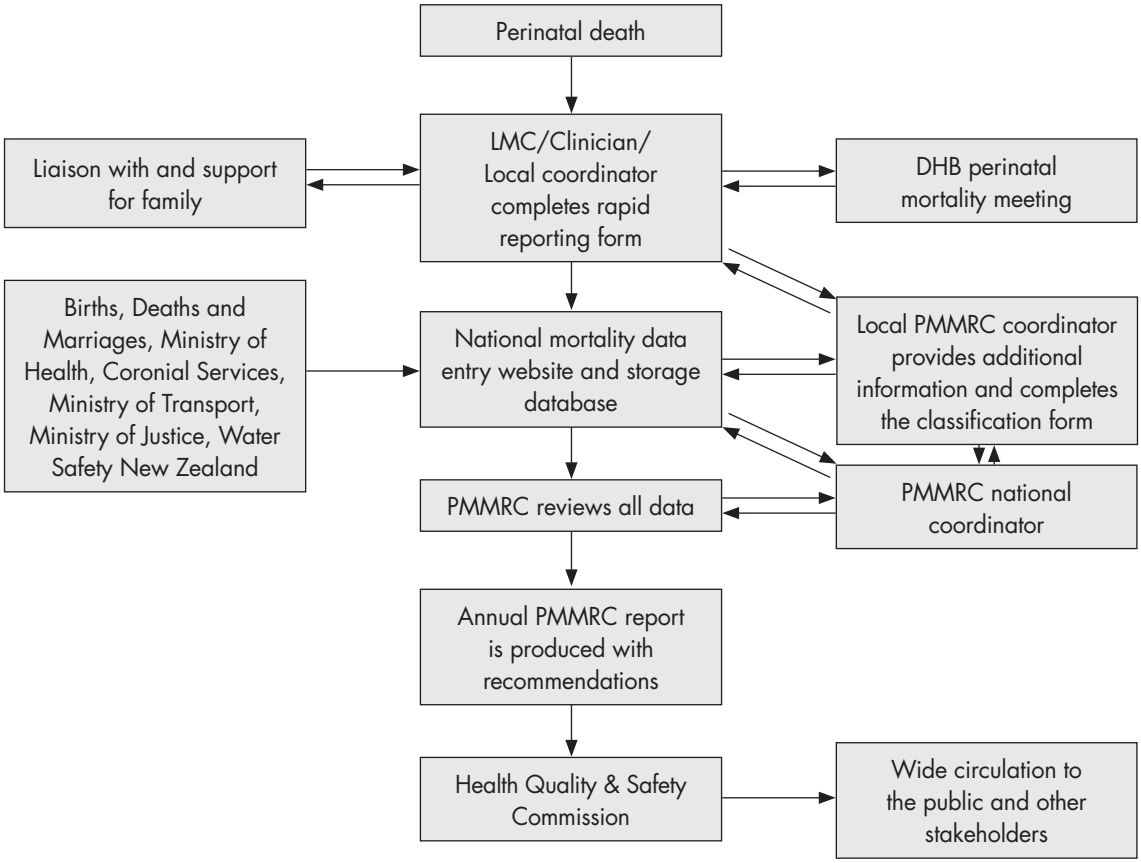
The Maternal Mortality Review Working Group (MMRWG) has identified potentially avoidable maternal deaths since 2006. From 2009, the MMRWG started to use the same tool identifying contributory factors and potentially avoidable death as that used for perinatal deaths.

The clinical notes for a random sample of deaths in 2009 (excluding congenital abnormality and sudden unexpected death in infancy (SUDI) deaths) were used in a study to validate the PMMRC local process for the identification of contributory factors and potentially avoidable perinatal related mortality. This was done by comparing the findings of local review for identification of contributory factors and potentially avoidable perinatal related mortality with a multidisciplinary independent panel using the same methodology.

Clinical notes from 48 perinatal related deaths were reviewed by both panels. There was substantial agreement (Kappa 0.63) in identification of contributory factors but only moderate agreement (Kappa 0.50) in identification of potentially avoidable perinatal related deaths between local and independent review. Analysis of non-concordant cases identified areas where modification of the tool and further education of local reviewers might improve the local process. The full results of this study will be available on the PMMRC website when published.

Figure 1.1 outlines the PMMRC process. A user guide describing the definitions and data elements used by the PMMRC (PMMRC 2009) is available online at *http://www.hqsc.govt.nz/pmmrc*

Figure 1.1: Flow of information in the PMMRC's perinatal data collection process



PMMRC data validation

Data are regularly validated, using a standard set of queries, to eliminate duplicate records, complete missing mother or baby information, clarify DHB of residence (where this is inconsistent with the given residential address) and rectify other inconsistencies.

The national coordinator reviews all perinatal death classifications and checks complicated cases with a PMMRC member with expertise in stillbirth classifications.

Each year, an audit is undertaken to compare these data with the clinical records from the relevant DHBs to ensure data recorded are accurate.

The audit of 2011 data focused on term unexplained antepartum death and term intrapartum related death in relation to adequacy of perinatal death investigations including post-mortem and, where relevant, the intrapartum care provided. The audit standards used included guidance developed by the Royal Australian and New Zealand College of Obstetricians and Gynaecologists (RANZCOG 2010) and the New Zealand College of Midwives, and the PMMRC booklet *How to Investigate a Perinatal Death* (PMMRC 2014). A summary of findings specific to term unexplained antepartum stillbirth and term intrapartum related death is included under Special Topics in section 1.4.

The audit also assessed the accuracy and completeness of the PMMRC data obtained from the clinical notes from the DHB and LMC, including review of the PSANZ perinatal mortality classification.

The PMMRC audit of 2011 perinatal deaths reviewed 33 term unexplained antepartum deaths (PSANZ-PDC 10) and 22 term intrapartum related deaths, of which, 9 were intrapartum stillbirths and 13 were neonatal deaths. The information provided below relates to the audit of these 55 deaths.

There were two cases (4 percent) where the auditor's and the original primary perinatal death classification (PSANZ-PDC) varied. In one case, a term unexplained antepartum stillbirth was found to be an intrapartum death, and in the other case, perinatal infection was identified as the primary cause for hypoxic peripartum death and subsequent neonatal death. In six cases (11 percent), the subcategory of the PSANZ-PDC or the neonatal death classification (PSANZ-NDC) varied as a result of the audit. In five cases, this was secondary to identification of specific placental pathology and in one case, neonatal infection was sub-classified. The PMMRC data were updated to reflect these findings.

The vast majority of data fields audited on both the maternal and baby rapid reporting forms concurred with the clinical notes; however, there were some discrepancies that occurred more commonly than others. The number of antenatal scans before 22 weeks gestation was commonly incorrectly completed (11 percent), as was the number of antenatal visits (47 percent) and the gestation at booking (5 percent).

When comparing these findings to last year's audit of the same data fields, there have been some improvements in the completeness of data submitted to the PMMRC. The most noticeable improvements were in the reduction in missing gestation at booking data (64 percent down to 5 percent) and testing for gestational diabetes data (14 percent down to 7 percent).

These findings were presented to the PMMRC local coordinators at their annual meeting to highlight areas for improvement, along with a reminder of the importance of complete and accurate data.

Denominator data

New Zealand birth registrations

The denominator data used in this report consist of New Zealand birth registrations during the 2006–2012 calendar years. The New Zealand birth registration dataset approximates the number of births in a year in New Zealand. It is closer to the true number of births than the hospital discharge dataset as it includes births outside hospitals. Furthermore, it includes ethnicity data as notified by parents at birth registration.

This source of ethnicity is also used for the numerator where a birth registration has been made. Ethnicity in the hospital discharge dataset (otherwise known as the National Minimum Dataset – NMDS) is also apparently provided by mothers for themselves and for their babies and becomes part of the National Health Index (NHI) dataset. However, comparisons of mother and baby ethnicity between the birth registration dataset and NMDS in previous years have shown significant differences.

The birth registration dataset of New Zealand births is collated by BDM from birth notifications supplied by public and private hospitals and by LMCs in the case of home births. Births are only added to the birth registration dataset when the birth is registered by the parents, which can occur up to some years following birth. The registration dataset is based on date of registration and so includes births from previous years and fewer than all births from the current year. While this dataset is representative of the total number of births in a year, it does not truly represent the denominator.

A disadvantage of the birth registration dataset for reporting maternity analyses in New Zealand is that it includes limited maternity data. The dataset does not retain an individual's unique NHI identification number (for either the mother or the baby), and so the data it contains cannot be linked to hospital discharge data or LMC data for further analyses.

The denominator birth registration dataset includes both live births and stillbirths. As this dataset relates to stillbirths registered in the calendar year and not deaths in the calendar year and does not indicate which babies died as neonates, the full registration set has been used as the denominator for rates.

The current year's fetal deaths have been removed from the denominator for the calculation of neonatal death rates.

New Zealand National Maternity Collection (MAT)

The New Zealand National Maternity Collection (MAT) is a relatively new initiative combining data collected by LMCs, which is required to enable claims for payment, with hospital discharge data. This dataset now represents the best approximation of live births in New Zealand in any year and provides data on body mass index (BMI), parity, smoking, LMC registration and gestation at registration for the maternity population of New Zealand.

The PMMRC would prefer to use this dataset as the denominator for analysis as it includes clinical variables which are known predictors of perinatal related death.

However, there are some limitations to the use of the MAT dataset at this time.

- DHBs cannot currently provide registration data such as BMI and smoking on the approximately 15 percent of mothers for whom they provide primary maternity care (recorded in the MAT dataset as 'No LMC' or 'Other'). These mothers more often reside in areas of higher deprivation (New Zealand Index of Deprivation 2006 (NZDep2006)), are more often Pacific and Indian ethnicity, and more often reside in Counties Manukau, Auckland, West Coast, Nelson Marlborough, Northland and Whanganui DHB areas. As these sociodemographic factors, along with associated clinical variables such as smoking, parity and BMI, are also known to be associated with perinatal related mortality rates, these systematically missing data between the numerator (deaths) and denominator (all births) may result in bias in analysis findings.

- More than 90 percent of the smoking and BMI data are missing from the MAT dataset for live births in 2007.

- The MAT and the PMMRC datasets derive and define ethnicity differently. Maternal ethnicity is derived from BDM birth registration in the PMMRC dataset, while the MAT dataset 'derives ethnicity from ethnic codes reported to NMDS (National Minimum Dataset for hospital discharges) birth and postnatal events, LMC Labour & Birth claims and NHI at time of delivery. The three highest priority ethnic codes that reach a threshold proportion are stored in the Aggregated Pregnancy table' (National Health Board Business Unit 2011). It is possible that this difference may introduce numerator–denominator bias.

It is expected that some of these issues will be resolved in the near future, as the Ministry of Health and DHBs work to enable transfer of registration data to the MAT dataset.

To avoid bias that may result from any of these issues, the following approach has been taken in use of the MAT data in this report.

1. The birth registration dataset has been used as the denominator in the unadjusted analyses in this report (except when MAT data are used for both numerator and denominator). This ensures that numerator and denominator definitions are concordant and that all data can be included in the analyses. This also allows current data to be compared with previous years.

2. The deaths identified by the PMMRC process were matched with the MAT dataset (using maternal NHI and date of birth, within a four-week range either side of the PMMRC recorded date of birth). This matching process was successful for 91.4 percent of perinatal related deaths (92.2 percent of late terminations, 90.4 percent of stillbirths and 92.8 percent of neonatal deaths).

3. The MAT dataset has been used for smoking and BMI analyses because the registration set does not include these key clinical variables.

4. The MAT dataset has been used for multivariate analysis to estimate the independent associations of ethnicity, age, deprivation decile, smoking, parity and BMI with stillbirth and neonatal death.

NB: Only data for perinatal related deaths where the match between the PMMRC dataset and the MAT dataset was successful have been included in the analyses described in 3 and 4 above, and MAT data only were used for the analysis.

Data analysis

Percentages

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

Figures

In figures where graphs have two y-axes, the data relating to the left-side y-axis are presented as bars, and the data relating to the right-side y-axis are presented as points, joined by a line where they represent continuous or ordinal data.

Confidence intervals

Ninety-five percent confidence intervals (CIs) for perinatal mortality rates have been computed using the methods for vital statistics described by the Centers for Disease Control and Prevention (Heron 2011). The CI represents the degree of uncertainty around the point estimate of the rate for the particular period. This uncertainty depends on the absolute number of deaths and the number of births from which the deaths arose. If the number of births is large, then the CI (that is, the level of uncertainty) is generally small; if the number of births is small, the CI is large. The CI represents the limits within which the 'true' rate is most likely to lie. This calculation is necessary when numbers are small because the point estimate of the rate calculated from the data given may by chance have taken a wide range of values. The CI describes this range.

It is possible to compare rates by looking at the CIs. If the CIs for two rates do not overlap, it is likely that the rates are different. This is equivalent to the rates being statistically significantly different at the $p<0.05$ level. If the CIs do overlap, the rates may or may not be different.

In Figure 1.26, which shows perinatal related mortality rates by the mother's DHB of residence, the CIs for perinatal related mortality rates by DHB have been plotted along with the national perinatal related mortality rate. If the CI for the DHB of residence rate does not include the national rate, then it is likely that this DHB of residence rate differs from the national average rate.

Statistical testing

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

Where tests for trend have been used, a score test for linear trend of the log odds has been performed in STATA9 using the 'tabodds' function or in EpiInfo using the chi-squared test for trend. A p-value of <0.05 has been used to indicate statistical significance.

Missing data

Cases that have missing data have still been included in the data tables and are generally discussed in the text. Percentages in the tables generally include missing data, although the text sometimes describes findings among women with complete data only. However, where missing data exceed 30 percent of all possible data points, the data have generally not been presented.

At the lower extremes of gestation and birthweight, denominator numbers are small. As the denominator set is registrations rather than births in the relevant year, the denominator is not an exact count of all births in the year. For this reason, perinatal related mortality rates at the lower extremes have not been reported.

Multiple year data

In this report, the figures illustrating perinatal related mortality rates sometimes include combined data for the five full years that the PMMRC has collected data (2007–2012) where it has been shown there is no trend over time. This increases the numbers and so improves the confidence around the estimates given. In general, the data for the 2012 year alone are presented in table form in the text and the combined five-year data in table form in Appendix A.

Definitions

Ethnicity

Mother and baby ethnicities for perinatal related deaths were collected from two sources: from information supplied to the BDM Registrar (with priority given to information in the birth registration over information in the death registration) and from rapid reporting forms completed by LMCs (for example, in cases where the death had not been registered by the time of analysis), with information from BDM taking priority over data from rapid reporting forms. In both instances, ethnicity was recorded as that identified by the mother/parents. The ethnicity in the deaths dataset (held by BDM) is not validated. Death registration forms are usually completed by either the parents or a funeral director.

Mother and baby ethnicities in the denominator birth registration set are those provided by the parent(s) to BDM at birth registration and are thus consistent with numerator data.

Multiple ethnicities can be identified for both mother and baby. The PMMRC followed the guidelines in *Ethnicity Data Protocols for the New Zealand Health and Disability Sector* (Ministry of Health 2004) for prioritising ethnicity for the 2006 and 2007 reports. These prioritised ethnicity into the following hierarchy: Māori, Pacific peoples, Indian, Other Asian, Other (including Other European and Not Stated) and New Zealand European. Indian has been identified as a separate ethnicity from Other Asian because New Zealand data suggest that pregnancies of Indian women are at higher risk than those of Other Asian women.

In 2008–2010, sole/combination and prioritised ethnicity outputs were presented in this report. In 2011–2012, ethnicity has been reported as prioritised ethnicity (as outlined in *Ethnicity Data Protocols for the Health and Disability Sector* (Ministry of Health 2004), and as reported in the 2006–2008 PMMRC reports). This method is frequently used in health statistics in New Zealand. Where multiple ethnic groups are recorded for an individual the process prioritises minority ethnic groups that might otherwise be swamped by New Zealand European. In doing so, it does not allow individuals to identify a group with which they most feel affinity. It is a simple system that results in relatively few groups for analysis and, when used across different datasets, ensures a standardised process is used.

In 2012, mothers' ethnicity for the PMMRC dataset of perinatal related deaths has been extracted, in order of priority, from BDM registration of birth (74 percent) or PMMRC rapid response forms (26 percent). Babies' ethnicity for the PMMRC dataset of perinatal deaths has been extracted, in order of priority, from BDM registration of birth (74 percent), BDM registration of death (5 percent) or PMMRC rapid response forms (21 percent).

In 2012, the denominator birth registration dataset included two ethnicities for 24.6 percent of all babies registered compared with two ethnicities for 13.9 percent of mothers registered. The dataset included three ethnicities for 6.0 percent of babies and three ethnicities for 1.4 percent of mothers. This difference in the number of ethnicities a mother reports for herself compared with the number of ethnicities she gives for her baby means mortality rates may be different depending on whether the mother's or the baby's ethnicity is used in analyses.

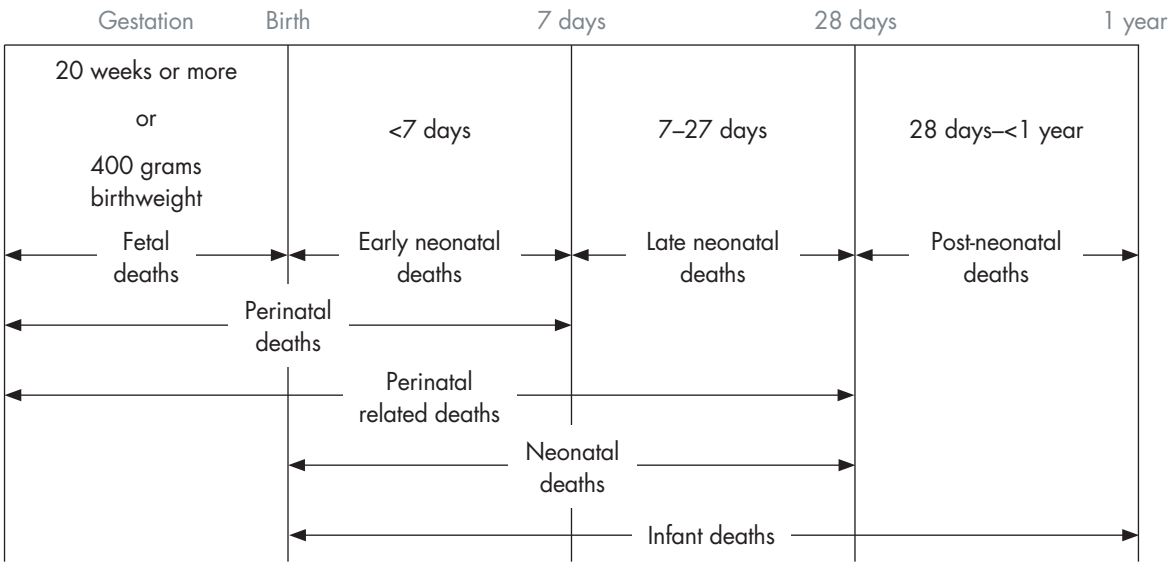
Mother and baby ethnicity specific perinatal related mortality rates have again been reported. Maternal ethnicity specific mortality rates are presented in the body of the report, and baby ethnicity specific perinatal related mortality rates are given in Appendix A.

Smoking

A comparison, among the deaths matched to the MAT dataset, of smoking variables at registration and at two weeks postnatal in the MAT dataset with the smoking variable in the PMMRC perinatal deaths dataset, which asks about smoking at the start, throughout and at the time of the baby's death, suggests that there is an underestimation of smoking rates in the MAT dataset. Therefore, a derived variable has been used in analyses including MAT data, defining smoker as smoking at registration or at two weeks postnatal.

Perinatal and infant mortality

Figure 1.2: Definitions of perinatal and infant mortality



Adapted from NZHIS (2007) and Ministry of Health (2010).

Fetal death

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. Note that the term 'stillbirth' does not include terminations in this report. Where a termination of pregnancy died after birth, the pregnancy is included as a termination of pregnancy and therefore as a fetal death rather than as a neonatal death.

Termination of pregnancy

Termination of pregnancy is the interruption of an ongoing pregnancy.

Fetal death rate

Fetal death rate is calculated as fetal deaths per 1000 babies born at 20 weeks gestation or beyond or weighing at least 400g if gestation is unknown.

Neonatal death

Neonatal death is the death of any baby showing signs of life at 20 weeks gestation or beyond (for the purposes of this PMMRC dataset) or weighing at least 400g if gestation is unknown. Early neonatal death is a death that occurs up until midnight of 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.

Neonatal death rate

Neonatal death rate is calculated as neonatal deaths per 1000 live born babies at 20 weeks gestation or beyond or weighing at least 400g if gestation is unknown.

Perinatal mortality rate

Perinatal mortality rate is calculated in New Zealand as fetal deaths and early neonatal deaths per 1000 total babies born alive or born dead at 20 weeks gestation or beyond, or weighing at least 400g if gestation is unknown.

In some places, this report refers to a United Kingdom (UK) definition of perinatal mortality, which was developed for the surveillance of perinatal deaths in the UK and is based on the UK legal definition of stillbirths, which excludes fetal deaths before 24 weeks gestation (CMACE 2011a).

Perinatal related mortality rate

Perinatal related mortality rate refers to fetal deaths and early and late neonatal deaths per 1000 total babies born at 20 weeks gestation or beyond or weighing at least 400g if gestation is unknown.

International (World Health Organization) perinatal mortality rates

International (World Health Organization (WHO)) perinatal mortality rates have been included in the report this year as recommended by the WHO (WHO 2006a) to facilitate international comparison. These are rates of fetal death, neonatal death, perinatal mortality and perinatal related mortality of babies weighing ≥1000g, or ≥28 weeks if birthweight is unknown per 1000 total births of babies ≥1000g, or ≥28 weeks if birthweight is unknown. Babies without birthweight or gestation are to be included if they have been registered.

Lethal and terminated fetal abnormalities

Lethal and terminated fetal abnormalities are all perinatal related deaths classified by the PSANZ perinatal death classification system as PSANZ-PDC 1 (congenital abnormality) and neonatal deaths classified by the PSANZ neonatal death classification system as PSANZ-NDC 1 (congenital abnormality).

Intrapartum stillbirth rate

Intrapartum stillbirth rate calculates deaths of babies of at least 24 weeks gestation without congenital abnormality who entered labour alive but then died during labour as a rate per 1000 births 24 weeks and beyond without lethal congenital abnormality.

Customised birthweight centiles

Customised birthweight centiles adjust newborn size for maternal weight, height, ethnicity and parity, as well as for infant sex and gestation at birth. For fetal deaths, the gestation at the time of estimated death (not birth) is used to calculate the birthweight centile. If gestation at death is unknown or gestation at death is <20 weeks or is seven days or more prior to birth, then customised centile is not calculated.

New Zealand Index of Deprivation 2006 (NZDep2006)

The New Zealand Index of Deprivation 2006 (NZDep2006) is an area-based measure of socioeconomic deprivation based on variables from the Census of Population and Dwellings 2006 in New Zealand. The score is assigned according to maternal place of residence and is presented as a decile or quintile. Increasing deciles of deprivation, from least deprived at decile 1 to most deprived at decile 10, are associated with higher mortality and rates of many diseases (Salmond and Crampton 2002a, 2002b). Meshblock unit-level data are used throughout this report. Generally, data are presented as quintiles rather than deciles so that individual categories are large enough for analysis.

Lead maternity carer (LMC)

Lead maternity carer (LMC) is defined as the practitioner or caregiver service selected by the mother as the service that will have the legal, professional and practical responsibility for ensuring both she and her baby receive clinically appropriate care up to and following birth.

Registration with a lead maternity carer (LMC)

Registration with a lead maternity carer (LMC) is the process by which a woman selects her LMC and occurs at the time of the first antenatal visit. Registration (previously known as booking) occurs when a woman chooses her LMC. From the time of registration, the LMC is responsible for the woman's maternity care. Date of registration is synonymous with the start of antenatal care.

Neonatal encephalopathy

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

Contributory factors

Contributory factors were defined as modifiable components of the health system and issues of quality of care that cover a broad spectrum of organisation and/or management, personnel and access and/or engagement with care factors.

Potentially avoidable death

Potentially avoidable death is when the absence of a contributory factor may have prevented the death.

Place of birth

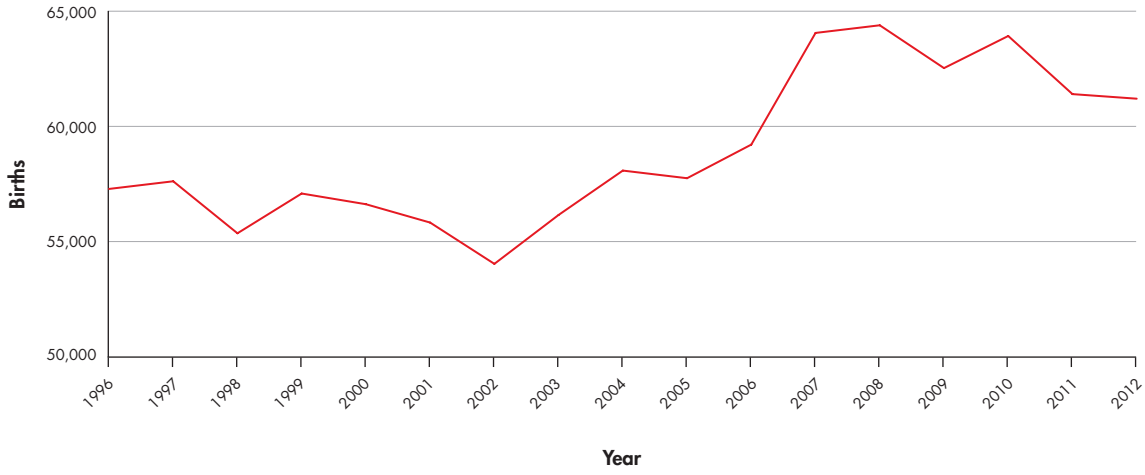
Place of birth is defined as:

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

1.3 Births in New Zealand

New Zealand birth registrations 2012

Figure 1.3: Total live birth registrations in New Zealand 1996–2012

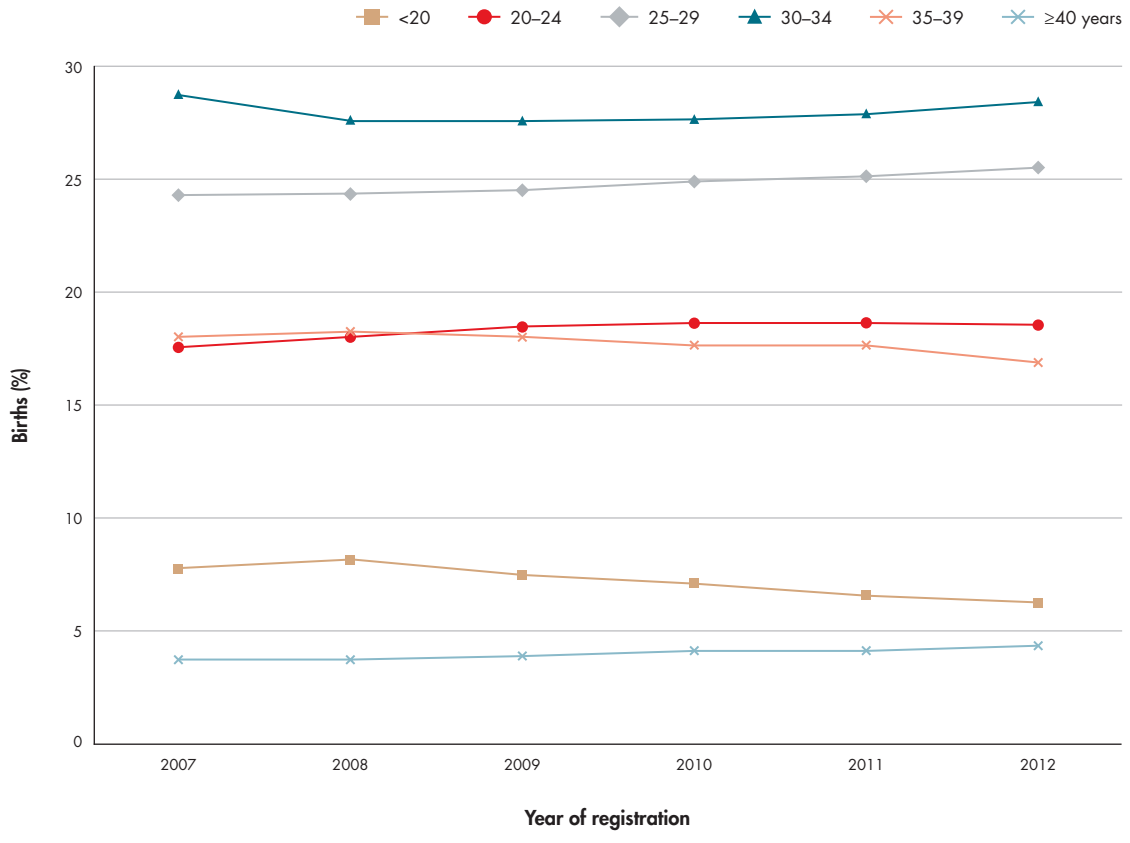


Amended from Statistics New Zealand.

There has been a decline in total births in New Zealand in the years 2011 and 2012 from the record high levels in 2007–2010.

Maternal age

Figure 1.4: Trends in maternal age among birth registrations in New Zealand 2007–2012



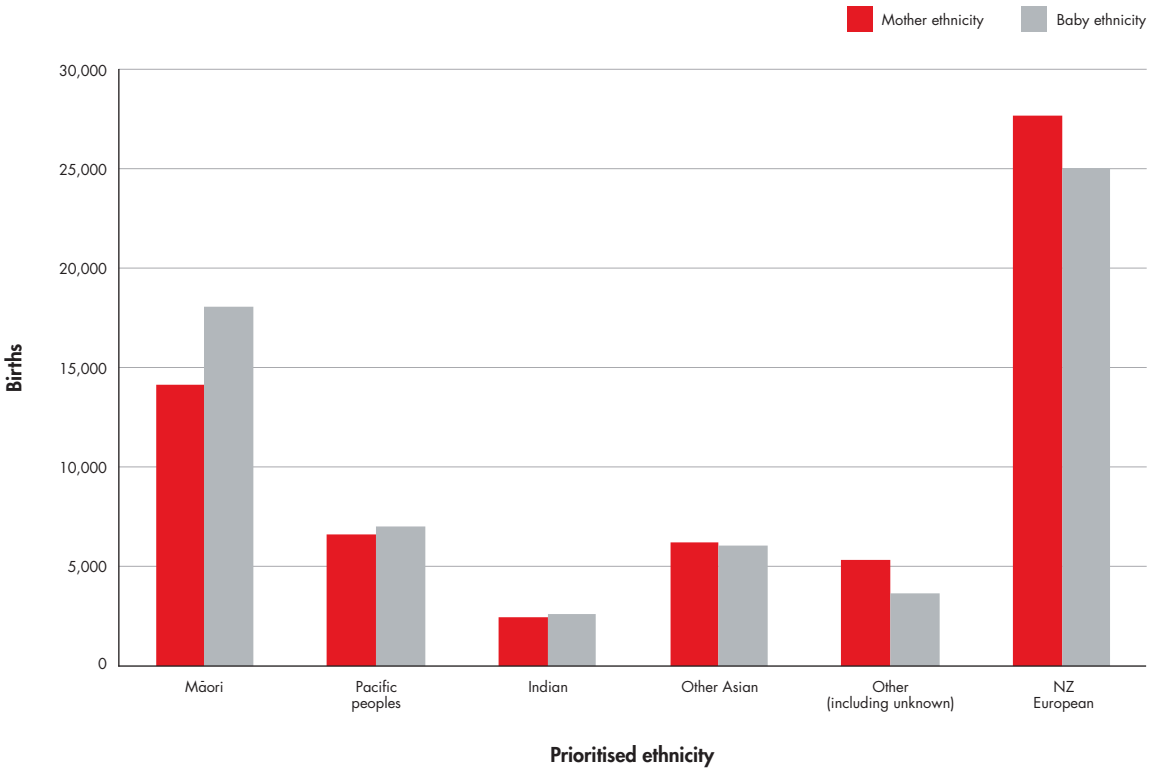
The mean age of mothers in New Zealand in 2012 was 29.2 years, and this has changed little since 2007, when it was 29.15. The greatest number of births in New Zealand occurred among mothers in the five-year age band of 30–34 years (28.4 percent). In 2012 in New Zealand, 6.3 percent of births were to teenage mothers and 4.3 percent to women 40 years or older. Figure 1.4 demonstrates the changes in distribution of maternal age in New Zealand from 2007 to 2012. Although there has been minimal change in the mean age of mothers in New Zealand, there have been significant changes in some age categories; for example, the proportion of teen mothers has decreased from 7.76 percent in 2007 to 6.27 percent in 2012.

Ethnicity

The process for collection of ethnicity data is outlined in section 1.2.

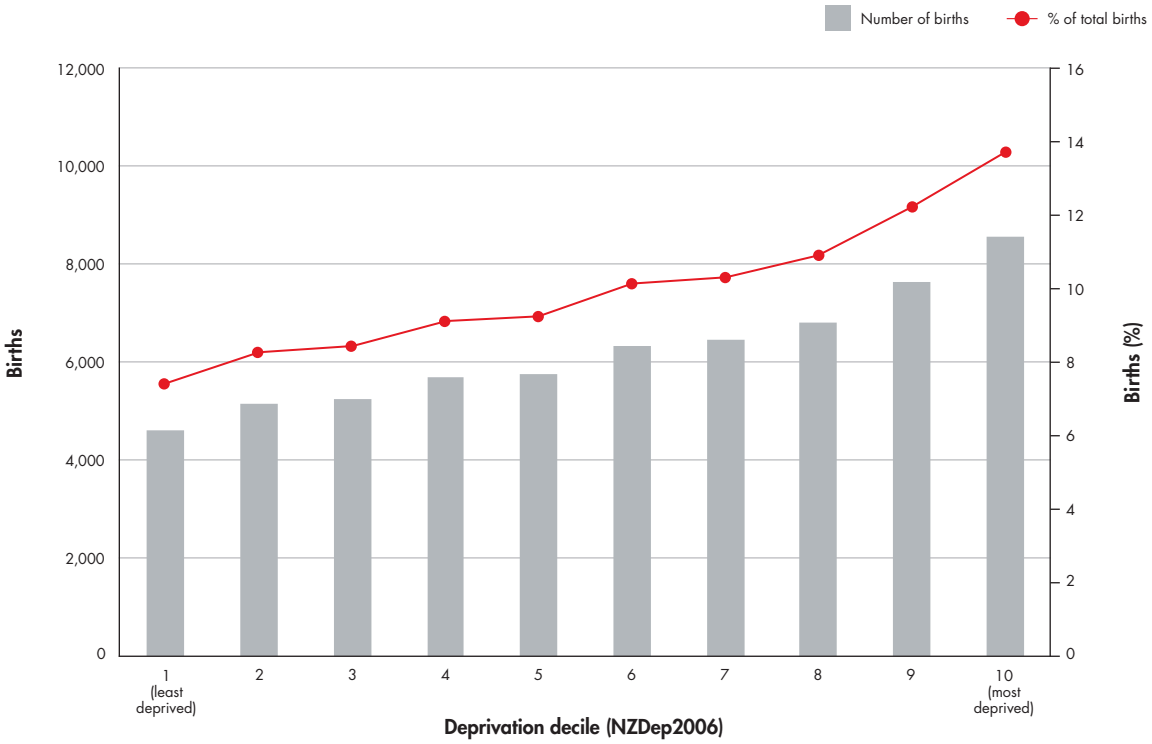
Prioritised ethnicity assigns only one ethnicity per person, prioritising responses according to the following hierarchy: Māori, Pacific peoples, Indian, Other Asian, Other (including other European and missing responses) and New Zealand European. Using prioritised ethnicity output, 44.3 percent of mothers identified as New Zealand European, 22.7 percent as Māori, 10.6 percent as Pacific peoples, 3.9 percent as Indian, 9.9 percent as Other Asian and 8.5 percent as Other ethnicities. The distribution of prioritised ethnicity among mothers and babies in the 2012 birth registration dataset is shown in Figure 1.5, with further information provided in Table 1.8 and Table A8.

Figure 1.5: Distribution of prioritised ethnicity (mother and baby) among births in New Zealand 2012 (total births = 62,425)



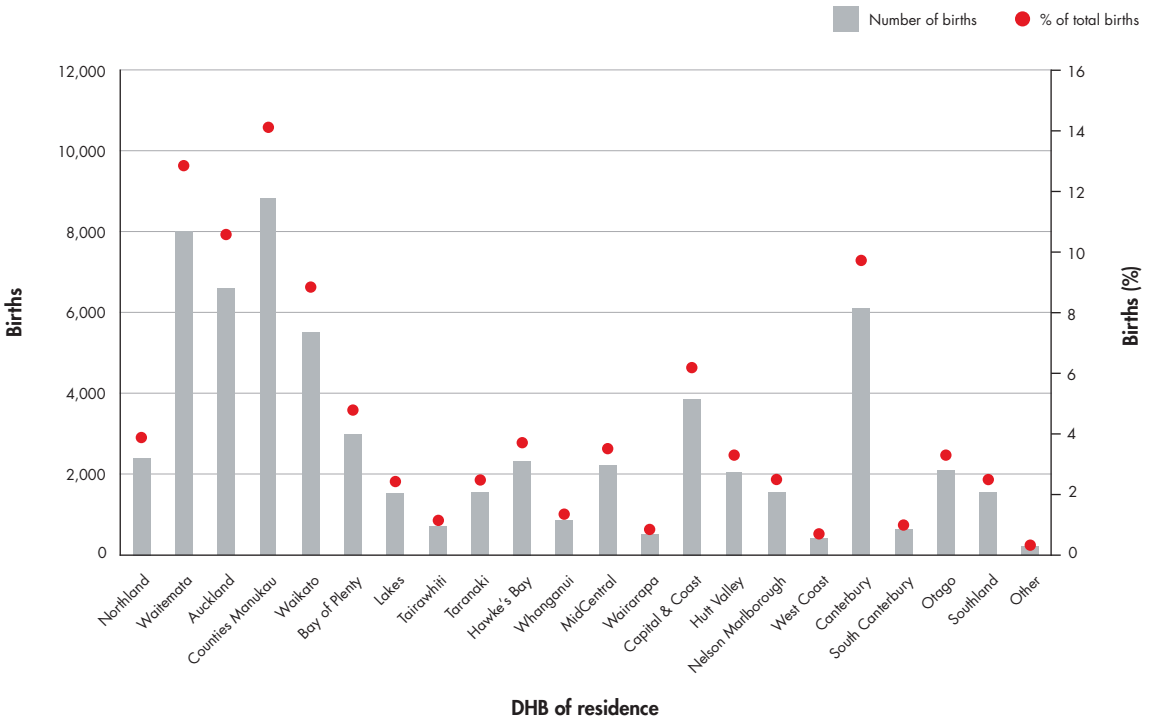
Socioeconomic deprivation and DHB of residence

Figure 1.6: Distribution of deprivation deciles (NZDep2006) among birth registrations in 2012 (total births excluding unknown = 62,213)



Families living in the most deprived areas (decile 10) had the most births (13.7 percent). Proportionately more babies are born in the higher deciles (6–10) compared to lower deciles (1–5).

Figure 1.7: Distribution of births by DHB of maternal residence among birth registrations in 2012 (total births = 62,425)



Associations between demographic variables

Socioeconomic deprivation and DHB of residence

Figure 1.8: Distribution of deprivation quintiles (NZDep2006) by maternal ethnicity (prioritised) among births registered in 2012 (total births = 62,425)

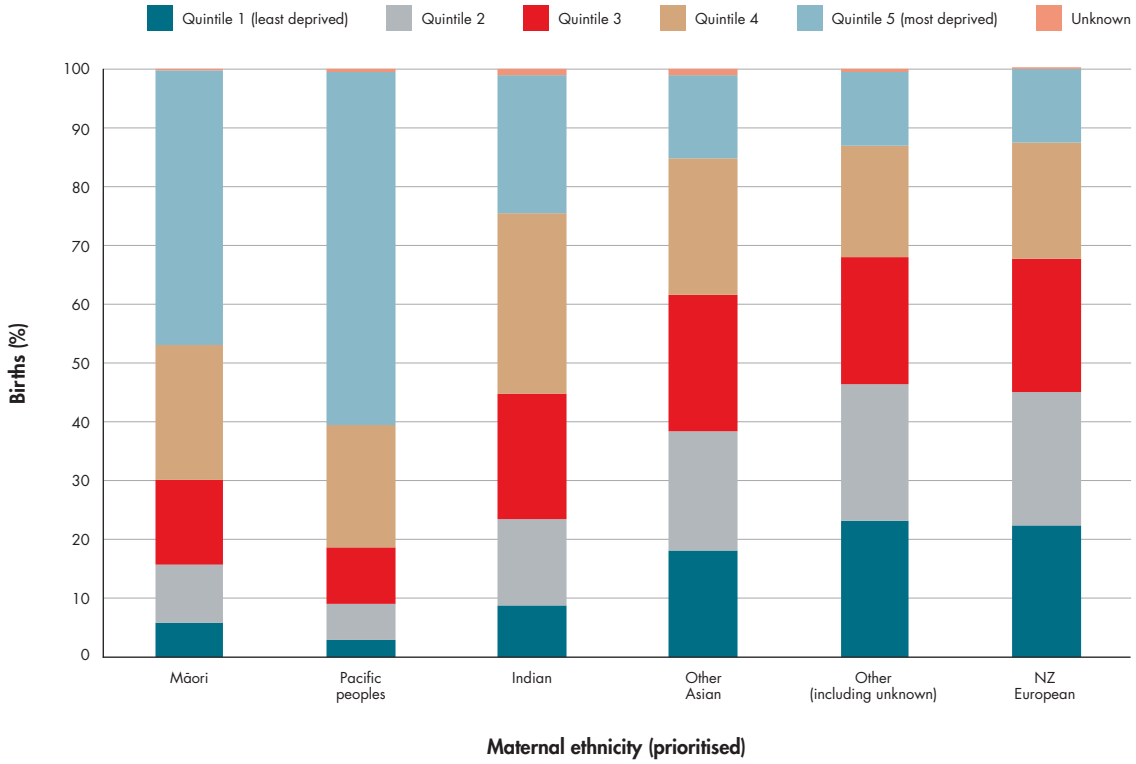
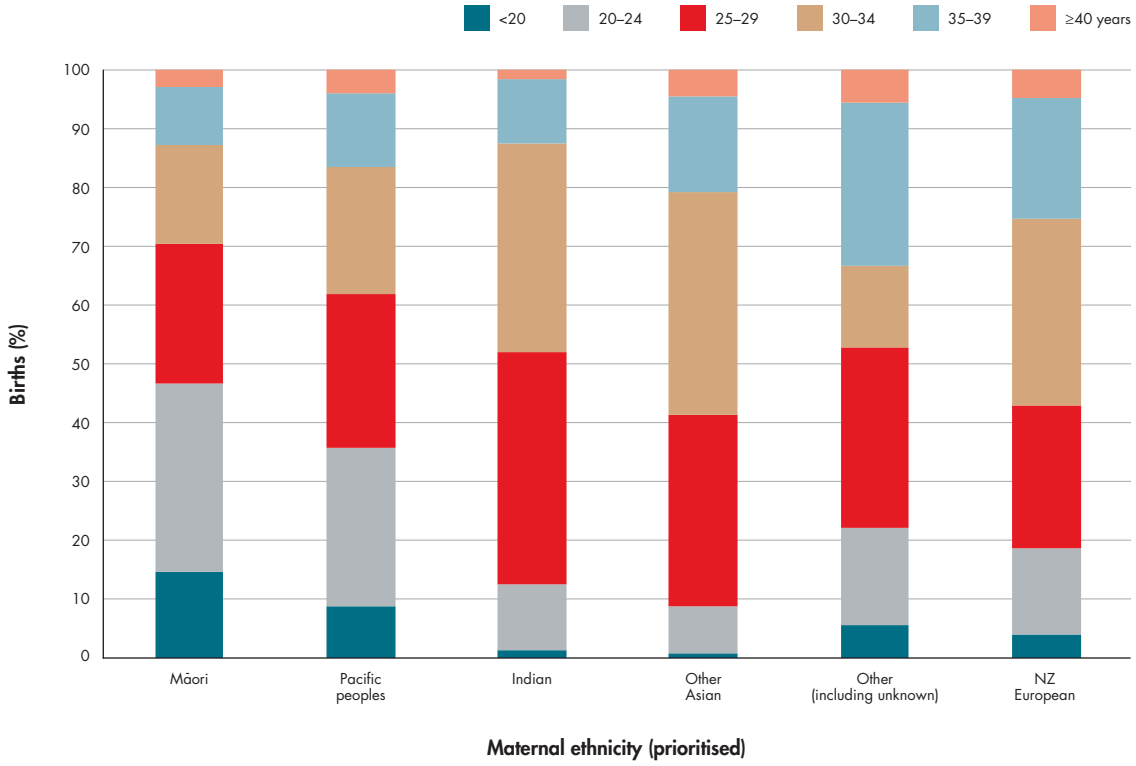


Figure 1.8 shows the distribution of deprivation quintiles within maternal ethnic groups. There is an unequal distribution of deprivation (NZDep2006) by ethnicity. There is no difference in distribution between New Zealand European and Other, but all other ethnicities differ significantly from each other. Pacific mothers are living in significantly more deprived (NZDep2006 deciles 9–10) areas than any other ethnic group. Māori live in more deprived areas than all groups other than Pacific peoples. Indian mothers live in more deprived areas than Other Asian, Other and New Zealand European mothers. Other Asian mothers live in more deprived areas than New Zealand European and Other ethnicities.

Age and ethnicity

Figure 1.9: Distribution of maternal age by maternal ethnicity (prioritised) among birth registrations in 2012 (total births = 62,425)

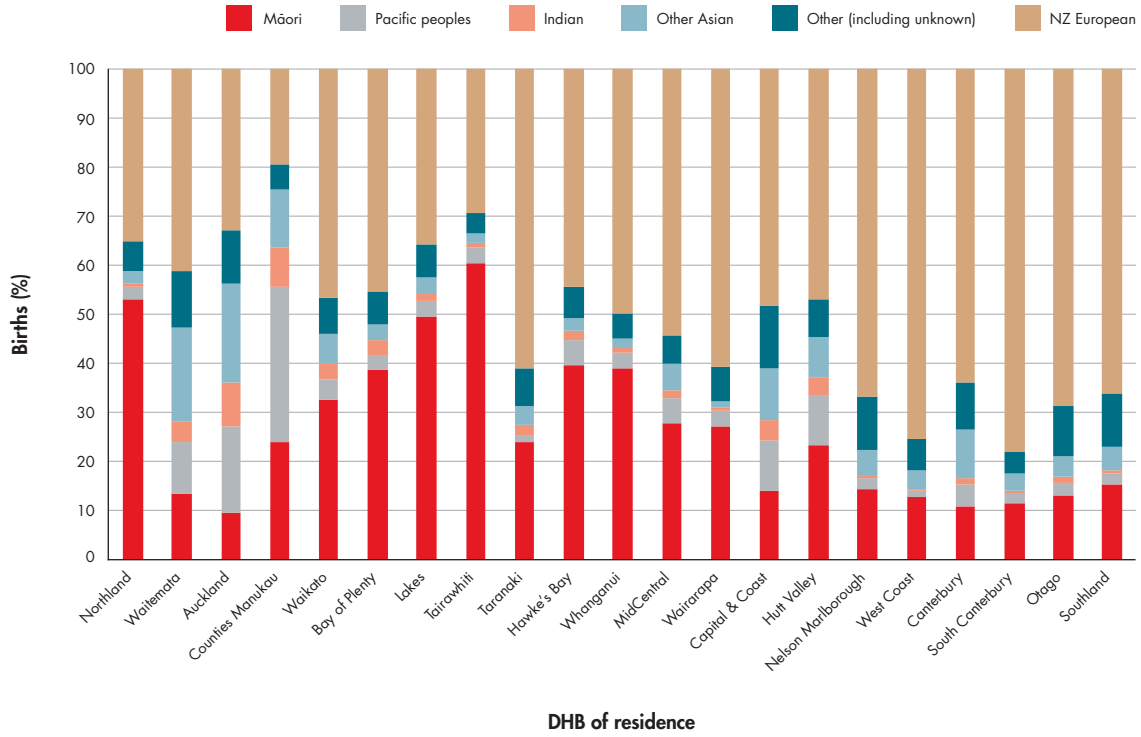


Mothers who identify themselves as Māori had the youngest age distribution. That is, a higher proportion of Māori mothers were in the younger age groups. The differences in maternal age distribution by ethnicity may reflect both differences in the age distribution of the underlying population as well as differences in maternal age at birth by ethnicity.

DHB of residence, ethnicity and socioeconomic deprivation

DHB and ethnicity

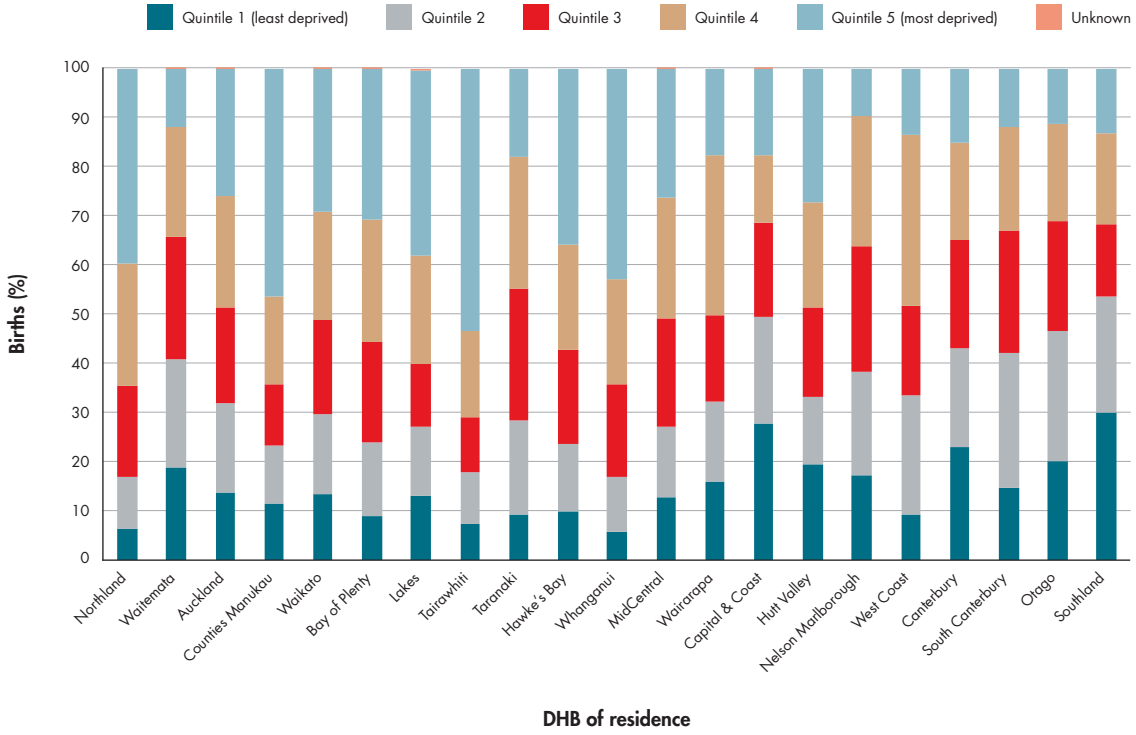
Figure 1.10: Distribution of maternal ethnicity (prioritised) by DHB of maternal residence, among birth registrations in 2012 (total births excluding unknown DHB = 62,230)



There is wide variation in distribution of maternal ethnicity across the different regions in New Zealand. In the South Island (the six DHBs on the right of the figure), the proportion of New Zealand European mothers giving birth is higher than in the North Island. Northland, Lakes and Tairawhiti have the highest proportions of births to Māori mothers of any region, and Auckland and Counties Manukau have the highest proportion of births to Pacific mothers. Counties Manukau has the lowest proportion of New Zealand European mothers of any DHB in the country.

DHB and socioeconomic deprivation

Figure 1.11: Distribution of deprivation quintile (NZ Dep2006) by DHB of maternal residence, among birth registrations in 2012 (total births excluding unknown DHB = 62,230)



The distribution of births by New Zealand deprivation index quintile (NZDep2006) is also not uniform across the country, with the greatest number of births in the highest deprivation quintile areas occurring in the Tairawhiti and Counties Manukau regions. This is consistent with population distribution of deprivation decile areas in New Zealand.

1.4 Perinatal Mortality 2012

Perinatal mortality rates

Table 1.1: Summary of New Zealand perinatal mortality rates 2012

	Using NZ definition		Using UK definition*	
	n	Rate	n	Rate
Total births	62,425		62,248	
Fetal deaths (terminations of pregnancy and stillbirths)#	491	7.9	282	4.5
Terminations of pregnancy	171	2.7	60	1.0
Stillbirths	320	5.1	222	3.6
Early neonatal deaths <7 days	142		142	
Late neonatal deaths 7–27 days	36		36	
Neonatal deaths <28 days+	178	2.9	178	2.9
Perinatal mortalities^	633	10.1	424	6.8
Perinatal related mortalities•	669	10.7	460	7.4
Perinatal mortalities excluding lethal and terminated fetal abnormalities~	444	7.1	326	5.2
Perinatal related mortalities excluding lethal and terminated fetal abnormalities~	466	7.5	348	5.6

* Rates calculated using UK definition for perinatal mortality: babies stillborn after 24 weeks gestation and deaths of live born babies per 1000 live births and stillbirths (CMACE 2011a).
\# Fetal death rate per 1000 babies born (includes terminations and stillbirths).
\+ Neonatal death rate per 1000 live born babies.
^ Fetal deaths and early neonatal deaths per 1000 babies born.
• Fetal deaths and early and late neonatal deaths per 1000 babies born.
~ Lethal and terminated fetal abnormalities are all perinatal related deaths with PSANZ-PDC of congenital abnormality and neonatal deaths with PSANZ-NDC of congenital abnormality.

The PMMRC perinatal related mortality rates are calculated from numerator data provided by LMCs, clinicians and DHB local coordinators, reviewed by local perinatal mortality review committees and collated centrally by a national coordinator, and denominator data from the registration of all births in New Zealand in a year. This differs from the methodology used by the Ministry of Health in its reports and so the rates presented in this report may differ slightly from those reported in Ministry documents. The PMMRC considers that this report presents as complete a set of perinatal related deaths as can currently be achieved for the 2012 year in New Zealand.

Table 1.2: Summary of New Zealand perinatal mortality rates 2007–2012

	2007		2008		2009		2010		2011		2012	
	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate
Total births	65,602		65,872		63,665		65,124		62,604		62,425	
Fetal deaths (terminations of pregnancy and stillbirths)*	511	7.8	524	8.0	543	8.5	494	7.6	501	8.0	491	7.9
Terminations of pregnancy	143	2.2	145	2.2	137	2.2	151	2.3	171	2.7	171	2.7
Stillbirths	368	5.6	379	5.8	406	6.4	343	5.3	330	5.3	320	5.1
Early neonatal deaths <7 days	134		133		136		165		139		142	
Late neonatal deaths 7–27 days	33		43		46		45		25		36	
Neonatal deaths <28 days#	167	2.6	176	2.7	182	2.9	210	3.2	164	2.6	178	2.9
Perinatal mortalities+	645	9.8	657	10.0	679	10.7	659	10.1	640	10.2	633	10.1
Perinatal related mortalities^	678	10.3	700	10.6	725	11.4	704	10.8	665	10.6	669	10.7
Perinatal mortalities (excluding lethal and terminated fetal abnormalities)•	460	7.0	488	7.4	511	8.0	462	7.1	445	7.1	444	7.1
Perinatal related mortalities (excluding lethal and terminated fetal abnormalities)•	479	7.3	516	7.8	542	8.5	493	7.6	461	7.4	466	7.5

* Fetal death rate per 1000 babies born (includes terminations and stillbirths).
\# Neonatal death rate per 1000 live born babies.
\+ Fetal deaths and early neonatal deaths per 1000 babies born.
^ Fetal deaths and early and late neonatal deaths per 1000 babies born.
• Lethal and terminated fetal abnormalities are all perinatal related deaths with PSANZ-PDC of congenital abnormality and neonatal deaths with PSANZ-NDC of congenital abnormality.

The perinatal related mortality rate, which includes late terminations of pregnancy, stillbirths and early and late neonatal deaths, from 20 weeks gestation to 27 days of life, in New Zealand in 2012, was 10.7 per 1000 total births. This is unchanged across the years 2007–2012 (Figure 1.12 and Table 1.2) since the PMMRC began targeted ascertainment of all perinatal related deaths.

However, over this time, there has been a significant fall in the stillbirth rate (score test for linear trend p=0.047), and a significant rise in the late termination of pregnancy rate (score test for linear trend p=0.005).

Figure 1.12: Perinatal related mortality rates using New Zealand definitions (per 1000 births) 2007–2012

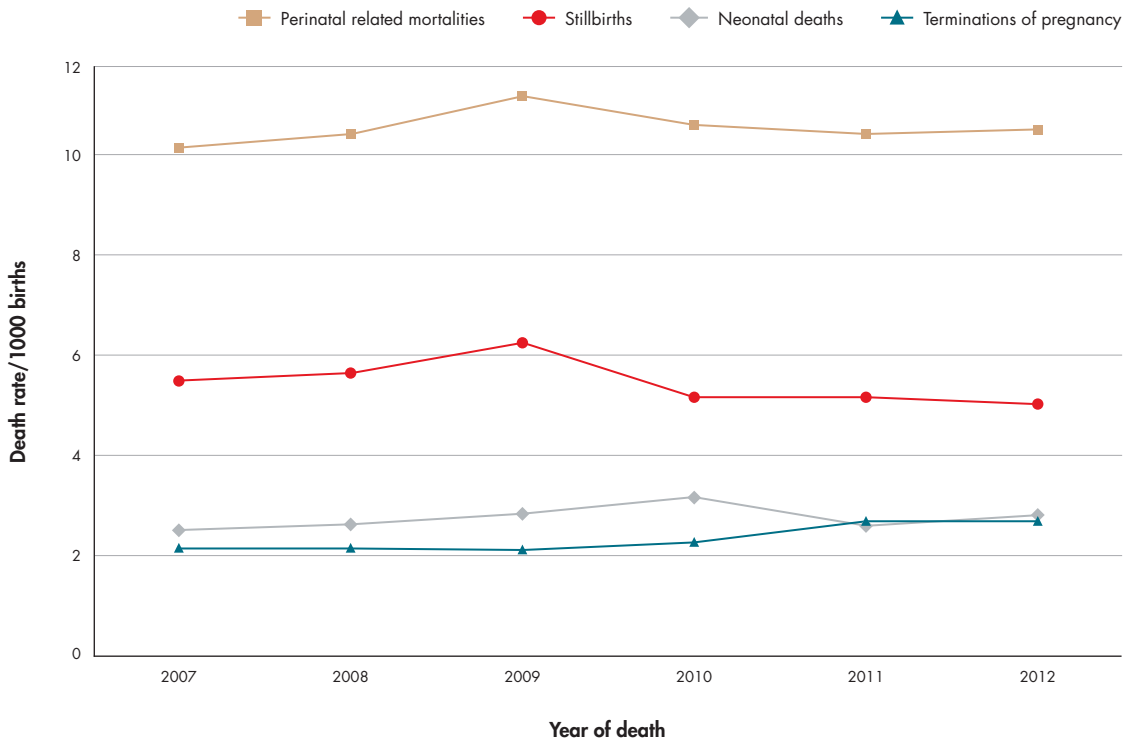
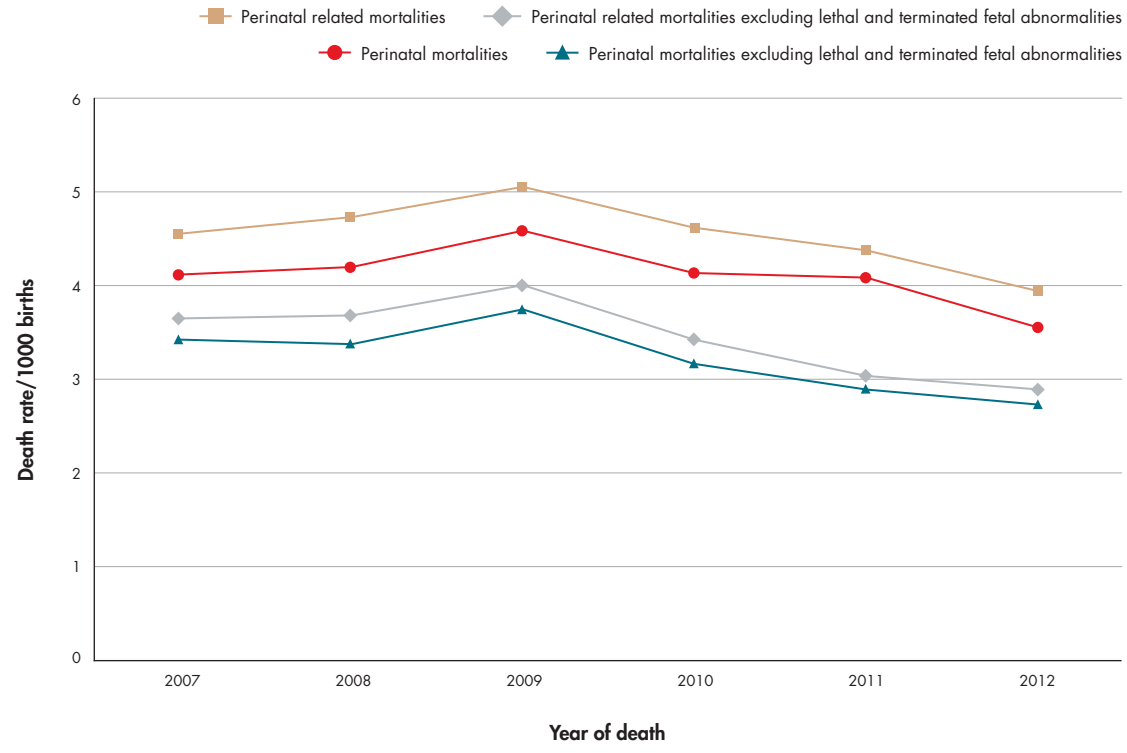


Figure 1.13: Perinatal mortality rates using international definitions 2007–2012



'Perinatal related mortality' includes late neonatal deaths (7–27 days) while 'perinatal mortality' excludes late neonatal deaths.

There is a significant reduction in perinatal related mortality (chi-squared for linear trend p=0.047 overall and p=0.0015 if congenital abnormality deaths are excluded) using the international definition, recommended by the WHO, of perinatal related deaths from 1000g or 28 weeks if birthweight is unknown (see 'Methodology' section 1.2) (Figure 1.13).

There is a significant reduction in perinatal related mortality using the international definition, recommended by the WHO, of perinatal related deaths from 1000g or 28 weeks if birthweight is unknown.

There is a difference in trends using the New Zealand and international rate definitions (Figure 1.12 and Figure 1.13) because the significant decrease in stillbirth rate is reflected in the international rate while the significant increase in terminations is not apparent in the international rate as these are almost always at 20–23 weeks and the international rate excludes births below 1000g or 28 weeks (Figure 1.14).

Figure 1.14: Burden of perinatal related deaths by gestation at birth and type of death 2007–2012

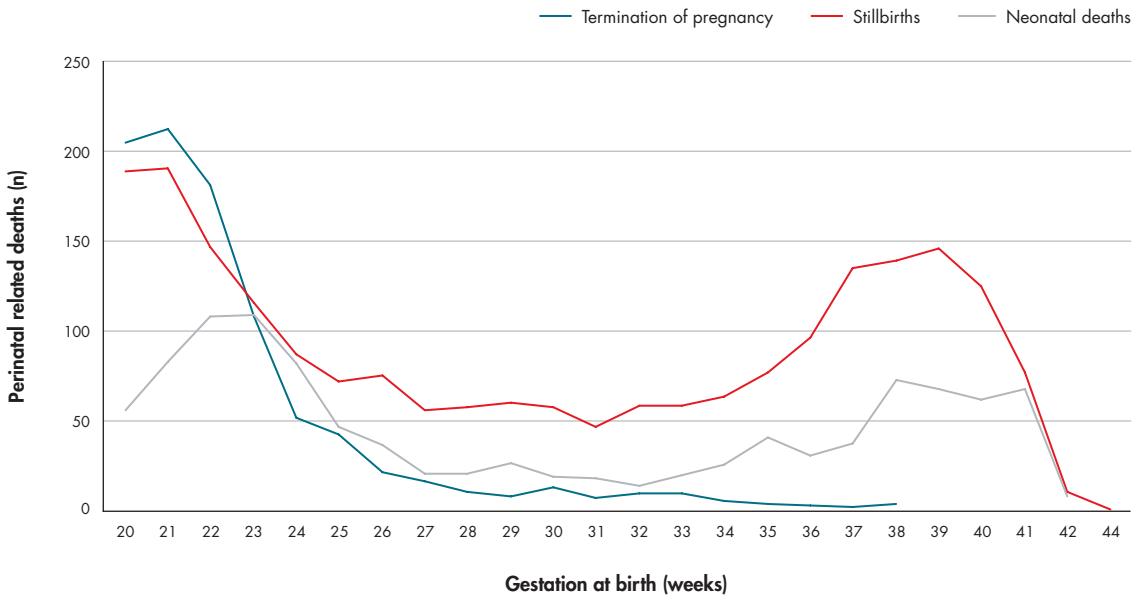


Table 1.3: Perinatal death classification (PSANZ-PDC) specific perinatal related mortality rate using international definition (≥1000g or ≥28 weeks if birthweight unknown) 2007–2012

Year of death	2007		2008		2009		2010		2011		2012		Chi-squared test for trend (p)
Total births (international definition)	n=65,050		n=65,303		n=63,153		n=64,574		n=62,078		n=61,892		
	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	
Perinatal death classification (PSANZ-PDC)													
Congenital abnormality	58	0.89	69	1.06	64	1.01	77	1.19	84	1.35	64	1.03	0.10
Perinatal infection	15	0.23	15	0.23	14	0.22	12	0.19	11	0.18	9	0.15	0.19
Hypertension	7	0.11	7	0.11	13	0.21	11	0.17	9	0.14	3	0.05	0.59
Antepartum haemorrhage	22	0.34	25	0.38	24	0.38	23	0.36	17	0.27	13	0.21	0.10
Maternal conditions	14	0.22	9	0.14	19	0.30	19	0.29	7	0.11	17	0.27	0.65
Specific perinatal conditions	29	0.45	23	0.35	32	0.51	30	0.46	32	0.52	21	0.34	0.92
Hypoxic peripartum death	32	0.49	34	0.52	28	0.44	20	0.31	20	0.32	19	0.31	0.013
Fetal growth restriction	28	0.43	32	0.49	31	0.49	31	0.48	18	0.29	32	0.52	0.80
Spontaneous preterm	9	0.14	7	0.11	10	0.16	19	0.29	8	0.13	10	0.16	0.44
Unexplained antepartum death	71	1.09	74	1.13	76	1.20	46	0.71	62	1.00	47	0.76	0.014
No obstetric antecedent	11	0.17	14	0.21	7	0.11	10	0.15	4	0.06	9	0.15	0.18

Red indicates statistically significant trend.

Table 1.3 shows the numbers and rates of perinatal related deaths by PSANZ-PDC using the international definition of perinatal death. While there appears to have been a reduction in deaths from perinatal infection, antepartum haemorrhage, hypoxic peripartum death and in unexplained stillbirths, only the latter two are statistically significant downward trends ($p<0.05$) in this subgroup of perinatal deaths.

International comparisons

It can be difficult to make international comparisons of mortality data due to differences in definitions and in differences in method of data collection. The WHO definition is recommended to facilitate international comparison (WHO 2006a). The WHO definition reports weight-specific rates for deaths and births of at least 1000g or 28 weeks if birthweight is unknown (including babies where neither is known but the death or birth is recorded). The exclusion of births below 1000g/28 weeks means most babies who die from spontaneous preterm birth are excluded (in the internationally published rates), along with late terminations of pregnancy.

The 2011 data from Ireland, Scotland, England and Wales have been separately published for each country.

Table 1.4: International comparisons of perinatal mortality rates (per 1000 births) using UK and Australasian definitions 2011–2012

	UK definition (≥24 weeks gestation)				Australasian definition (≥20 weeks gestation)			
	Perinatal mortality*	Perinatal mortality excluding abnormalities*	Fetal deaths*	Early neonatal deaths#	Perinatal mortality*	Perinatal mortality excluding abnormalities*	Fetal deaths*	Neonatal deaths#
	Rate (95% CI)	Rate (95% CI)	Rate (95% CI)	Rate (95% CI)	Rate (95% CI)	Rate (95% CI)	Rate (95% CI)	Rate (95% CI)
2011								
New Zealand	6.7 (6.1–7.4)	4.9 (4.4–5.5)	4.5 (3.9–5.0)	2.2 (1.9–2.6)	10.6 (9.8–11.5)	7.4 (6.7–8.1)	8.0 (7.3–8.7)	2.6 (2.3–3.1)
Australia+	na	na	na	na	9.8 (9.5–10.2)	na	7.3 (7.0–7.6)	2.6 (2.4–2.8)
England and Wales^	7.5 (7.3–7.7)	na	5.2 (5.1–5.4)	2.3 (2.2–2.4)	na	na	na	na
Ireland•	6.1 (5.6–6.7)	4.1 (3.6–4.5)	4.3 (3.8–4.8)	1.9 (1.5–2.2)	na	na	na	na
Scotland~	6.9 (6.3–7.6)	na	5.1 (4.5–5.7)	1.9 (1.5–2.2)	na	na	na	na
2012								
New Zealand	6.8 (6.2–7.5)	5.2 (4.7–5.8)	4.5 (4.0–5.1)	2.3 (1.9–2.7)	10.7 (9.9–11.6)	7.5 (6.8–8.2)	7.9 (7.2–8.6)	2.9 (2.5–3.3)
England and Wales^	7.0 (6.8–7.2)	na	4.9 (4.7–5.0)	2.2 (2.0–2.3)	na	na	na	na

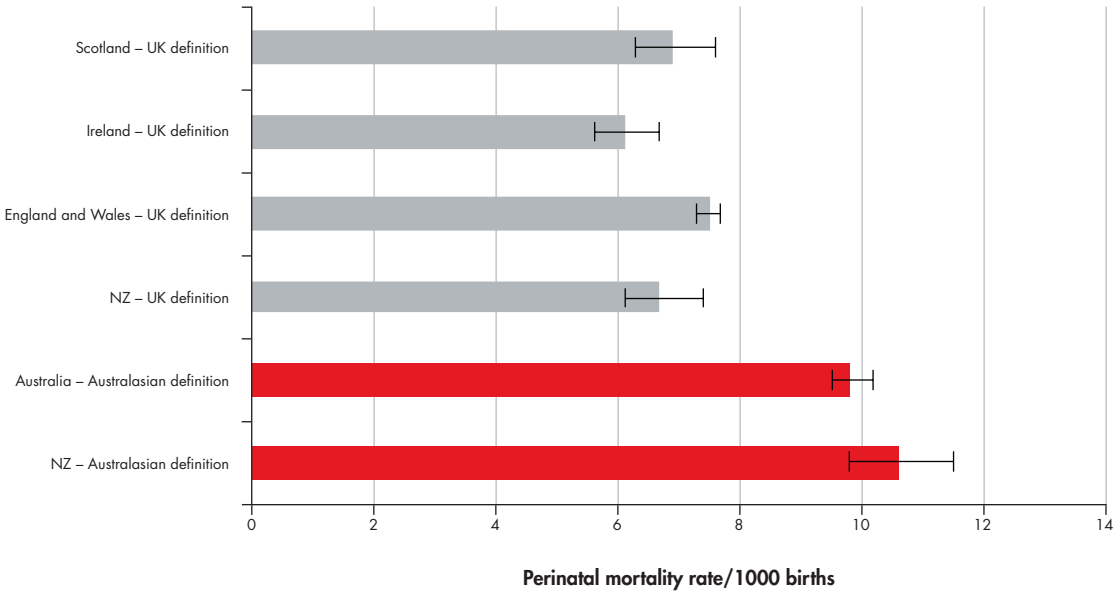
* per 1000 births.
\# per 1000 live births.
\+ (Li et al 2013)
^ (Office for National Statistics 2012)
• (Manning et al 2013)
~ (Healthcare Improvement Scotland 2013)
na = not available.

Table 1.4 includes the currently available perinatal mortality rates from the UK and Australia for 2011 and 2012.

Perinatal mortality rates, using the Australasian definition (of 20 weeks and over, including stillbirths and late neonatal deaths) and the UK definition (from 24 weeks and including stillbirths and only early neonatal deaths), are illustrated in Figure 1.15.

The confidence intervals (CIs) for the New Zealand perinatal mortality rate overlap the CIs of all UK countries using the UK definition and also overlap the CI of the Australian rate using the Australasian definition. This shows that in 2011, the New Zealand perinatal mortality rate did not differ from the perinatal mortality rate in the UK or in Australia, and the 2012 rate does not vary from the rate in England and Wales.

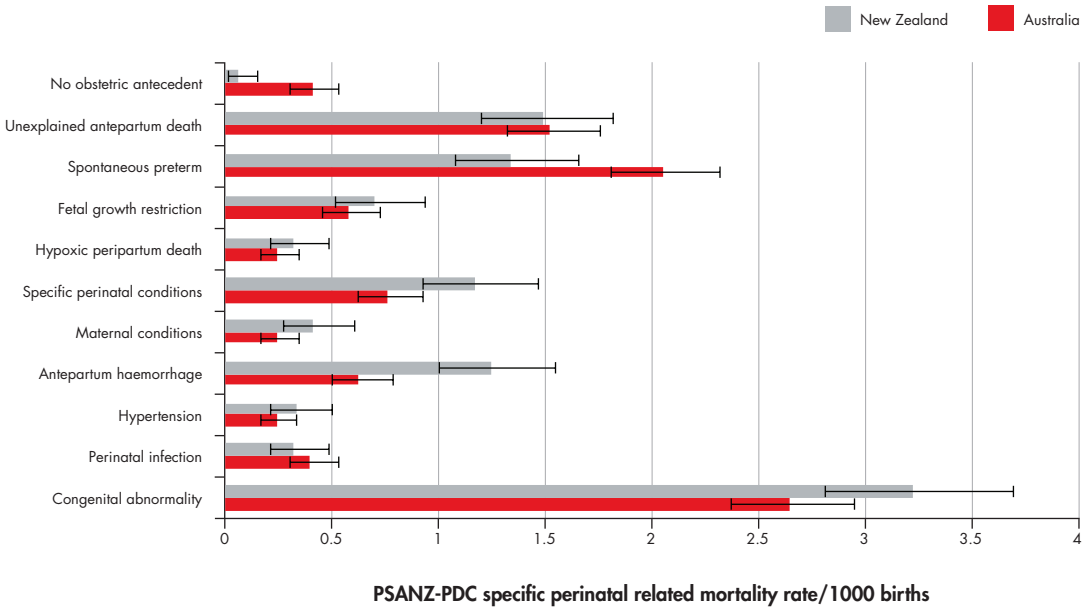
Figure 1.15: Perinatal mortality rate international comparisons using Australasian and UK definitions 2011 (with 95% CIs)



International comparison of cause of death

As both New Zealand and Australia use PSANZ-PDC as a classification system for perinatal deaths, and have the same definition for perinatal deaths, it is possible to make tentative comparisons, although not all Australian jurisdictions have reported PSANZ-PDC to date.

Figure 1.16: Comparison of PSANZ-PDC cause of death between New Zealand and Australia (four jurisdictions) 2011 (with 95% CIs)



In 2011, Queensland, Western Australia, South Australia and Tasmania provided PSANZ-PDC cause of death data. These are the most recent data available from Australia so comparable 2011 New Zealand data have been presented.

There are significant differences between the two countries in deaths with no obstetric antecedent, spontaneous preterm birth, antepartum haemorrhage and specific perinatal conditions. It is likely that the higher rate of spontaneous preterm birth in Australia is balanced by the higher rates of antepartum haemorrhage and (possibly) specific perinatal conditions in New Zealand and that these differences relate to application of the PSANZ-PDC system. PDC specific rates for all other PSANZ-PDC classifications are not statistically significantly different between New Zealand and Australia.

Causes of perinatal related death

Obstetric antecedent classification

Table 1.5: Perinatal related deaths by perinatal death classification (PSANZ-PDC) 2012

Perinatal death classification (PSANZ-PDC)	Fetal deaths				Neonatal deaths		Perinatal related deaths	
	Termination of pregnancy		Stillbirths					
	n=171		n=320		n=178		n=669	
	n	%	n	%	n	%	n	%
Congenital abnormality	128	74.9	35	10.9	38	21.3	201	30.0
Perinatal infection	3	1.8	9	2.8	7	3.9	19	2.8
Hypertension	5	2.9	8	2.5	5	2.8	18	2.7
Antepartum haemorrhage	7	4.1	31	9.7	22	12.4	60	9.0
Maternal conditions	10	5.8	19	5.9	7	3.9	36	5.4
Specific perinatal conditions	10	5.8	42	13.1	18	10.1	70	10.5
Hypoxic peripartum death	-	-	10	3.1	9	5.1	19	2.8
Fetal growth restriction	1	0.6	42	13.1	6	3.4	49	7.3
Spontaneous preterm	7	4.1	37	11.6	57	32.0	101	15.1
Unexplained antepartum death	-	-	87	27.2	-	-	87	13.0
No obstetric antecedent	-	-	-	-	9	5.1	9	1.3

Figure 1.17: Relative distribution of fetal and neonatal deaths by perinatal death classification (PSANZ-PDC) 2012

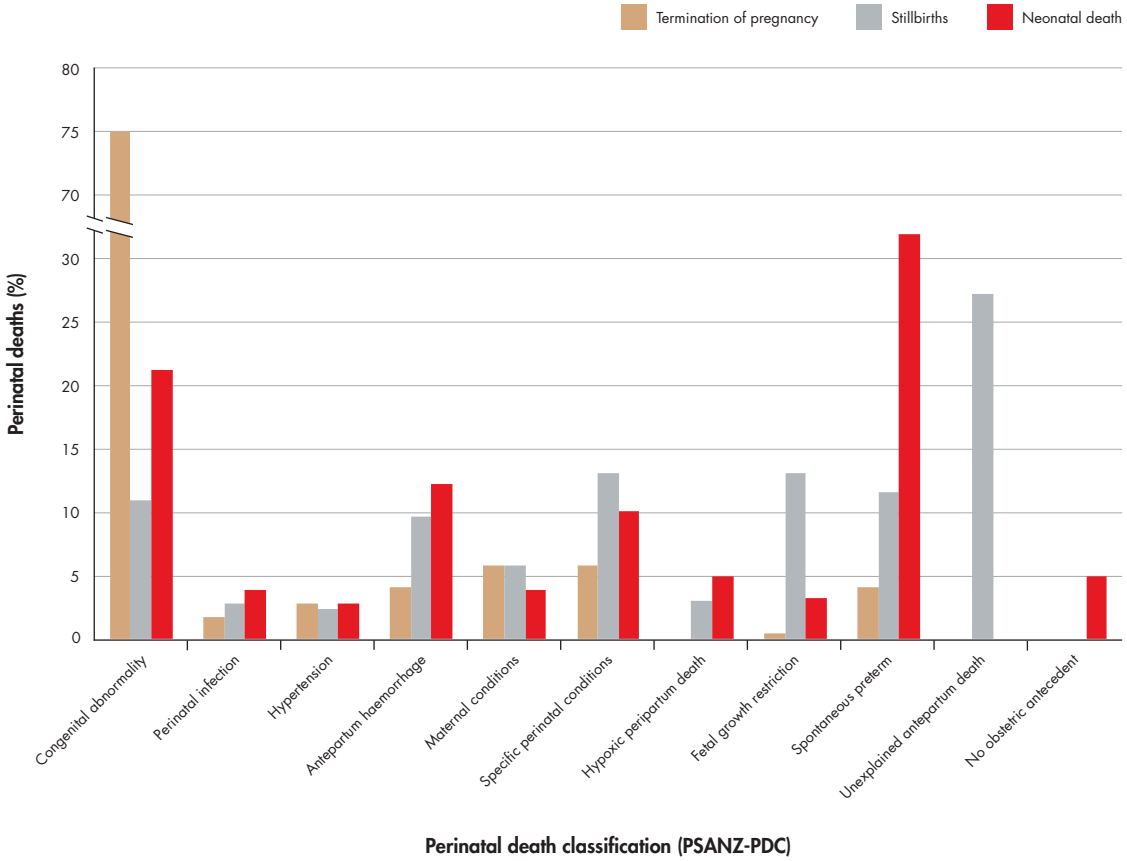


Figure 1.17 shows the distribution of cause of death (PSANZ-PDC) within late terminations of pregnancy, stillbirths and neonatal deaths for 2012. This figure demonstrates the predominance of congenital abnormalities among late terminations of pregnancy and the relative importance of unexplained stillbirth. Spontaneous preterm birth is the predominant cause of neonatal death.

Figure 1.18: Perinatal death classification (PSANZ-PDC) specific perinatal related death rates by year 2007–2012

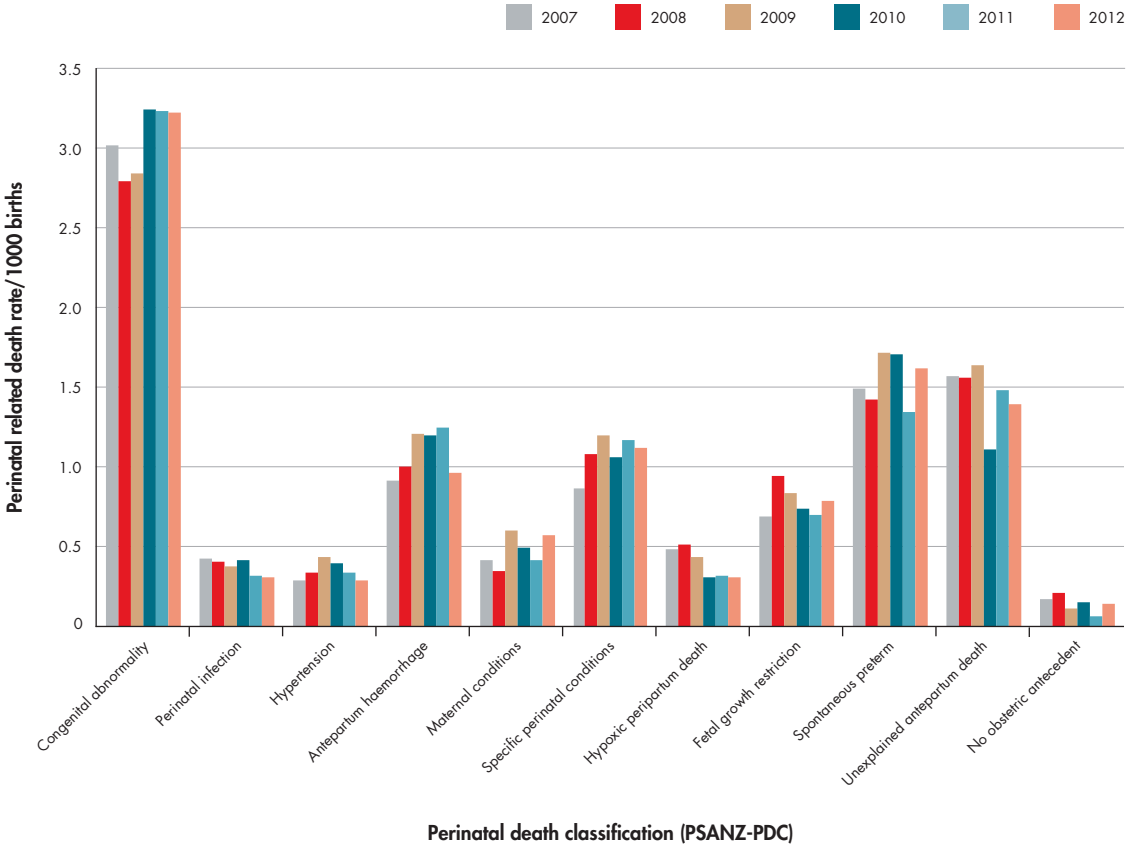


Figure 1.18 shows perinatal related death rates by cause of death (PSANZ-PDC) for 2007–2012. The only statistically significant change in perinatal related death rates overall, as tested by score test for linear trend, is in hypoxic peripartum death, which has reduced significantly from 2007 to 2012 (p=0.01). Any other apparent changes are not statistically significant overall, including an apparent increase in perinatal related death from congenital abnormality (p=0.14). However, as is apparent in latter parts of the report, whether there are statistically significant differences by PSANZ-PDC category differs in specific sub-groups; for example, in term unexplained stillbirth. This can be confusing, but is inherent in analysis of perinatal related deaths which include deaths from heterogeneous and often unknown causes.

Epidemiology and perinatal mortality

This section begins with the univariate analyses for the associations between demographic and clinical factors and perinatal death, followed by multivariate analysis of the factors independently associated with stillbirth and neonatal death.

Gender

Table 1.6: Perinatal related death rates (per 1000 births) by gender 2012

	Total births		Fetal deaths						Neonatal deaths			Total perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	n=62,425		n=171			n=320			n=178			n=669		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Gender														
Male	31,902	51.3	92	53.8	2.88	154	48.1	4.83	91	51.1	2.87	337	50.4	10.56
Female	30,523	48.7	78	45.6	2.56	156	48.8	5.11	85	47.8	2.81	319	47.7	10.45
Unknown	-	-	1	0.6	-	10	3.1	-	2	1.1	-	13	1.9	-

There were no statistically significant differences in perinatal related mortality rates between male and female babies in 2012.

Maternal age

Table 1.7: Perinatal related death rates (per 1000 births) by maternal age 2012

	Total births		Fetal deaths						Neonatal deaths			Total perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	n=62,425		n=171			n=320			n=178			n=669		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Maternal age (years)														
<20	3,914	6.3	14	8.2	3.58	31	9.7	7.92	18	10.1	4.65	63	9.4	16.10
20–24	11,596	18.6	22	12.9	1.90	65	20.3	5.61	39	21.9	3.39	126	18.8	10.87
25–29	15,937	25.5	40	23.4	2.51	65	20.3	4.08	44	24.7	2.78	149	22.3	9.35
30–34	17,742	28.4	44	25.7	2.48	84	26.3	4.73	34	19.1	1.93	162	24.2	9.13
35–39	10,540	16.9	37	21.6	3.51	52	16.3	4.93	30	16.9	2.87	119	17.8	11.29
≥40	2,696	4.3	14	8.2	5.19	23	7.2	8.53	13	7.3	4.89	50	7.5	18.55

There has been no significant increase or decrease in perinatal related mortality rate within any age category presented over the years 2007–2012 and so the data have been combined. By increasing numbers in the numerator and denominator, combining data improves the accuracy of the estimates in the analysis.

Figure 1.19: Perinatal related death rates (per 1000 births) by maternal age (with 95% CIs) 2007–2012

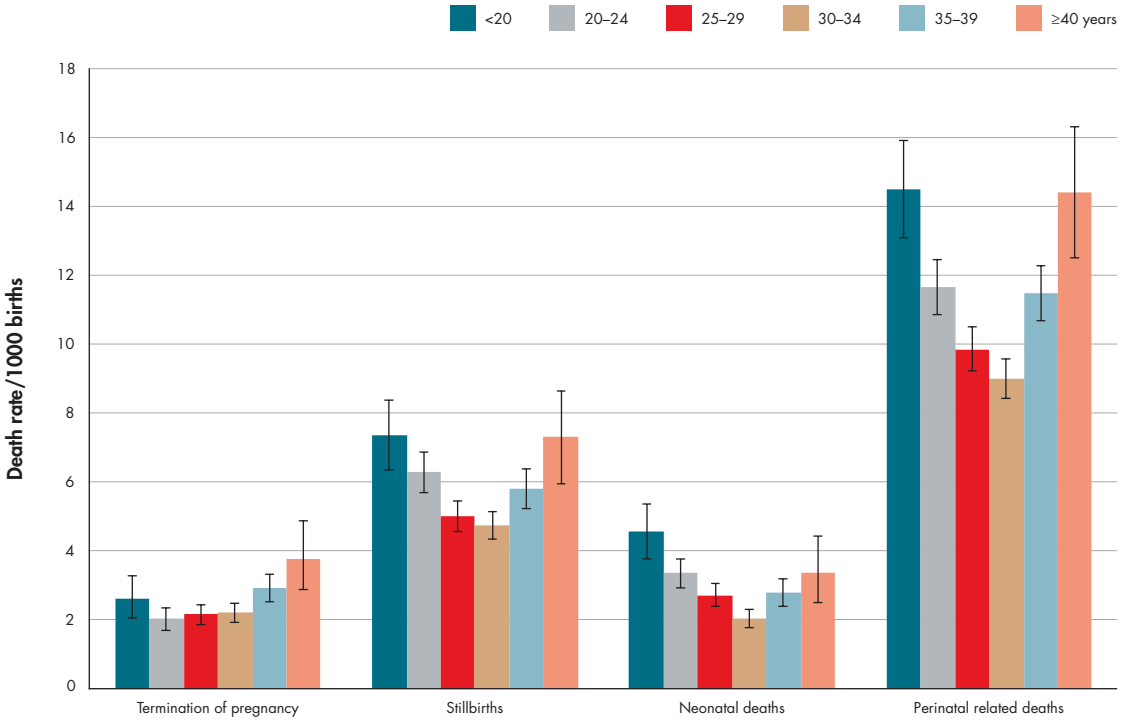


Figure 1.19 illustrates the unadjusted association between maternal age and perinatal related mortality, with the highest mortality rates among mothers under the age of 20 years and mothers of 40 years and older. The mothers with the lowest risk of perinatal mortality are those aged 30–34 years.

There are some differences in the association between age and perinatal mortality; that is, mothers under 20 have the highest risk for neonatal death, while mothers of 40 and older have the highest risk of late termination of pregnancy. However, in all categories of perinatal related death, there is an apparent 'U' shaped curve with highest risk at the extremes of maternal age.

The association between young maternal age and perinatal mortality is most likely confounded by socioeconomic deprivation and smoking. As noted in the 2009 PMMRC report, approximately half of teenage mothers whose babies die reside in the highest deprivation quintile areas, and approximately half are current smokers. Multivariate analysis of births from 2008 to 2012 to mothers in New Zealand with an LMC (self-employed midwife, private obstetrician or GP) showed that maternal age was not an independent risk factor for stillbirth or neonatal death excluding congenital abnormalities and multiple births.

Figure 1.20: Perinatal death classification (PSANZ-PDC) specific perinatal related death rates (excluding termination of pregnancy) by maternal age (with 95% CIs) 2007–2012

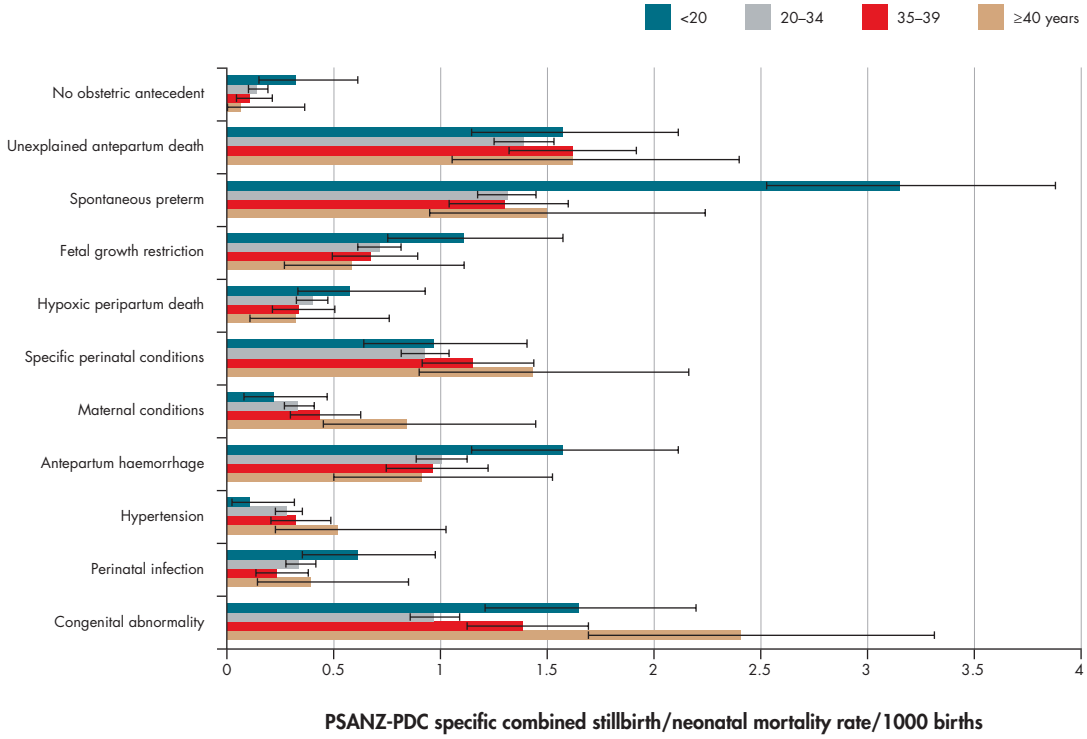


Figure 1.20 illustrates the differences in cause of death (PSANZ-PDC) specific perinatal related mortality rates by maternal age.

Spontaneous preterm birth is more than twice as often the cause of perinatal related death among babies of teenage mothers than of mothers of any other age category. Maternal conditions and congenital abnormalities are significantly more common antecedent causes of perinatal death in older mothers compared to mothers aged 20–34.

The higher rate of combined stillbirth and neonatal death among teenage mothers and mothers 40 and older compared to mothers 20–34 years of age from congenital abnormalities is due to euploid (non-chromosomal) abnormalities among teenage mothers and from chromosomal abnormalities for mothers 40 years and older.

Ethnicity

The use of maternal ethnicity (rather than baby ethnicity) has a small effect on the magnitude of the ethnicity specific mortality rates but not on the comparison between ethnicities. For this reason, only maternal data and figures are provided in the body of the report. Tables using baby ethnicity are presented in Appendix A (Table A8 and Table A9).

Table 1.8: Perinatal related death rates (per 1000 births) by maternal ethnicity (prioritised) 2012

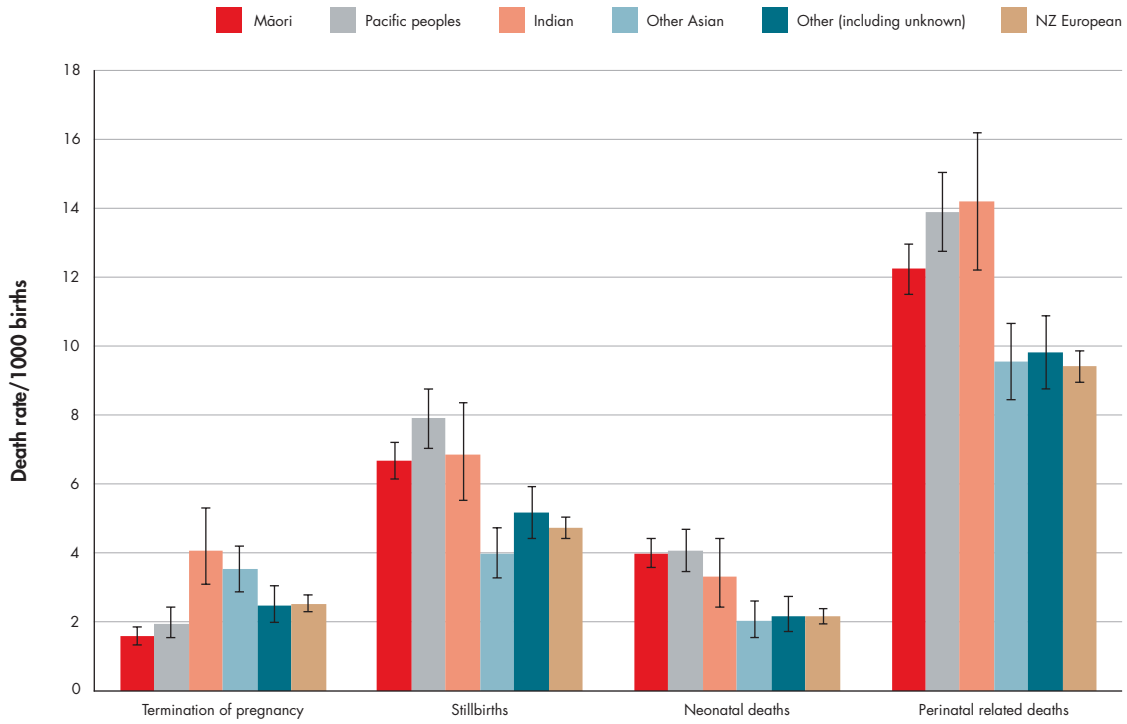
	Total births		Fetal deaths						Neonatal deaths			Perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	n=62,425		n=171			n=320			n=178			n=669		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Ethnicity (mother)														
Māori	14,143	22.7	33	19.3	2.33	77	24.1	5.44	52	29.2	3.71	162	24.2	11.45
Pacific peoples	6,631	10.6	15	8.8	2.26	50	15.6	7.54	30	16.9	4.57	95	14.2	14.33
Indian	2,459	3.9	14	8.2	5.69	16	5.0	6.51	8	4.5	3.29	38	5.7	15.45
Other Asian	6,199	9.9	23	13.5	3.71	27	8.4	4.36	12	6.7	1.95	62	9.3	10.00
Other (including unknown)	5,317	8.5	19	11.1	3.57	27	8.4	5.08	16	9.0	3.04	62	9.3	11.66
NZ European	27,676	44.3	67	39.2	2.42	123	38.4	4.44	60	33.7	2.18	250	37.4	9.03

From 2007 to 2012 there was no statistically significant change in overall perinatal related death rates within any ethnic group (analyses not shown).

The overall perinatal related death rate for Māori, Pacific and Indian mothers is higher than among Other Asian, Other and New Zealand European mothers (Figure 1.21).

The relationship between ethnicity and perinatal related mortality varies by type of death (for example, termination, stillbirth or neonatal death) (Figure 1.21).

Figure 1.21: Perinatal related death rates (per 1000 births) by maternal ethnicity (prioritised) (with 95% CIs) 2007–2012



Māori mothers have lower rates of late termination of pregnancy compared to Indian, Other Asian, Other and New Zealand European mothers. Indian and Other Asian mothers have significantly higher rates of late termination of pregnancy compared to Māori, Pacific and New Zealand European mothers.

Māori and Pacific maternal ethnicities are associated with significantly higher rates of stillbirth and neonatal death compared with New Zealand European, Other Asian and Other maternal ethnicities.

Indian mothers have significantly higher rates of stillbirth and neonatal deaths compared to New Zealand European mothers. Indian mothers' rate of stillbirth is also significantly higher than that of Other Asian mothers.

Although the rate of stillbirth appears higher for Pacific mothers than Māori, there are no statistically significant differences in the rates of late termination, stillbirth or neonatal death between Māori and Pacific mothers.

Age, socioeconomic status, obesity and smoking are risk factors for perinatal death that are also associated with ethnicity and may, therefore, confound the association between ethnicity and perinatal death.

Multivariate analysis of births from 2008 to 2012 undertaken for this report found that Indian ethnicity was independently associated with an increase in the risk of stillbirth and Māori and Pacific ethnicity with an increased risk of neonatal death of babies born at less than 28 weeks (Table 1.22 and Table 1.24).

Māori and Pacific mothers had significantly higher rates of death classified as 'spontaneous preterm birth' than mothers from all other ethnic groups.

Figure 1.22: Perinatal death classification (PSANZ-PDC) specific perinatal related death rates (per 1000 births) (excluding termination of pregnancy) by ethnicity (prioritised maternal) 2007–2012

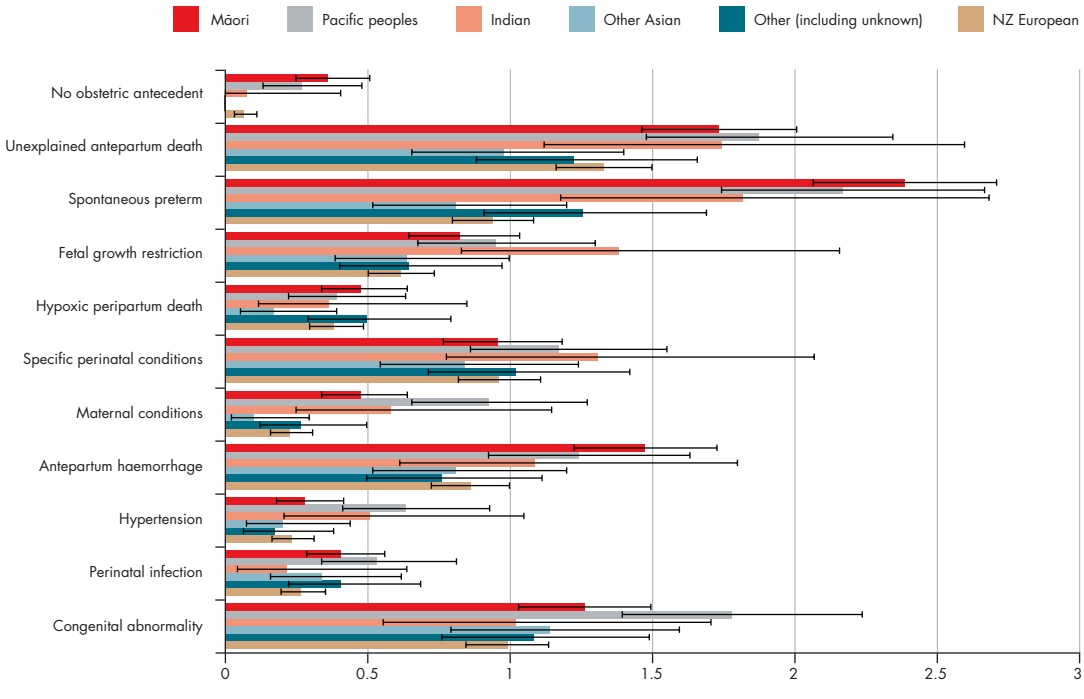


Figure 1.22 shows perinatal death classification (PSANZ-PDC) specific perinatal related death rates (excluding termination of pregnancy) for all mothers by prioritised ethnicity over the time period 2007–2012.

Māori and Pacific mothers had significantly higher rates of deaths associated with 'no obstetric antecedent' than New Zealand European mothers.

'Other Asian' mothers had a significantly lower rate of deaths classified as 'unexplained antepartum death' than Māori and Pacific mothers.

Māori and Pacific mothers had significantly higher rates of death classified as 'spontaneous preterm birth' than mothers from the Other Asian, Other and New Zealand European ethnic groups.

The rate of death associated with 'maternal conditions' was significantly higher among Pacific mothers than among Māori, Other Asian, Other and New Zealand European mothers.

The death rate for the 'antepartum haemorrhage' classification was significantly higher for Māori mothers than Other Asian, Other and New Zealand European mothers.

The death rate associated with 'hypertension' was higher among Pacific mothers than Other and New Zealand European ethnic group mothers.

Pacific mothers experienced a higher rate of deaths associated with 'congenital abnormalities' compared to New Zealand European mothers. This probably reflects lower rates of termination of pregnancy but may also be related to increased obesity, known to be associated with increased risk of congenital abnormalities (Stothard et al 2009).

Socioeconomic disadvantage

Table 1.9: Perinatal related death rates (per 1000 births) by deprivation quintile (NZDep2006) 2012

Deprivation quintile	Total births		Fetal deaths						Neonatal deaths			Perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	n=62,425		n=171			n=320			n=178			n=669		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
1 (least deprived)	9,767	15.6	30	17.5	3.07	30	9.4	3.07	21	11.8	2.16	81	12.1	8.29
2	10,928	17.5	33	19.3	3.02	56	17.5	5.12	26	14.6	2.40	115	17.2	10.52
3	12,093	19.4	35	20.5	2.89	58	18.1	4.80	22	12.4	1.83	115	17.2	9.51
4	13,241	21.2	22	12.9	1.66	62	19.4	4.68	37	20.8	2.81	121	18.1	9.14
5 (most deprived)	16,184	25.9	50	29.2	3.09	110	34.4	6.80	72	40.4	4.49	232	34.7	14.34
Unknown	212	0.3	1	0.6	-	4	1.3	-	-	-	-	5	0.7	-

Figure 1.23: Perinatal related death rates (per 1000 births) by deprivation quintile (NZDep2006) (with 95% CIs) 2007–2012

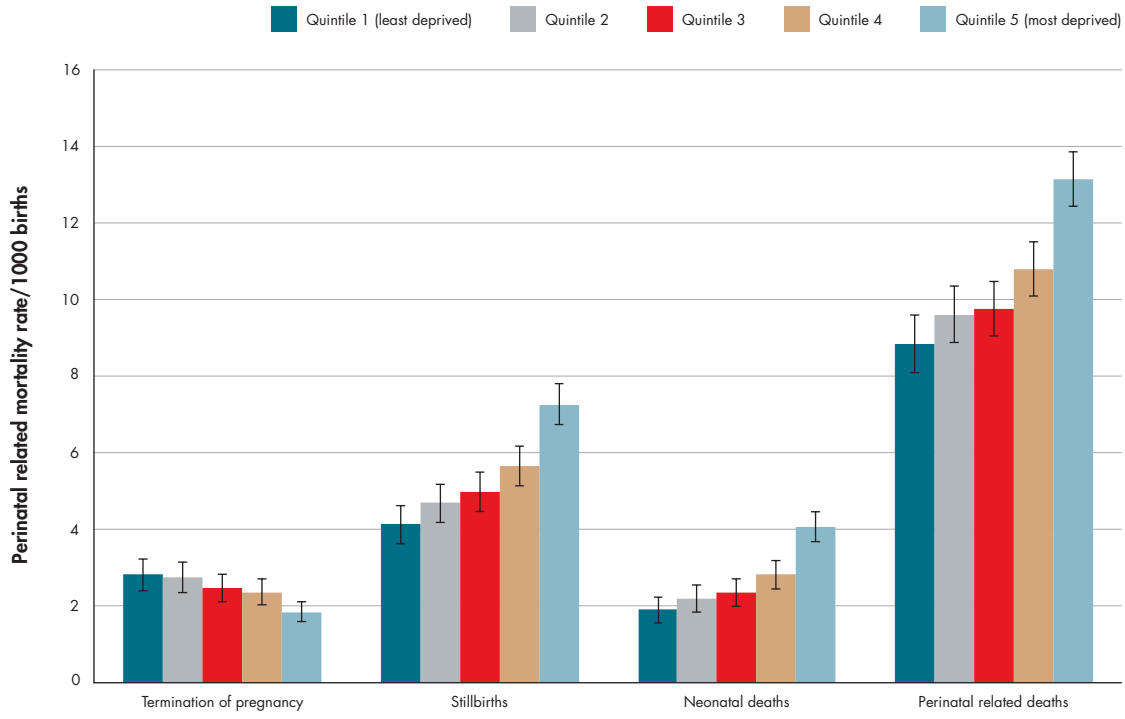


Figure 1.23 includes combined data from 2007 to 2012 and shows a clear increase in perinatal related mortality with increasing socioeconomic deprivation as measured by NZDep2006 and represented as quintiles of increasing deprivation. This association is consistent for stillbirth and for neonatal death, but is reversed for late termination of pregnancy, where there is a reducing rate of late termination with increased deprivation quintile.

The multivariate analyses presented in this report (Table 1.22 and Table 1.24) suggest that socioeconomic status is an independent predictor of neonatal death of babies born at 20–27 weeks gestation after adjusting for ethnicity, BMI, parity, smoking and maternal age.

Figure 1.24: Perinatal death classification (PSANZ-PDC) specific perinatal related death rates (per 1000 births) (excluding termination of pregnancy) by deprivation quintile (NZDep2006) (with 95% CIs) 2007–2012

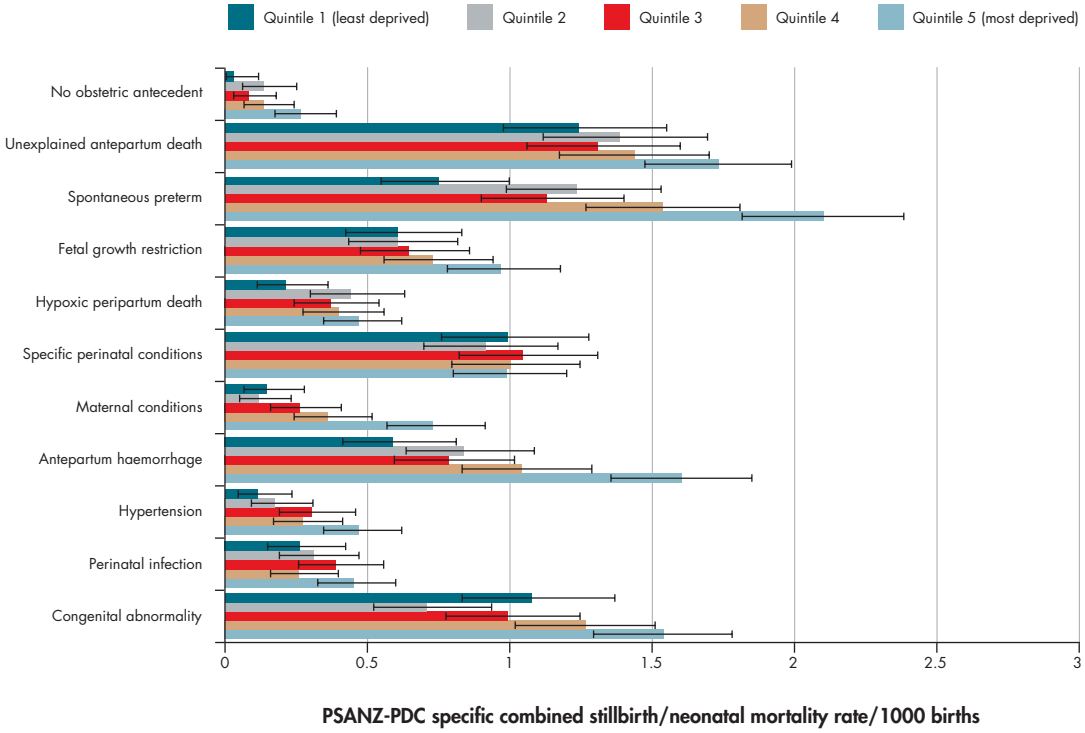


Figure 1.24 shows combined stillbirth and neonatal death rates for each antecedent cause (PSANZ-PDC) by deprivation quintile – quintile 1 (least deprived) at the top of each cause down to quintile 5 (most deprived) at the bottom. The aim of this analysis is to determine how antecedent causes of combined stillbirth and neonatal death are related to increasing deprivation.

There is a significant increasing trend in (combined) stillbirth and neonatal death with increasing deprivation quintile due to all causes other than specific perinatal conditions and perinatal infection.

Maternal body mass index (BMI)

Table 1.10: Maternal body mass index (BMI) among perinatal related deaths 2007–2012

	Fetal deaths							
	Termination of pregnancy		Stillbirths		Neonatal deaths		Perinatal related deaths	
	n=918		n=2147		n=1077		n=4141	
	n	%	n	%	n	%	n	%
Maternal BMI (kg/m²)								
<18.50	22	2.4	45	2.1	28	2.6	95	2.3
18.50–24.99	411	44.8	745	34.7	340	31.6	1,496	36.1
25.00–29.99	191	20.8	520	24.2	238	22.1	949	22.9
30.00–34.99	89	9.7	279	13.0	149	13.8	517	12.5
35.00–39.99	48	5.2	159	7.4	82	7.6	289	7.0
≥40	21	2.3	106	4.9	49	4.5	176	4.3
Unknown	136	14.8	292	13.6	191	17.7	619	14.9

Table 1.10 provides data on BMI for mothers of perinatal related deaths 2012. These data are from the PMMRC dataset and were obtained from LMCs. At least half (51.3 percent) of the mothers of perinatal related deaths in 2012 were overweight or obese, and 25.9 percent were obese (BMI >30). There is a dose-dependent relationship between obesity and poor pregnancy outcomes, including perinatal death (Stacey et al 2011).

Table 1.11: Perinatal related death rates (per 1000 births) by body mass index (BMI) 2008–2012 (restricted to MAT data*)

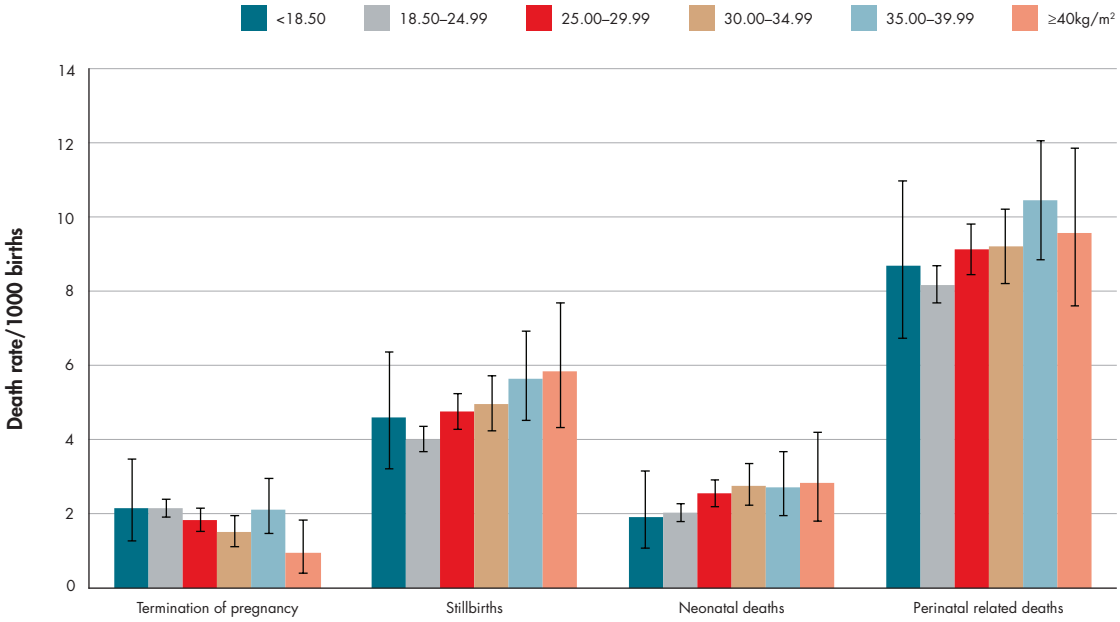
		Fetal deaths											
	Total births (MAT)	Termination of pregnancy			Stillbirths			Neonatal deaths			Perinatal related deaths		
	n=276,911	n=530			n=1,232			n=630			n=2,392		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Maternal BMI (kg/m²)													
<18.50	7,846	2.8	17	3.2	2.17	36	2.9	4.59	15	2.4	1.92	68	2.8	8.67
18.50–24.99	129,564	46.8	279	52.6	2.15	520	42.2	4.01	260	41.3	2.02	1,059	44.3	8.17
25.00–29.99	76,462	27.6	140	26.4	1.83	364	29.5	4.76	193	30.6	2.54	697	29.1	9.12
30.00–34.99	34,791	12.6	52	9.8	1.49	173	14.0	4.97	95	15.1	2.75	320	13.4	9.20
35.00–39.99	15,622	5.6	33	6.2	2.11	88	7.1	5.63	42	6.7	2.71	163	6.8	10.43
≥40	8,581	3.1	8	1.5	0.93	50	4.1	5.83	24	3.8	2.82	82	3.4	9.56
Unknown	4,045	1.5	1	0.2	-	1	0.1	-	1	0.2	-	3	0.1	-

* This table includes data from the national MAT dataset for all births and for perinatal deaths where there was a match with the MAT dataset for 2008–2012 excluding women with No or Other LMC recorded in the national dataset (ie, mothers with a DHB primary maternity service provider).

Table 1.11 provides data from the MAT dataset for all births and for perinatal deaths where there was a match with the MAT dataset for 2008–2012 excluding women with 'No LMC' or 'Other LMC' recorded in the national dataset (that is, mothers with a DHB primary maternity service provider). Comparison with data in Table 1.10 demonstrates the bias potentially introduced using different datasets in analysis where missing data are not random.

The rate of overweight and obesity among birthing mothers in the MAT dataset compared to mothers of babies who died who have data in the MAT dataset presented in Table 1.11 shows a lower rate of overweight and obesity in both groups. However, because this analysis provides denominator data it is possible to see an underlying association between BMI and perinatal related death. There is no association, or an inverse association, apparent between BMI and termination of pregnancy but an increase in stillbirth and neonatal death rates in mothers with overweight and obese BMI compared to mothers with normal BMI (18.50–24.99).

Figure 1.25: Perinatal related death rates (per 1000 births) by body mass index (BMI) (with 95% CIs) 2008–2012



The multivariate analyses presented in Table 1.22 and Table 1.24, which are limited to mothers with an LMC, and exclude multiple pregnancy and congenital abnormalities, suggest that there is a statistically significant increase in stillbirth with increasing BMI which is independent of ethnicity, age, smoking, parity and socioeconomic status, but no association between BMI and neonatal death. These analyses should be repeated once a complete dataset of national pregnancy data is available.

Increasing BMI over 25kg/m² is an independent risk factor for stillbirth after adjusting for confounding due to ethnicity, maternal age, smoking, parity and socioeconomic deprivation decile.

Public health initiatives to prevent obesity should be supported. Optimal weight gain according to BMI should be discussed and encouraged during pregnancy.

A healthy BMI for pregnancy

The following has been adapted from *Guidance for Healthy Weight Gain in Pregnancy (Final Draft)* (Ministry of Health 2014). This will be available on the Ministry of Health website at: *http://www.health.govt.nz/your-health/healthy-living/pregnancy*

Prior to planned pregnancy, health practitioners should discuss optimal nutrition and activity to support pre-conceptual health. Weight loss is recommended prior to pregnancy for women whose BMI falls within the obese category.

During pregnancy (uncomplicated singleton pregnancy)

Accurately calculate BMI for all pregnant women at booking visit – height in bare feet and weight measured in light clothing.

Discuss recommended gestational weight gain with pregnant women at booking (see table below).

Encourage women to monitor their weight at regular periods during pregnancy (using the same scales) and record their own weight regularly during pregnancy and in the postpartum period and bring a copy of this information to their antenatal visits for discussion. If it is not possible for women to record their own weight, they can be weighed on a regular basis at antenatal visits.

Recommendations for total, and rate of, weight gain during uncomplicated singleton pregnancy, by pre-pregnancy BMI

Pre-pregnancy BMI (kg/m²)	Total weight gain range (kg)	Rates of weight gain 2nd and 3rd trimester (mean range in kg/week)*
Underweight (<18.5)	12.5–18	0.51 (0.44–0.58)
Normal weight (18.5–24.9)	11.5–16	0.42 (0.35–0.50)
Overweight (25.0–29.9)	7–11.5	0.28 (0.23–0.33)
Obese (≥30.0)	5–9	0.22 (0.17–0.27)

* Calculations assume a 0.5–2kg weight gain in the first trimester (based on Siega-Riz et al 1994; Abrams et al 1995; Carmichael et al 1997).
Source: IOM and NRC 2009.

Maternal smoking

Table 1.12: Maternal smoking at the time of perinatal related death 2012

Currently smoking	Fetal deaths				Neonatal deaths		Perinatal related deaths	
	Termination of pregnancy		Stillbirths					
	n=171		n=320		n=178		n=669	
	n	%	n	%	n	%	n	%
Yes	34	19.9	86	26.9	47	26.4	167	25.0
No	134	78.4	233	72.8	129	72.5	496	74.1
Unknown	3	1.8	1	0.3	2	1.1	6	0.9

Twenty-seven percent of mothers of stillborn babies and of babies who died after birth were recorded as smoking at the time of their baby's death in 2012. As smoking status can change during pregnancy, the PMMRC collects data on smoking in and prior to pregnancy. Twenty-eight non-smokers at birth are recorded as having stopped smoking during pregnancy (Table 1.13). This means that at least 32 percent of mothers of stillbirths and 31 percent of mothers of neonatal deaths were smoking at the start of pregnancy.

Table 1.13: Maternal smoking history and perinatal related death (among non-smokers at birth) 2012

Smoking history *(among current non-smokers)*	Fetal deaths				Neonatal deaths		Perinatal related deaths	
	Termination of pregnancy		Stillbirths					
	n=134		n=233		n=129		n=496	
	n	%	n	%	n	%	n	%
Never smoked	101	75.4	168	72.1	96	74.4	365	73.6
Stopped before this pregnancy	18	13.4	33	14.2	20	15.5	71	14.3
Stopped <16 weeks gestation	2	1.5	11	4.7	6	4.7	19	3.8
Stopped ≥16 weeks gestation	2	1.5	5	2.1	2	1.6	9	1.8
Unknown	11	8.2	16	6.9	5	3.9	32	6.5

Table 1.14: Perinatal related death rates (per 1000 births) by smoking 2008–2012 (restricted to MAT data*)

	Total births (MAT)		Fetal deaths						Neonatal deaths			Perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	n=276,911		n=530			n=1,232			n=630			n=2,392		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Smoking														
Yes	46,777	16.9	74	14.0	1.58	275	22.3	5.88	165	26.2	3.55	514	21.5	10.99
No	226,505	81.8	456	86.0	2.01	957	77.7	4.23	464	73.7	2.06	1,877	78.5	8.29
Missing data	3,629	1.3	-	-	-	-	-	-	1	0.2	-	1	0.0	-

* This table includes data from the national MAT dataset for all births and for perinatal deaths where there was a match with the MAT dataset for 2008–2012 excluding women with No or Other LMC recorded in the national dataset (ie, mothers with a DHB primary maternity service provider).

Table 1.14 provides data from the MAT dataset for all births and for perinatal deaths where there was a match with the MAT dataset for 2008–2012 excluding women with 'No LMC' or 'Other LMC' recorded in the national dataset (that is, mothers with a DHB primary maternity service provider).

The rate of smoking at either registration or two weeks postnatal among women with an LMC (self-employed midwife, private obstetrician or GP) with data in the MAT dataset in the combined years 2008–2012 was 16.9 percent. This rate compares with a rate of 22 percent among mothers of stillbirths and 26 percent among mothers of neonatal deaths. The relative risk of stillbirth and neonatal mortality among mothers smoking in or soon after pregnancy is 1.4 and 1.7 respectively.

Multivariate analysis including New Zealand births from 2008 to 2012, among mothers with a registered LMC (Table 1.22 and Table 1.24), found that smoking was an independent risk factor for stillbirth

and neonatal death after adjusting for confounding due to ethnicity, maternal age, BMI, parity and socioeconomic deprivation decile (NZDep2006). The odds for stillbirth were 1.56 (95 percent CI 1.33–1.84) after adjustment, 1.6 for neonatal death at 20–27 weeks (95 percent CI 1.13–2.26) and 1.9 for neonatal death from 28 weeks (95 percent CI 1.34–2.69).

Published studies consistently demonstrate that smoking is associated with preterm and small for gestational age (SGA) birth, placental abruption, stillbirth and perinatal mortality. Smoking cessation is one of few known effective intervention strategies for perinatal related mortality. The earlier that a woman stops smoking during pregnancy, the better the outcome for her and her baby. Of eligible mothers (current and past smokers) of stillbirths and neonatal deaths, only 29 percent were recorded as being offered smoking cessation support. Data were not available within the PMMRC dataset for 39 percent of women eligible for smoking cessation support.

Table 1.15: Maternal smoking cessation support offered and perinatal related death 2012

Smoking cessation support offered *(among current smokers and non-smokers other than those who have 'never smoked')*	**Fetal deaths**				**Neonatal deaths**		**Perinatal related deaths**	
	Termination of pregnancy		**Stillbirths**					
	n=67		**n=151**		**n=80**		**n=298**	
	n	%	n	%	n	%	n	%
No	19	28.4	46	30.5	29	36.3	94	31.5
Yes – by LMC only	8	11.9	34	22.5	15	18.8	57	19.1
Yes – referred to external agents	5	7.5	11	7.3	6	7.5	22	7.4
Unknown	35	52.2	60	39.7	30	37.5	125	41.9

The following is adapted from *The New Zealand Guidelines for Helping People Quit Smoking (Final Draft)* (Ministry of Health 2014). This will be available on the Ministry of Health website: (http://www.health.govt.nz)

Smoking rates in women are highest in the age range where most women have children.

- All health care workers who have contact with pregnant women who smoke should give brief advice to stop and offer assistance at the earliest opportunity.
- Preventing harm to their unborn baby is a strong motivator for pregnant women to become smokefree. Brief advice works best if it is tailored to the individual's situation; for example, linking the benefits of quitting to better pregnancy outcomes for the woman and her baby.
- More women will make a quit attempt if the brief advice includes an offer of referral to cessation support services.
- Recommend referral to a stop smoking service to every pregnant woman who smokes.
- Where pregnant women continue to smoke, health care workers should repeat brief advice and offer referral to cessation support regularly throughout the pregnancy.
- Nicotine replacement therapy in pregnancy carries a small potential risk to the fetus, but using nicotine replacement therapy is far safer than smoking while pregnant.
- Offering the partner and wider whānau referral to a stop smoking service will also assist the pregnant woman to stop.

Smoking is an independent risk factor for stillbirth and neonatal death after adjusting for confounding due to ethnicity, maternal age, BMI, parity and socioeconomic deprivation decile.

As smoking is a modifiable risk factor for both stillbirth and neonatal death, every effort must be made to encourage women to engage in effective smoking cessation programmes prior to, during and after pregnancy.

Maternal alcohol and substance use

Table 1.16: Maternal alcohol and substance use and perinatal related death 2012

	Fetal deaths							
	Termination of pregnancy		Stillbirths		Neonatal deaths		Perinatal related deaths	
	n=171		n=320		n=178		n=669	
	n	%	n	%	n	%	n	%
Alcohol and substance use								
Yes	12	7.0	36	11.3	29	16.3	77	11.5
No	134	78.4	258	80.6	133	74.7	525	78.5
Unknown	25	14.6	26	8.1	16	9.0	67	10.0
Specific substances								
Alcohol	10	5.8	27	9.2	25	14.0	62	9.3
Amphetamine/P	2	1.2	1	0.3	1	0.6	4	0.6
Ecstasy	-	-	1	0.3	-	-	1	0.1
Marijuana	5	2.9	9	3.1	12	6.7	26	3.9
Methadone	-	-	1	0.3	1	0.6	2	0.3
Other	-	-	1	0.3	-	-	1	0.1
Unknown	-	-	2	0.7	1	0.6	3	0.4

Data were obtained on alcohol and substance use among 90 percent of mothers whose babies died in 2012. Alcohol was reportedly used by 62 (9.3 percent) of all mothers and marijuana by 3.9 percent. It is likely that alcohol and substance use are under-reported. Substance use was reported as a barrier to access and/or engagement with care at local perinatal death review for 17 mothers in 2012 (Table 1.42).

There are no national data on alcohol consumption and marijuana use in pregnancy with which to compare these figures.

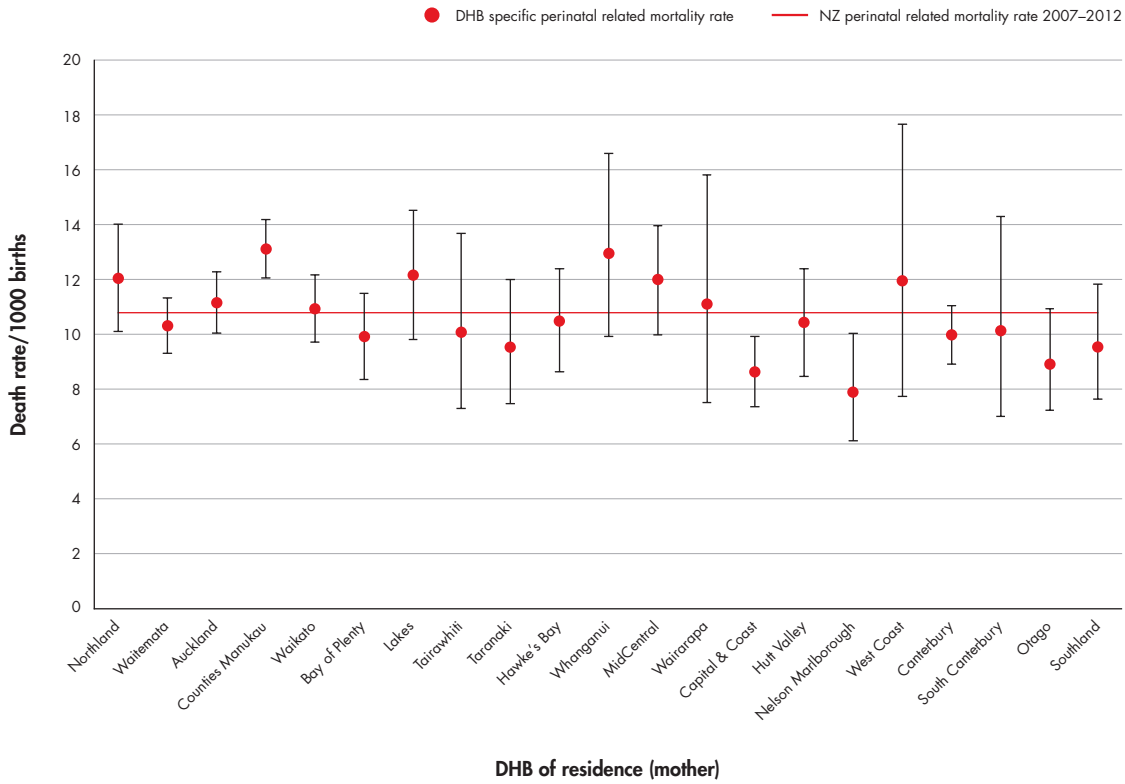
In the sixth PMMRC report (PMMRC 2012), it was reported that 232 women drank alcohol during pregnancy, and 110 used marijuana over the years 2007–2010, although data were missing on 18 percent of mothers overall. A further analysis of these mothers and pregnancies where perinatal death occurred revealed the following:

Both alcohol and marijuana were associated with perinatal death due to spontaneous preterm birth and death without obstetric antecedent – principally SIDS [sudden infant death syndrome], postnatally acquired infection, accidents and SUDI deaths – when compared to mothers whose babies died who did not report alcohol or marijuana use. Women whose babies died and who reported alcohol and marijuana use were more likely to be Māori, smokers, from socioeconomically deprived areas and under age 25. These factors are all also associated with perinatal death from spontaneous preterm birth and from SUDI. It may be that marijuana and alcohol use in pregnancy are underlying reasons why these social determinants are associated with perinatal death.

Pregnant women may under-report alcohol and substance use. Further investigation into the frequency of substance use among pregnant women should be undertaken to estimate the impact. Additional support services tailored for pregnant women may need to be developed.

District health board (DHB) of residence

Figure 1.26: Perinatal related death rates (per 1000 births) by DHB of residence (mother) compared to New Zealand perinatal related mortality (with 95% CIs) 2007–2012



An analysis of perinatal related deaths in 2007–2009 compared to 2010–2012 was undertaken to determine whether there were any statistically significant changes in rate of perinatal related death for any DHB of residence from the first to the second triennium. No significant differences were found.

The confidence intervals, represented by the error bars above and below the point estimates, span the range of values that are consistent with the point estimate given the size of the population in the area. If these ranges do not include the national rate, represented by the horizontal line, the rate in that area was statistically significantly different from the national rate. If the ranges do not cross, then adjacent rates are different.

Only Counties Manukau DHB has a statistically significantly higher perinatal related mortality rate compared to the line indicating the national rate. Rates of similar magnitude, but not statistically significantly different from the national rate, are seen in other DHB regions as shown in Figure 1.26. Some of these DHB regions also have high rates of socioeconomic deprivation.

Figure 1.27: Stillbirth rate (per 1000 births) by DHB of residence (mother) compared to New Zealand stillbirth rate (with 95% CIs) 2007–2012

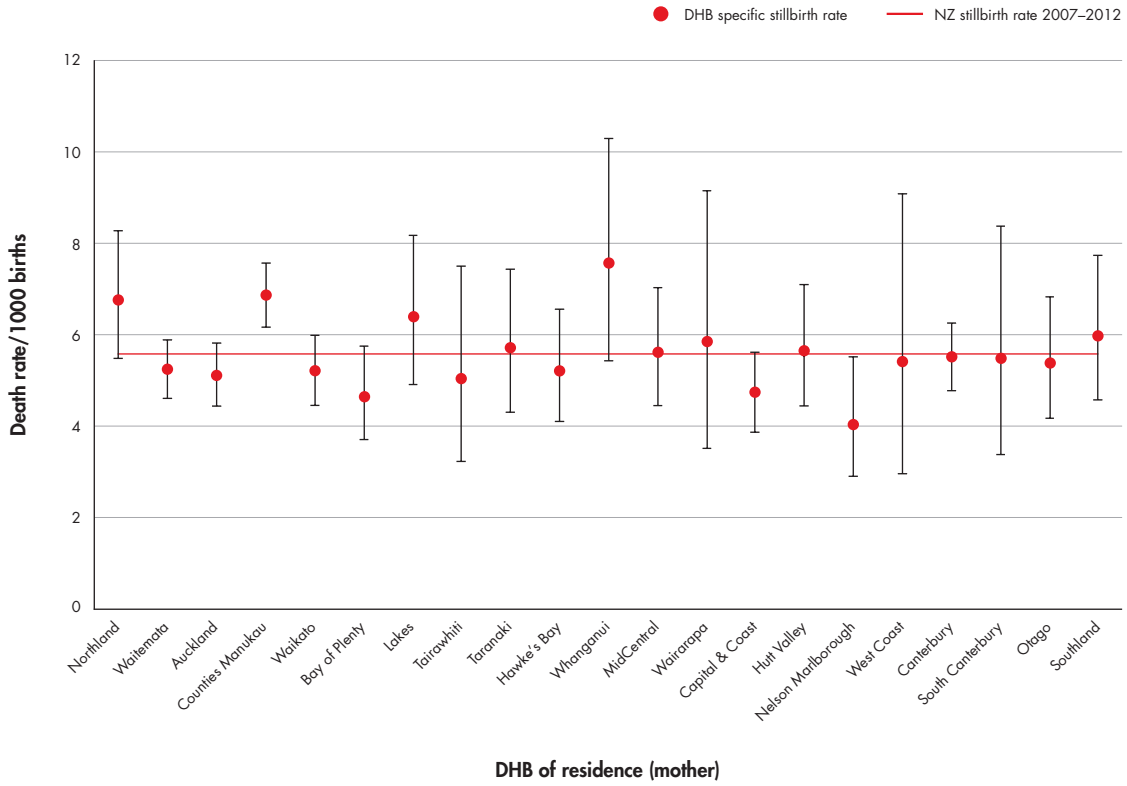
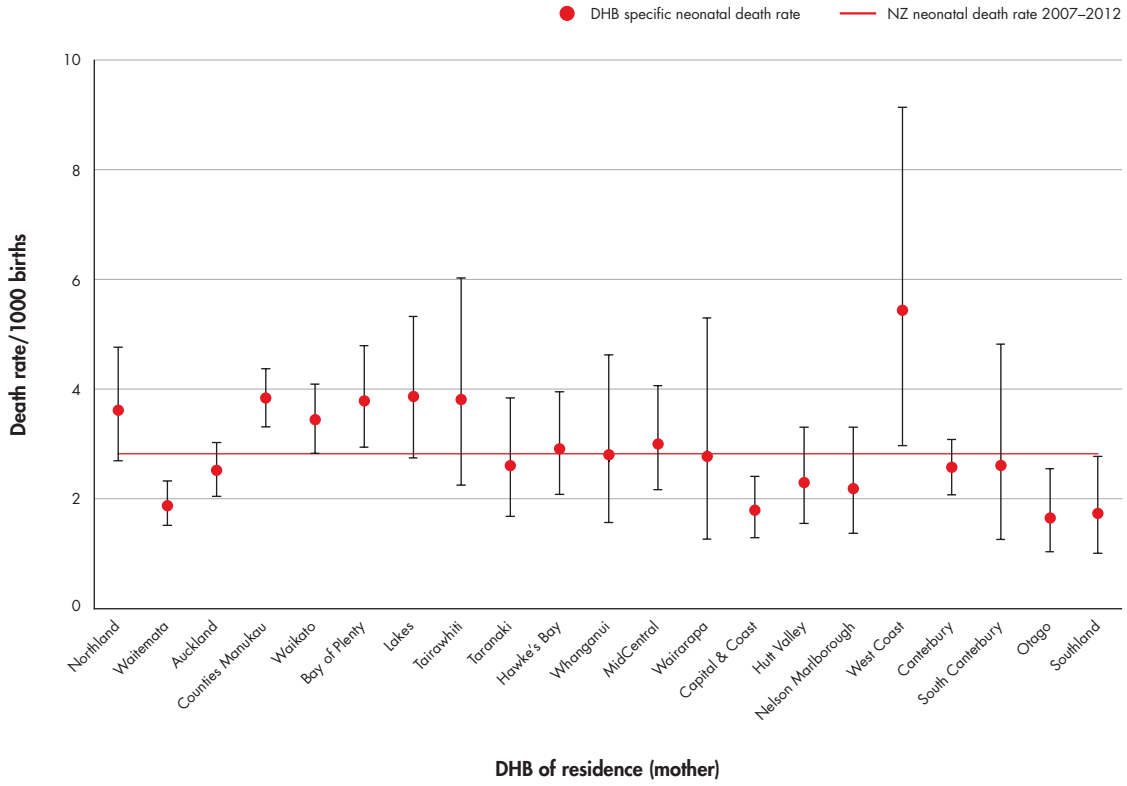


Figure 1.27 and Figure 1.28 illustrate stillbirth and neonatal death rates respectively by DHB of residence, providing further information for DHBs on where there might be issues for their regions. There are greater variations from the national rate among neonatal death rates by DHB than stillbirth rates, which is consistent with the stronger associations between demography and neonatal death.

Figure 1.28: Neonatal death rate (per 1000 births) by DHB of residence (mother) compared to New Zealand neonatal death rate (with 95% CIs) 2007–2012



It was not possible this year to use multivariate analysis to adjust for the influences of sociodemographic factors on perinatal related mortality rates at individual DHBs because of the lack of denominator data from DHBs providing primary maternity care.

Gestation and birthweight

Table 1.17: Perinatal related death rates (per 1000 births) by gestation and birthweight 2012

	Total births		Fetal deaths						Neonatal deaths			Perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	n=62,425		n=171			n=320			n=178			n=669		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Gestation at birth (weeks)														
20–23	259	0.4	140	81.9	*	98	30.6	*	67	37.6	*	305	45.6	*
24–27	255	0.4	23	13.5	90.20	51	15.9	200.00	31	17.4	171.27	105	15.7	411.76
28–31	519	0.8	5	2.9	9.63	30	9.4	57.80	15	8.4	30.99	50	7.5	96.34
32–36	3,992	6.4	3	1.8	0.75	54	16.9	13.53	16	9.0	4.07	73	10.9	18.29
37–40	46,680	74.8	-	-	-	78	24.4	1.67	38	21.3	0.82	116	17.3	2.49
≥41	10,700	17.1	-	-	-	9	2.8	0.84	11	6.2	1.03	20	3.0	1.87
Unknown	20	0.0	-	-	-	-	-	-	-	-	-	-	-	-
Birthweight (g)														
<500	230	0.37	112	65.5	*	105	32.8	*	37	20.8	*	254	38.0	*
500–999	302	0.48	45	26.3	149.01	60	18.8	198.68	63	35.4	319.80	168	25.1	556.29
1000–1499	387	0.62	7	4.1	18.09	28	8.8	72.35	11	6.2	31.25	46	6.9	118.86
1500–1999	762	1.22	4	2.3	5.25	12	3.8	15.75	8	4.5	10.72	24	3.6	31.50
2000–2499	2,430	3.89	1	0.6	0.41	32	10.0	13.17	11	6.2	4.59	44	6.6	18.11
2500–2999	8,251	13.22	1	0.6	0.12	28	8.8	3.39	13	7.3	1.58	42	6.3	5.09
3000–3499	20,678	33.12	-	-	-	33	10.3	1.60	18	10.1	0.87	51	7.6	2.47
3500–3999	19,947	31.95	-	-	-	16	5.0	0.80	12	6.7	0.60	28	4.2	1.40
4000–4499	7,767	12.44	-	-	-	2	0.6	0.26	3	1.7	0.39	5	0.7	0.64
≥4500	1,643	2.63	-	-	-	1	0.3	-	-	-	-	1	0.1	-
Unknown	28	0.04	1	0.6	-	3	0.9	-	2	1.1	-	6	0.9	-

* Denominator data unreliable where asterisk is present, and therefore rates have not been calculated.

Table 1.17 provides estimates of mortality rates by gestation at birth and birthweight. Few babies born at 20–23 weeks or weighing under 500g survive. Some years, such as this, more babies appear to have died in the 20–23 week and <500g categories than were born. This is in part a consequence of the use of a numerator that is deaths in 2012 and a denominator compiled from birth registrations in 2012 (that is, some babies born prior to 2012 will be included in the denominator and some born in 2012 will be registered in later years). For this reason, perinatal related mortality rates at the lower extremes have not been reported.

The majority of perinatal related deaths occur in babies under 28 weeks and under 1000g. Perinatal related death is uncommon after 31 weeks and above 1499g.

Figure 1.29: Perinatal related death risk (per 1000 babies remaining in utero) by gestational age at birth 2007–2012

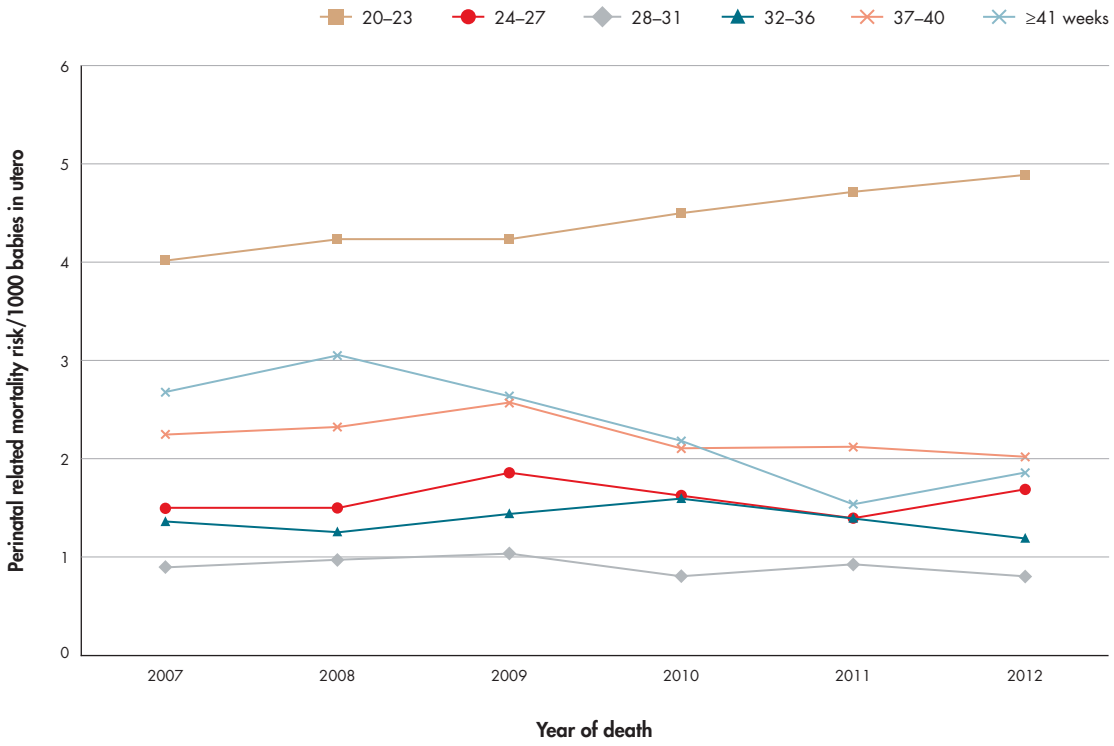


Figure 1.29 shows perinatal related death risk by gestational age group at birth as a proportion of pregnancies remaining in utero. This provides an estimate of the risk of perinatal related death for a continuing pregnancy at that gestation.

The greatest risk to pregnancy is in the period from 20 to 23 weeks followed by the risk at term. There is statistically significant increasing risk of perinatal related death at 20–23 weeks in the years from 2007 to 2012 and a significant reduction from 41 weeks.

There is no significant increase in risk of perinatal related death for babies in utero after 40 weeks compared to babies in utero at 37–40 weeks. This may be a reflection of current practice to monitor and appropriately induce post-term.

Obstetric antecedent (PSANZ-PDC) and neonatal (PSANZ-NDC) cause of death by gestational age

Table 1.18: Perinatal death classification (PSANZ-PDC) of fetal death by gestational age 2007–2012

Perinatal death classification (PSANZ-PDC)	Total	20–23		24–27		28–31		32–36		37–40		≥41 weeks	
		n	%	n	%	n	%	n	%	n	%	n	%
Congenital abnormality	**922**	620	67.2	130	14.1	56	6.1	63	6.8	42	4.6	11	1.2
Perinatal infection	**96**	33	34.4	14	14.6	11	11.5	10	10.4	20	20.8	8	8.3
Hypertension	**108**	18	16.7	31	28.7	19	17.6	20	18.5	18	16.7	2	1.9
Antepartum haemorrhage	**288**	160	55.6	25	8.7	25	8.7	32	11.1	44	15.3	2	0.7
Maternal conditions	**155***	62	40.0	22	14.2	14	9.0	21	13.5	34	21.9	2	1.3
Specific perinatal conditions	**323**	117	36.2	51	15.8	24	7.4	57	17.6	72	22.3	2	0.6
Hypoxic peripartum death	**69**	-	-	-	-	-	-	4	5.8	46	66.7	19	27.5
Fetal growth restriction	**274**	34	12.4	48	17.5	46	16.8	60	21.9	71	25.9	15	5.5
Spontaneous preterm	**265***	202	76.2	43	16.2	12	4.5	8	3.0	-	-	-	-
Unexplained antepartum death	**562**	102	18.1	60	10.7	55	9.8	113	20.1	204	36.3	28	5.0
Total	**3,062**	**1,348**	**44.0**	**424**	**13.8**	**262**	**8.6**	**388**	**12.7**	**551**	**18.0**	**89**	**2.9**

* Gestation of two babies unknown.

Table 1.18 and Table 1.19 include combined data on the cause of death (PSANZ-PDC) by gestation at birth from 2007 to 2012 for fetal and neonatal deaths respectively. Combining data provides more stable estimates of the association between PSANZ-PDC and gestation at birth of perinatal related deaths, as numbers in some categories are small.

Table 1.19: Perinatal death classification (PSANZ-PDC) of neonatal death by gestational age 2007–2012

Perinatal death classification (PSANZ-PDC)	Total	20–23		24–27		28–31		32–36		37–40		≥41 weeks	
		n	%	n	%	n	%	n	%	n	%	n	%
Congenital abnormality	**255**	3	1.2	6	2.4	42	16.5	81	31.8	96	37.6	27	10.6
Perinatal infection	**49**	13	26.5	9	18.4	3	6.1	4	8.2	11	22.4	9	18.4
Hypertension	**26**	4	15.4	13	50.0	6	23.1	2	7.7	1	3.8	-	-
Antepartum haemorrhage	**131**	82	62.6	29	22.1	6	4.6	8	6.1	5	3.8	1	0.8
Maternal conditions	**26**	7	26.9	5	19.2	3	11.5	3	11.5	7	26.9	1	3.8
Specific perinatal conditions	**93**	48	51.6	17	18.3	3	3.2	11	11.8	13	14.0	1	1.1
Hypoxic peripartum death	**84**	-	-	-	-	1	1.2	4	4.8	55	65.5	24	28.6
Fetal growth restriction	**27**	1	3.7	5	18.5	4	14.8	3	11.1	12	44.4	2	7.4
Spontaneous preterm	**331**	198	59.8	103	31.1	17	5.1	13	3.9	-	-	-	-
No obstetric antecedent	**55**	-	-	-	-	-	-	3	5.5	41	74.5	11	20.0
Total	**1,077**	**356**	**33.1**	**187**	**17.4**	**85**	**7.9**	**132**	**12.3**	**241**	**22.4**	**76**	**7.1**

Spontaneous preterm birth is the most commonly assigned obstetric antecedent cause of neonatal death, identified in almost a third of cases.

In contrast to fetal death, where congenital abnormality occurs at early gestations associated with termination of pregnancy, congenital abnormality is a common cause of neonatal death among babies born at or near term. Congenital abnormality is the most common cause of neonatal death at term, responsible for 39 percent over the six years 2007–2012. Hypoxic peripartum death is the next most common cause of neonatal death at term, responsible for 25 percent of term neonatal deaths from 2007 to 2012, but the proportion has decreased from 30 percent in 2007–2009 to 21 percent in 2010 and 2011 and 14 percent in 2012.

Hypertension, other maternal conditions and fetal growth restriction are uncommon obstetric antecedent causes of neonatal death.

Table 1.20: Neonatal death classification (PSANZ-NDC) of neonatal death by gestational age 2007–2012

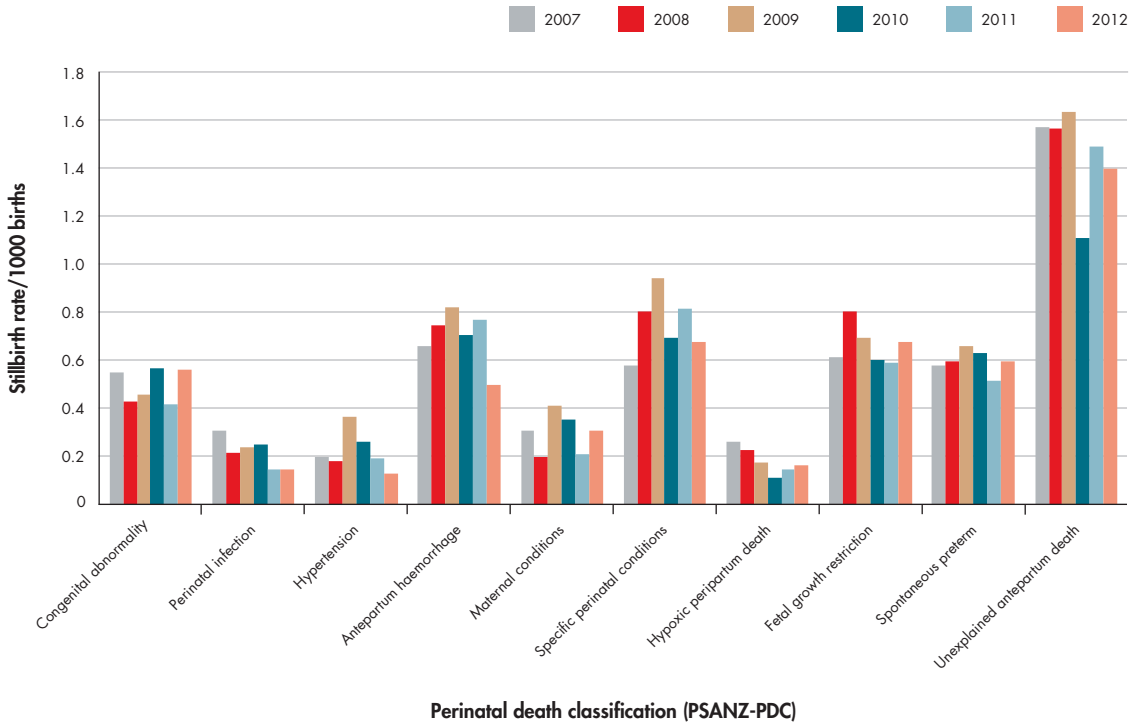
Neonatal death classification (PSANZ-NDC)	Total	20–23		24–27		28–31		32–36		37–40		≥41 weeks	
		n	%	n	%	n	%	n	%	n	%	n	%
Congenital abnormality	**258**	2	0.8	6	2.3	42	16.3	82	31.8	99	38.4	27	10.5
Extreme prematurity	**373**	332	89.0	40	10.7	1	0.3	-	-	-	-	-	-
Cardio-respiratory disorders	**76**	9	11.8	53	69.7	9	11.8	2	2.6	3	3.9	-	-
Infection	**96**	6	6.3	36	37.5	13	13.5	11	11.5	19	19.8	11	11.5
Neurological	**180**	6	3.3	29	16.1	12	6.7	23	12.8	81	45.0	29	16.1
Gastrointestinal	**20**	1	5.0	14	70.0	4	20.0	1	5.0	-	-	-	-
Other	**74**	-	-	9	12.2	4	5.4	13	17.6	39	52.7	9	12.2
Total	**1,077**	**356**	**33.1**	**187**	**17.4**	**85**	**7.9**	**132**	**12.3**	**241**	**22.4**	**76**	**7.1**

Extreme prematurity is the neonatal cause of death in a third of neonatal deaths. Eighty-nine percent of these deaths from prematurity are in babies born before 24 weeks gestation. At gestations of 24 weeks or later, congenital abnormality and neurological conditions predominate.

Stillbirth

There has been a significant reduction in the rate of stillbirth from 2007 to 2012 (p=0.047).

Figure 1.30: Perinatal death classification (PSANZ-PDC) specific stillbirth rates by year 2007–2012

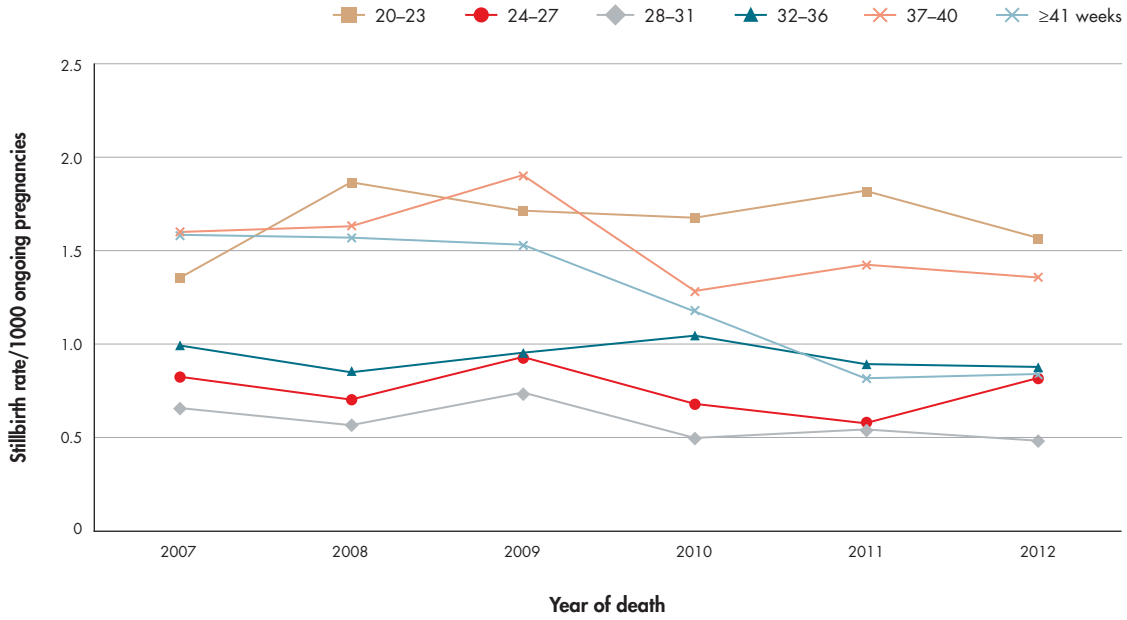


The largest numbers of stillbirths consistently fall in the 'unexplained' category (27 percent in 2012). Term unexplained stillbirth is further discussed on page 101.

The most frequently identified causes (PSANZ-PDC) of stillbirth are congenital abnormalities, antepartum haemorrhage, specific perinatal conditions, fetal growth restriction and spontaneous preterm birth, each responsible for 31–42 (10–15 percent) of stillbirths in 2012.

Stillbirth and gestation

Figure 1.31: Stillbirth rate (per 1000 ongoing pregnancies) by gestation group and year 2007–2012



There has been a statistically significant reduction in stillbirths at 41 weeks gestation and over (p=0.02). The apparent drop at 37–40 weeks does not reach statistical significance (p=0.07).

Unexplained stillbirth at term

Of 87 unexplained stillbirths in 2012, one-third (29) were born at term. Of these 29, 24 died at term with the remaining 5 dying prior to term but born at term. Unexplained stillbirths accounted for one-third of stillbirths at term in 2012 and 21 percent of all perinatal related deaths at term.

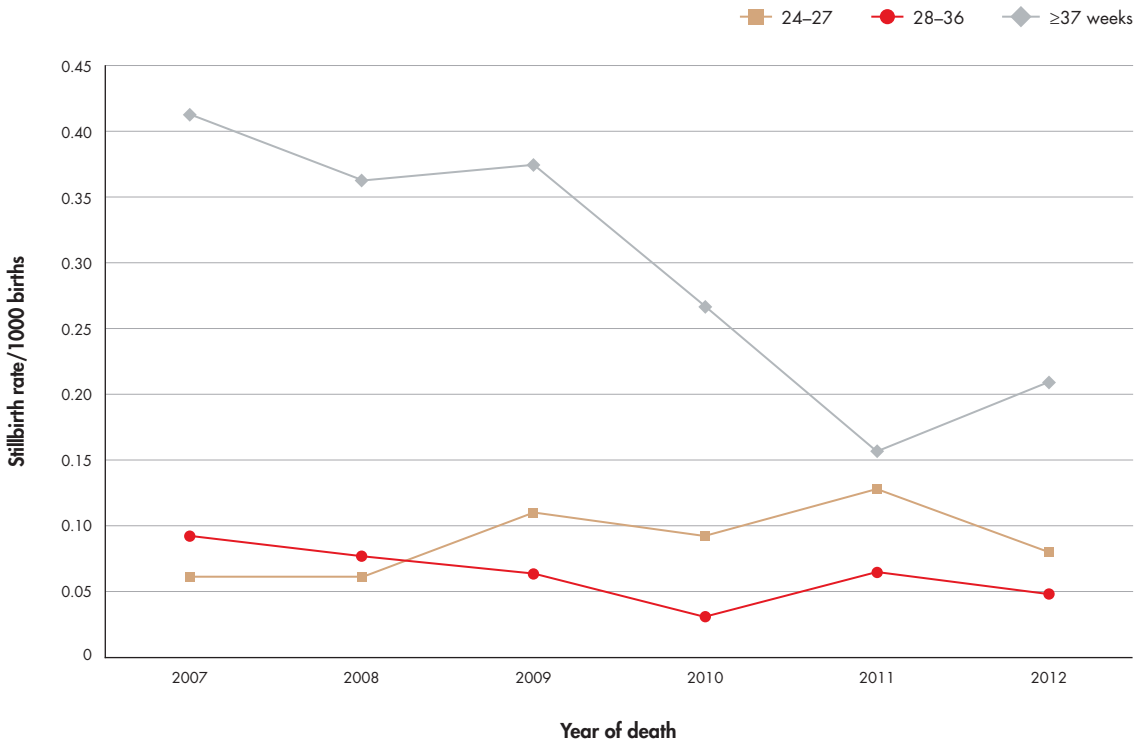
Intrapartum stillbirth

Table 1.21: Timing of stillbirth relative to labour by gestation 2012

Timing of stillbirth	All stillbirths		Stillbirths ≥24 weeks		Stillbirths ≥37 weeks		Stillbirths ≥37 weeks without congenital abnormality	
	n=320		n=222		n=87		n=80	
	n	%	n	%	n	%	n	%
Antepartum	225	70.3	178	80.2	61	70.1	56	70.0
Intrapartum – total	63	19.7	23	10.4	14	16.1	12	15.0
Intrapartum – first stage	18	5.6	11	5.0	9	10.3	8	10.0
Intrapartum – second stage	10	3.1	5	2.3	3	3.4	2	2.5
Intrapartum – unknown stage	35	10.9	7	3.2	2	2.3	2	2.5
Unknown	32	10.0	21	9.5	12	13.8	12	15.0

There were 63 known stillbirths in labour in 2012. Of these, 12 occurred at term in babies without congenital abnormality. This compares with 26 at term in babies without congenital abnormality in 2007. The intrapartum stillbirth rate (in labour deaths of babies of 24 weeks and beyond, excluding deaths caused by lethal congenital abnormality) was 0.32/1000 births 24 weeks and beyond without lethal congenital abnormality in 2012 (Table A5).

Figure 1.32: Intrapartum stillbirth rate (per 1000 births) by gestation (weeks) excluding congenital abnormalities 2007–2012



There has been a statistically significant reduction in the intrapartum stillbirth rate among babies at term, excluding those with congenital abnormalities (Figure 1.32).

Intrapartum stillbirths and neonatal hypoxic peripartum deaths (PSANZ-PDC 7) are discussed further on page 118.

There has been a statistically significant reduction in the intrapartum stillbirth rate among babies at term, excluding those with congenital abnormalities.

Adjusted associations between demographic variables and stillbirth

In 2013, the Ministry of Health made the MAT dataset of live births in New Zealand from 2007 to 2012 available to the PMMRC. This dataset, as described in section 1.2 Methodology, now represents the best approximation of live births in New Zealand in any year. It is compiled from claims data from LMCs and hospital discharge data.

The PMMRC would prefer to use the MAT dataset as the denominator for analysis as it includes clinical variables which are known predictors of perinatal related death; however, it is currently missing registration data such as BMI and smoking on the approximately 15 percent of mothers for whom DHBs provide primary maternity care, and some data definitions vary, as outlined in section 1.2 Methodology.

The MAT dataset has been used for the multivariate analyses presented in this report to estimate the independent associations of ethnicity, age, deprivation decile, smoking, parity and BMI, with stillbirth and neonatal death. **NB:** Only data for perinatal related deaths where the match between the PMMRC dataset and the MAT dataset was successful have been included in these analyses, and MAT data only were used for the analysis.

The deaths identified by the PMMRC process were matched with the MAT dataset (using maternal NHI and date of birth, within a four-week range either side of the PMMRC recorded date of birth). This matching process was successful for 91.4 percent of perinatal related deaths (92.2 percent of late terminations, 90.4 percent of stillbirths and 92.8 percent of neonatal deaths).

For analyses where the MAT data are used (including the multivariate analyses):

- all births and deaths where LMC at registration is 'No LMC' or 'Other LMC' have been excluded
- all births and deaths in 2007 have been excluded.

Exclusion of births and deaths where the DHB provides primary maternity care reduces the data available for analysis of some high risk groups (such as many Pacific mothers who reside in the Counties Manukau and Auckland DHB areas), thus reducing the statistical power and generalisability of the findings.

The findings of the multivariate analysis are restricted to 2008–2012 (90 percent of all smoking and BMI data are missing from the 2007 MAT dataset), to mothers who registered with an LMC (self-employed midwife, GP or private obstetrician) and who have a complete set of data for the variables included in the analysis; that is, ethnicity, maternal age, NZDep2006 decile, smoking, BMI, parity, plurality (multiple or singleton pregnancy) and year of baby's birth. It is probable that the findings can be extrapolated to mothers outside of these criteria but this cannot currently be tested.

It is expected that some of these issues will be resolved in the near future as the Ministry of Health and DHBs work to enable transfer of registration data to the MAT dataset.

A comparison of smoking variables at registration and at two weeks postnatal in the MAT dataset with the smoking variable in the PMMRC perinatal deaths dataset, which asks about smoking at the start, throughout and at the time of the baby's death, suggests that there is an underestimation of smoking rates in the MAT dataset. Therefore, a derived variable has been used in the multivariate analyses and defines smoker as smoking at registration or at two weeks postnatal.

The multivariate analyses aim to determine whether ethnicity, age and socioeconomic status are independent predictors of perinatal mortality, after adjustment for each other and for age, smoking, parity, BMI and year of birth, after excluding multiple births and babies dying from or with congenital abnormalities.

Table 1.22: Unadjusted and adjusted associations between demographic variables and stillbirth among mothers registered with an LMC 2008–2012 (excluding multiple births, late terminations and congenital abnormalities)

	OR unadjusted	95% CI	OR adjusted	95% CI
	Stillbirths 998 Live births 263,371		Stillbirths 994 Live births 262,242	
Year (2008–2012)(per year)	0.95	0.91–0.99	0.95	0.91–0.99
Ethnicity				
Māori	1.06	0.91–1.24	0.85	0.71–1.01
Pacific peoples	1.17	0.94–1.45	1.03	0.82–1.30
Indian	1.48	1.07–2.04	1.57	1.13–2.17
Other Asian	0.73	0.55–0.97	0.81	0.61–1.08
Other	0.93	0.75–1.14	0.97	0.79–1.20
NZ European	Referent		Referent	
NZDep2006 centile (per centile)	1.04	1.01–1.06	1.02	0.99–1.05
Smoking				
Smoker	1.54	1.34–1.79	1.56	1.33–1.84
Non-smoker	Referent		Referent	
BMI (kg/m^2)				
BMI <18.50	1.09	0.74–1.60	1.06	0.72–1.57
BMI 18.50–24.99	Referent		Referent	
BMI 25.00–29.99	1.19	1.03–1.39	1.18	1.01–1.37
BMI 30.00–34.99	1.27	1.05–1.53	1.24	1.02–1.51
BMI 35.00–39.99	1.4	1.09–1.81	1.36	1.05–1.77
BMI ≥40	1.48	1.07–2.04	1.47	1.06–2.05
Age (years)				
<20	1.43	1.15–1.77	1.2	0.95–1.51
20–39	Referent		Referent	
≥40	1.05	0.76–1.45	1.15	0.83–1.59
Parity				
Nulliparous	1.23	1.09–1.39	1.27	1.11–1.44
Multiparous	Referent		Referent	

Red indicates statistically significant increased or decreased odds.

There were 1591 singleton stillbirths and 313,821 singleton live births from 2008 to 2012. The analysis reported in Table 1.22, excluding births where there was 'No LMC' or 'Other LMC' (assumed to be hospital or DHB maternity services), potentially included 1232/1591 (77.4 percent) of stillbirths and 276,911/313,821 (88.2 percent) of live births. As noted above, exclusion of these individuals reduces the power of the analysis and also the reliability of the findings for generalising to the total population. A small number of further births were excluded from the final model because of missing data for at least one of the variables in the model.

Table 1.22 shows the independent associations between sociodemographic variables and stillbirth independent of all other variables in the table. The independent risk factors for stillbirth excluding multiple births and deaths from congenital abnormalities were smoking, raised BMI, nulliparity and Indian maternal ethnicity. There is an increasing odds ratio (OR) for stillbirth with increasing BMI.

The significant reduction in odds with year indicates that the significant decrease in stillbirth over time is not due to a change in population demography alone.

The univariate analysis illustrated in Figure 1.21 on page 46 shows a clearly significant increase in stillbirth for Māori, Pacific and Indian mothers compared to New Zealand European and Other Asian mothers. However, there is no significant increase in stillbirth for Māori and Pacific mothers in the univariate statistics given in Table 1.22. This is presumably due to the exclusion of a large number of Māori and Pacific mothers for whom the DHB provides primary maternity care from the analysis. As there is no association in the unadjusted analysis, the multivariate analysis cannot exclude an association between ethnicity and stillbirth.

Indian mothers had higher odds than New Zealand European of stillbirth independent of age, socioeconomic status, smoking BMI and parity. Nulliparous women had higher odds than multiparous but age was not an independent risk factor. Increasing BMI above the normal range of 19–25 was independently associated with a significant increase in odds of stillbirth. The odds of stillbirth among smokers compared to non-smokers, adjusting for all other factors in the model, were 1.56 (95 percent CI 1.33–1.84).

The reason for the increase in magnitude of the association between Indian ethnicity and stillbirth after adjusting for confounders is not known, and persists if ethnic specific BMI categories are used (sensitivity analysis not presented here).

There was no association between older maternal age and stillbirth, excluding multiple births and congenital abnormalities, either before or after adjustment for potential confounders and the apparent association between maternal age under 20 and stillbirth was no longer evident after adjustment for confounders.

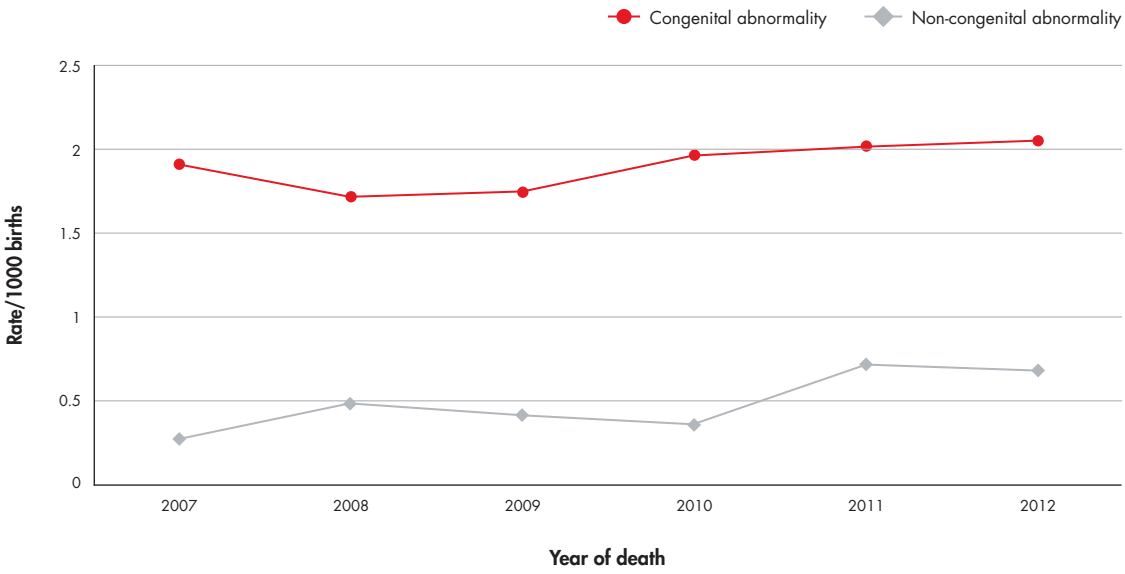
The association between NZDep2006 as a measure of socioeconomic deprivation also became non-significant in the multivariate analysis.

The following women are at increased risk of a stillbirth
(excluding stillbirth from multiple pregnancy and congenital abnormality):
• women who have a high BMI – as the BMI increases over 25, the risk increases
• women who smoke during pregnancy
• women of Indian ethnicity
• women having their first baby
(each of these risk factors is independent of the others and of age and socioeconomic deprivation).

Termination of pregnancy

There has been a significant increase in the rate of late termination of pregnancy 2007–2012 (score test for trend; p=0.005).

Figure 1.33: Termination of pregnancy rate (per 1000 births) by PSANZ-PDC (congenital abnormality and other PSANZ-PDC) 2007–2012



There has been no significant change in the numbers of late terminations due to congenital abnormality or in the rate of termination due to congenital abnormalities. There has been a significant increase in terminations of pregnancy associated with non-congenital conditions (Figure 1.33). This is an increase from 18 to 43 absolute cases from 2007 to 2012. These terminations are associated with perinatal infection, hypertension, antepartum haemorrhage, maternal conditions, specific perinatal conditions, fetal growth restriction and spontaneous preterm birth sequelae.

There were 22 terminations performed after 24 weeks gestation in 2012. The primary antecedent classifications for these cases were congenital abnormality in 16 and perinatal infection, hypertension, maternal condition and specific perinatal conditions in the remainder.

Neonatal deaths

Figure 1.34: Neonatal death rate (per 1000 total live births) by gestational age group 2007–2012

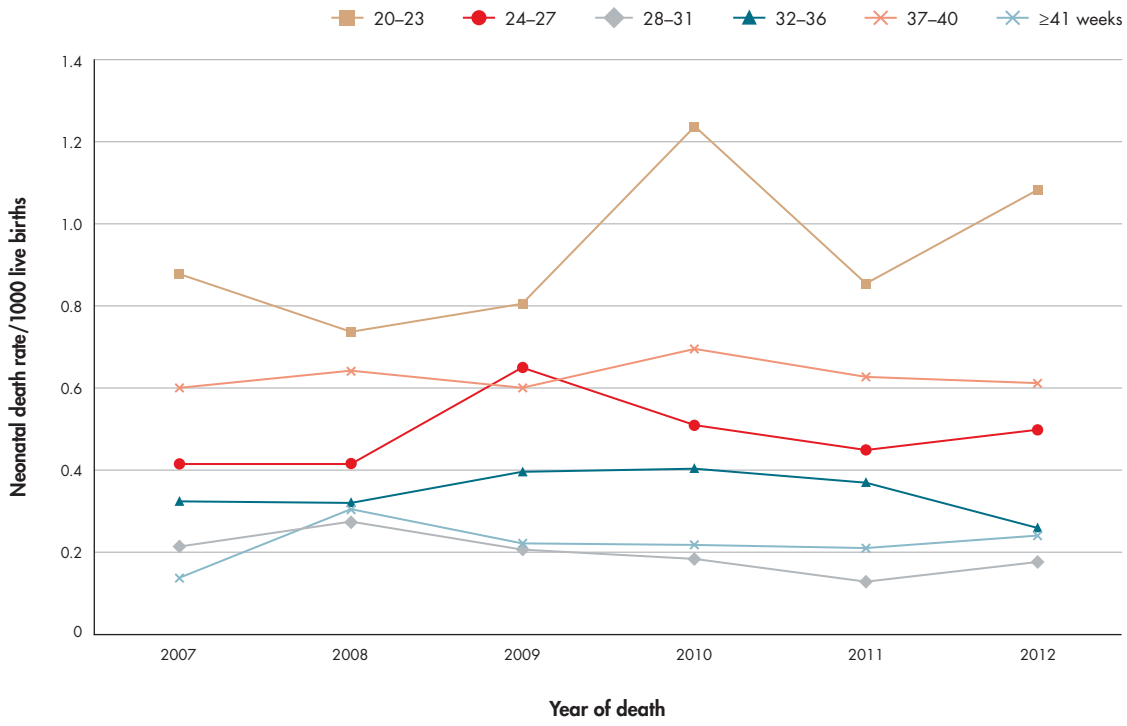


Figure 1.34 shows neonatal death rates by gestation per year. The denominator is total live births. This figure illustrates that the burden of neonatal deaths is highest at early gestations and again at term.

There appears to have been an increase in the neonatal death rate at 20–23 weeks from 2007 to 2012; however, the increase is not statistically significant (chi-squared test for trend p=0.07).

In 2007–2012, more than half (56 percent) of 20–23 week neonatal deaths were due to spontaneous preterm birth and 23 percent to antepartum haemorrhage.

Numbers of neonatal deaths do not appear to have changed at later gestations and the neonatal death rate overall has been relatively stable over the years 2007–2012 (Figure 1.12 on page 35), with fluctuations consistent with random variation. There are no statistically significant changes in cause of neonatal death, as seen in Figure 1.35 perinatal death classification (PSANZ-PDC) and Figure 1.36 neonatal death classification (PSANZ-NDC).

Figure 1.35: Perinatal death classification (PSANZ-PDC) specific neonatal death rates (per 1000 live births) over time 2007–2012

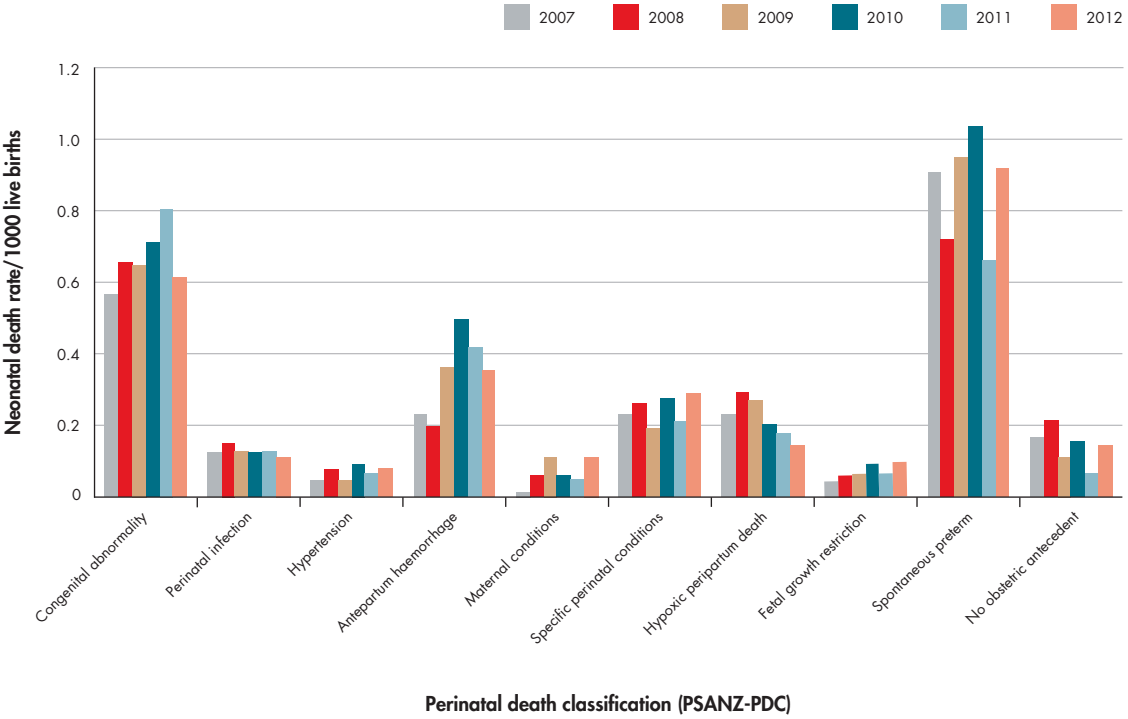


Figure 1.36: Neonatal death classification (PSANZ-NDC) specific neonatal death rates (per 1000 live births) over time 2007–2012

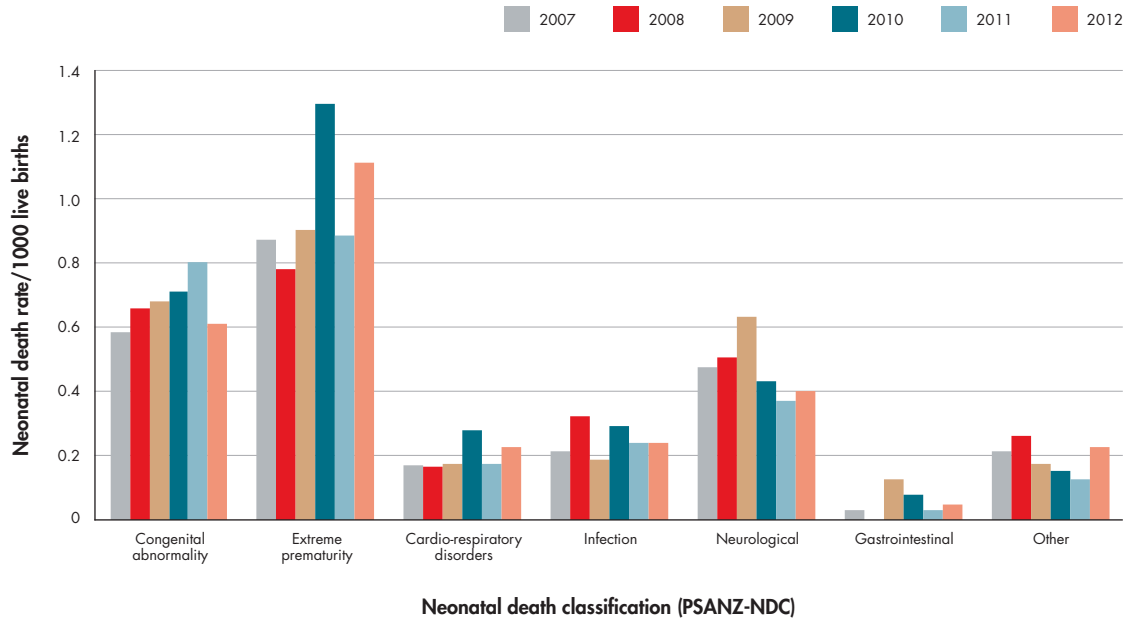


Table 1.23: Clinical details of neonatal deaths 2012

	Total		Congenital abnormalities		Neonatal deaths excluding congenital abnormalities							
					20–23		24–27		28–36		≥37 weeks	
	n=178		n=39		n=65		n=30		n=15		n=29	
	n	%	n	%	n	%	n	%	n	%	n	%
Age at death (days)												
0	95	53.4	12	30.8	57	87.7	11	36.7	5	33.3	10	34.5
1–6	47	26.4	13	33.3	6	9.2	12	40.0	5	33.3	11	37.9
7–13	23	12.9	11	28.2	2	3.1	4	13.3	2	13.3	4	13.8
14–20	7	3.9	2	5.1	-	-	1	3.3	1	6.7	3	10.3
21–27	6	3.4	1	2.6	-	-	2	6.7	2	13.3	1	3.4
Place of death												
Home	13	7.3	4	10.3	-	-	1	3.3	2	13.3	6	20.7
Hospital												
Delivery suite	56	31.5	5	12.8	38	58.5	6	20.0	4	26.7	3	10.3
Antenatal ward	1	0.6	-	-	1	1.5	-	-	-	-	-	-
Postnatal ward	5	2.8	3	7.7	1	1.5	-	-	-	-	1	3.4
Neonatal unit	59	33.1	15	38.5	5	7.7	21	70.0	8	53.3	10	34.5
Operating theatre	8	4.5	2	5.1	1	1.5	1	3.3	1	6.7	3	10.3
Emergency department	7	3.9	1	2.6	5	7.7	1	3.3	-	-	-	-
Other	25	14.0	8	20.5	13	20.0	-	-	-	-	4	13.8
Other	4	2.2	1	2.6	1	1.5	-	-	-	-	2	6.9
Apgar 5 minutes												
0–3	74	41.6	6	15.4	39	60.0	9	30.0	8	53.3	12	41.4
4–5	21	11.8	6	15.4	6	9.2	5	16.7	1	6.7	3	10.3
6–7	28	15.7	13	33.3	4	6.2	8	26.7	2	13.3	1	3.4
≥8	33	18.5	13	33.3	-	-	5	16.7	4	26.7	11	37.9
Unknown	22	12.4	1	2.6	16	24.6	3	10.0	-	-	2	6.9
Resuscitation at birth												
Yes	88	49.4	20	51.3	9	13.8	28	93.3	15	100.0	16	55.2
No	90	50.6	19	48.7	56	86.2	2	6.7	-	-	13	44.8
Outcome of resuscitation												
Baby resuscitated and transferred to another clinical care area	66	37.1	19	48.7	5	7.7	21	70.0	9	60.0	12	41.4
Baby unable to be resuscitated	21	11.8	1	2.6	4	6.2	6	20.0	6	40.0	4	13.8
Unknown	1	0.6	-	-	-	-	1	3.3	-	-	-	-

There were 178 neonatal deaths in 2012, of which 95 occurred within the first day, and 142 (80 percent) within the first seven days of life.

Neonatal deaths in Table 1.23 have been categorised as those due to congenital abnormalities and then by gestational age where congenital abnormalities have been excluded: extreme preterm (<24 weeks), very preterm (24–27 weeks), late preterm (28–36 weeks) and term (≥37 weeks).

Thirty-nine (22 percent) of the babies who died in the neonatal period had a congenital abnormality. Of the 139 babies that died without evidence of a congenital abnormality, 95 (68 percent) were born prior to 28 weeks gestation.

In the extreme preterm population, the majority (56/65 (86 percent)) did not receive resuscitation in the delivery unit. In the very preterm population, the majority (28/30 (93 percent)) did receive resuscitation. In the 28–36 week population there were 15 neonatal deaths, all of whom received resuscitation but in only 9 (60 percent) was it successful. This is a similar pattern to that seen in term infants.

Twenty-nine babies (16 percent of total/21 percent of those without identified congenital anomalies) died during the neonatal period following a term birth. Sixteen (55 percent) of these required resuscitation following birth and in 75 percent of these cases this allowed transfer of the baby from the delivery unit. Four babies (25 percent) were unable to be resuscitated. In 13 cases (45 percent) there was no immediate requirement for resuscitation in the delivery unit in a baby who later died.

There were six cases of SUDI among the neonatal deaths in 2012 (10 in 2008, 7 in 2009, 8 in 2010 and 5 in 2011). Four of these six mothers were Māori, four were smokers and five babies were co-sleeping.

Figure 1.37: Distribution of neonatal death classification (PSANZ-NDC) among neonatal deaths without lethal congenital abnormality by gestational age group 2007–2012

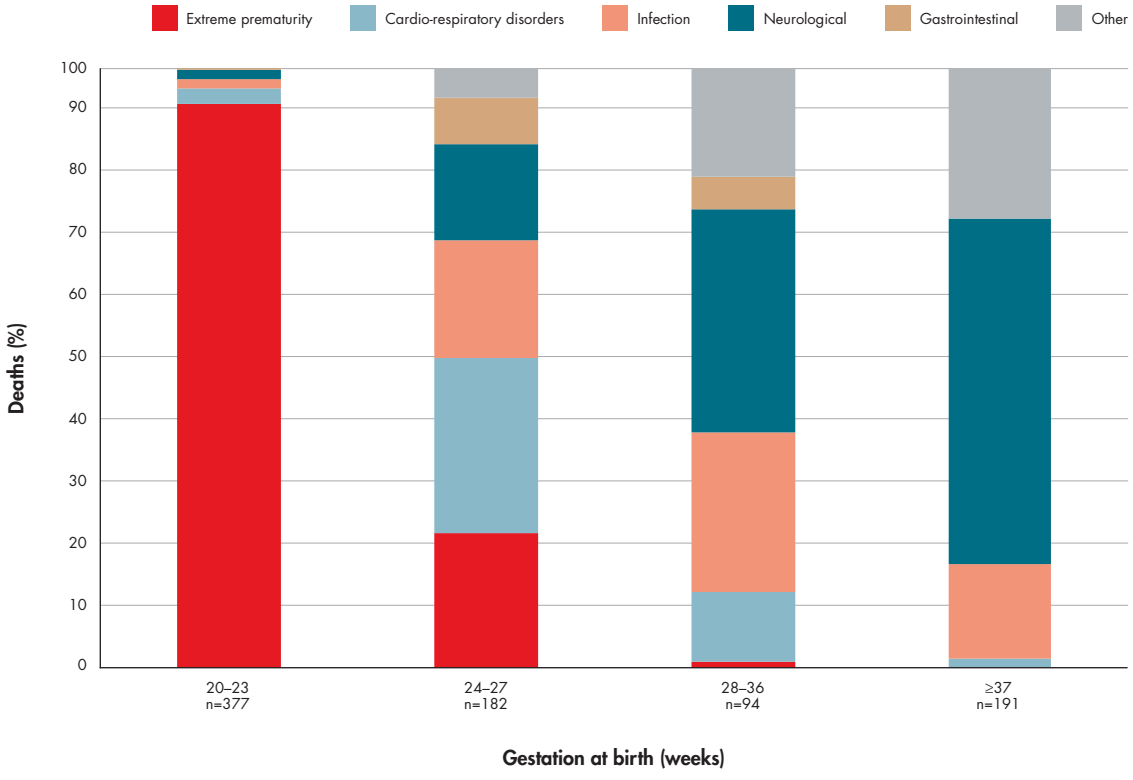
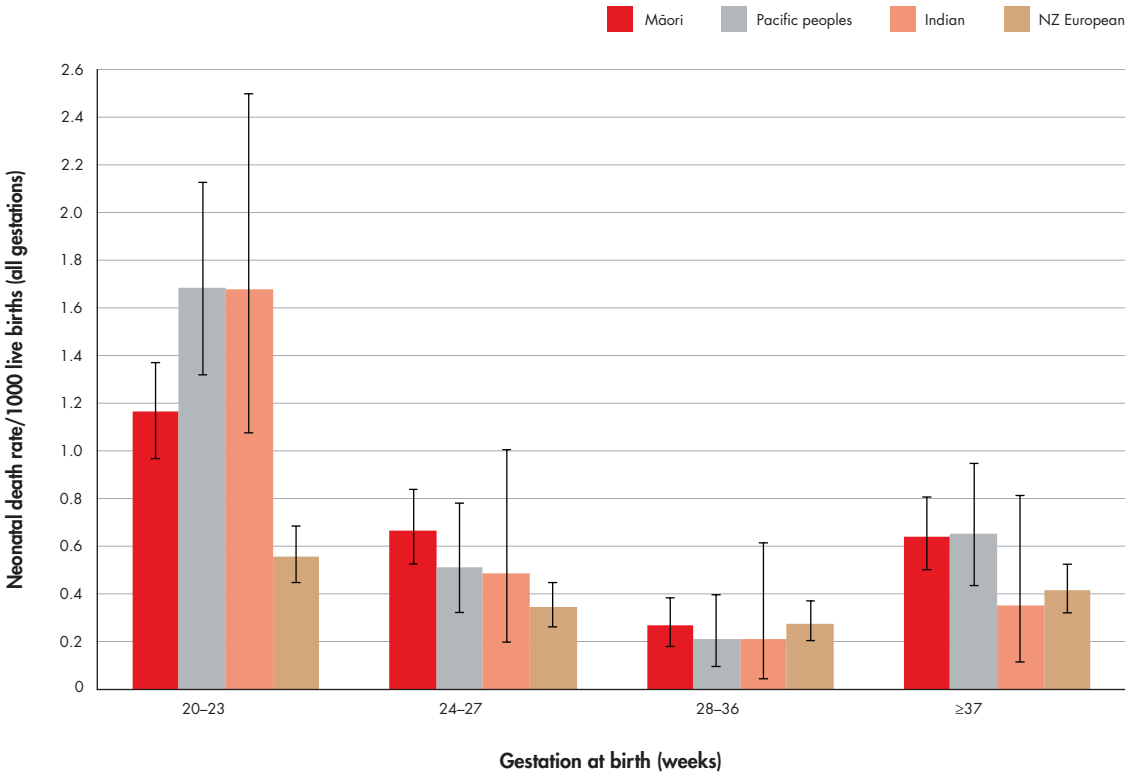


Figure 1.37 shows the distribution of cause of neonatal death (PSANZ-NDC) among extreme preterm, very preterm, late preterm and term babies, after excluding congenital abnormality.

Extreme prematurity is the cause of death in almost all live born babies at the extreme preterm end of neonatal deaths (20–23 weeks). Prematurity, as the principal cause of death, has reduced to around 20 percent of live born 'very preterm' babies, although the 30 percent of babies dying from cardio-respiratory disorders mostly died of hyaline membrane disease, bronchopulmonary dysplasia and pulmonary hypoplasia, which are recognised complications of premature birth. Among 28–36 week live born babies, neurological disorders are the most common cause of death. In this dataset, the neurological cause of death both in 28–36 week and term infants is almost exclusively hypoxic ischaemic encephalopathy (damage to the brain due to lack of oxygen).

Figure 1.38: Neonatal death rate (per 1000 live births) by gestation at birth and baby ethnicity (prioritised) 2007–2012 (excluding congenital abnormalities)



We know that there are ethnic disparities in neonatal death rates (the overall perinatal related death rate for Māori, Pacific and Indian mothers is higher than among Other Asian, Other and New Zealand European mothers) (Figure 1.21).

Figure 1.38 shows the rate of neonatal death excluding congenital abnormalities (as a proportion of total live births) at each gestation by prioritised ethnicity for Māori, Pacific, Indian and New Zealand European mothers. Māori, Pacific and Indian neonates were significantly more likely to die at 20–23 weeks than at any later gestation and also more likely to die at 20–23 weeks than New Zealand European neonates, reflecting the higher rates of preterm birth among these ethnic groups. Successful interventions to prevent preterm birth would reduce the ethnic disparities in neonatal and perinatal mortality.

The neonatal death rates by gestation were more similar for New Zealand European neonates, although they were significantly more likely to die at 20–23 weeks than at 28–36 weeks.

Adjusted associations between demographic variables and neonatal death

Figure 1.37 and Figure 1.38 show the strong associations between cause of death and gestation at birth among neonatal deaths and between gestation at birth and neonatal death by ethnicity. For these reasons, the multivariate analysis for neonatal death to determine the independent effects of ethnicity, age, socioeconomic status, parity, BMI and smoking was undertaken predicting neonatal death before and after 28 weeks separately.

Following is a copy of the outline of the methodology of this multivariate analysis, specifically the data used and relevant limitations in interpretation, as first described in the section 'Adjusted associations between demographic variables and stillbirth' on page 67, where further detail can be found.

The MAT dataset has been used for the multivariate analyses presented in this report to estimate the independent associations of ethnicity, age, deprivation decile, smoking, parity and BMI, with stillbirth and neonatal death. **NB:** Only data for perinatal related deaths where the match between the PMMRC dataset and the MAT dataset was successful have been included in these analyses, and MAT data only were used for the analysis.

The deaths identified by the PMMRC process were matched with the MAT dataset (using maternal NHI and date of birth, within a four-week range either side of the PMMRC recorded date of birth). This matching process was successful for 95.9 percent of perinatal related deaths (95.0 percent of late terminations, 95.1 percent of stillbirths and 98.2 percent of neonatal deaths).

For the multivariate analysis, because there is a systematic difference in availability of smoking and BMI data by LMC at registration, and LMC at registration is associated with perinatal related death (specifically this applies to mothers under the care of hospital primary maternity services), all births and deaths where LMC at registration is 'No LMC' or 'Other LMC' have been excluded, along with all births and deaths in 2007. This is unfortunate as it reduces the data available for analysis for some high risk groups (such as many Pacific mothers who reside in the Counties Manukau and Auckland DHB areas), thus reducing the statistical power and generalisability of the findings.

The findings of the multivariate analysis are restricted to 2008–2012 (90 percent of all smoking and BMI data are missing from the 2007 MAT dataset), to mothers who registered with an LMC (self-employed midwife, GP or private obstetrician) and who have a complete set of data for the variables included in the analysis; that is, ethnicity, maternal age, NZDep2006 decile, smoking, BMI, parity, plurality (multiple or singleton pregnancy) and year of baby's birth. It is probable that the findings can be extrapolated to mothers outside of these criteria but this cannot currently be tested.

Table 1.24: Unadjusted and adjusted associations between demographic variables and neonatal death of babies born at 20–27 weeks and from 28 weeks gestation among mothers registered with an LMC 2008–2012 (excluding multiple births, late terminations, stillbirths and congenital abnormalities)

	Neonatal death 20–27 weeks				Neonatal death ≥28 weeks			
	Neonatal deaths n=198 Live births n=262,996		Neonatal deaths n=198 Live births n=261,867		Neonatal deaths n=177 Live births n=262,996		Neonatal deaths n=177 Live births n=261,867	
	OR unadjusted	95% CI	OR adjusted	95% CI	OR unadjusted	95% CI	OR adjusted	95% CI
Ethnicity								
Māori	2.13	1.51–3.00	1.62	1.10–2.38	1.77	1.26–2.47	1.23	0.84–1.80
Pacific peoples	2.3	1.46–3.63	2.02	1.24–3.29	1.48	0.90–2.44	1.28	0.75–2.17
Indian	1.58	0.68–3.66	1.56	0.67–3.64	0.46	0.11–1.86	0.49	0.12–2.00
Other Asian	1.38	0.77–2.47	1.43	0.79–2.59	0.43	0.17–1.06	0.49	0.20–1.23
Other	1.24	0.75–2.06	1.3	0.78–2.16	0.7	0.39–1.27	0.77	0.42–1.39
NZ European	Referent		Referent		Referent		Referent	
NZDep2006 centile (per centile)	1.11	1.05–1.17	1.06	1.00–1.12	1.1	1.04–1.16	1.04	0.98–1.10
Smoking								
Smoker	1.92	1.41–2.61	1.6	1.13–2.26	2.49	1.82–3.40	1.9	1.34–2.69
Non-smoker	Referent		Referent		Referent		Referent	
BMI (kg/m²)								
BMI <18.50	1.18	0.52–2.71	1.11	0.48–2.56	0.68	0.21–2.16	0.71	0.22–2.27
BMI 18.50–24.99	Referent		Referent		Referent		Referent	
BMI 25.00–29.99	1.19	0.85–1.66	1.09	0.78–1.53	1.27	0.90–1.81	1.13	0.79–1.62
BMI 30.00–34.99	1.44	0.96–2.17	1.2	0.79–1.84	1.51	0.98–2.32	1.23	0.79–1.91
BMI 35.00–39.99	1.5	0.87–2.60	1.19	0.68–2.11	1.38	0.75–2.55	1.09	0.58–2.04
BMI ≥40	0.73	0.27–1.99	0.57	0.21–1.59	1.47	0.68–3.20	1.17	0.53–2.57
Age (years)								
<20	1.83	1.18–2.83	1.19	0.74–1.91	2.22	1.45–3.39	1.45	0.91–2.32
20–39	Referent		Referent		Referent		Referent	
≥40	1.42	0.75–2.68	1.65	0.87–3.15	0.63	0.23–1.70	0.71	0.26–1.93
Parity								
Nulliparous	1.29	0.98–1.70	1.38	1.02–1.86	1.18	0.87–1.58	1.23	0.89–1.69
Multiparous	Referent		Referent		Referent		Referent	

Red indicates statistically significant increased or decreased odds.

There were 710 singleton neonatal deaths and 307,135 singleton live births from 2008 to 2012. The analysis reported in Table 1.24 (excluding births where there was 'No LMC' or 'Other LMC' (assumed to be hospital or DHB maternity services)) potentially included 529 (74.5 percent) of singleton neonatal deaths and 265,106 (86.3 percent) of singleton live births. One hundred and fifty-four (29.1 percent) of eligible singleton neonatal deaths were excluded because of lethal or terminated congenital abnormality.

As noted above, exclusion of mothers because of missing data reduces the power of the analysis and also the reliability of the findings for generalising to the total population. A small number of further births were excluded from the final model because of missing data for at least one of the variables in the model.

Maternal smoking is independently associated with neonatal death at all gestations. Maternal BMI is not associated with neonatal death at either gestation, either in unadjusted or adjusted analyses.

Māori and Pacific ethnicity and nulliparity are independently associated with neonatal death of babies born at less than 28 weeks, presumably associated with preterm birth, as this is the most common cause of death at early gestations. However, the association between age under 20 years and neonatal death of babies born before 28 weeks is no longer significant after adjusting for the other variables in the analysis.

Only smoking was independently associated with neonatal death after birth at 28 or more weeks gestation.

The following women are at increased risk of a neonatal death after birth at 20–27 weeks gestation:
- *women of Māori and Pacific ethnicity*
- *women who smoke during pregnancy*
- *women living in areas of high socioeconomic deprivation*
- *women having their first baby*

(each of these risk factors is independent of the others and of age and BMI).

Women who smoke during pregnancy are also at increased risk of a neonatal death after birth at >28 weeks gestation, independent of ethnicity, socioeconomic deprivation, age, parity and BMI.

Table 1.25: Association between perinatal death classification (PSANZ-PDC) and neonatal death classification (PSANZ-NDC) among neonatal deaths 2012

Perinatal death classification (PSANZ-PDC)	Total	Neonatal death classification (PSANZ-NDC)						
		Congenital abnormality	Extreme prematurity	Cardio-respiratory disorders	Infection	Neurological	Gastro-intestinal	Other
Congenital abnormality	**38**	37	1	-	-	-	-	-
Perinatal infection	**7**	-	1	-	5	-	-	1
Hypertension	**5**	-	2	1	1	1	-	-
Antepartum haemorrhage	**22**	-	13	-	3	4	1	1
Maternal conditions	**7**	1	3	-	-	1	-	2
Specific perinatal conditions	**18**	-	13	-	1	2	-	2
Hypoxic peripartum death	**9**	-	-	-	-	9	-	-
Fetal growth restriction	**6**	-	-	2	-	2	1	1
Spontaneous preterm	**57**	-	36	10	3	5	1	2
No obstetric antecedent	**9**	-	-	1	2	1	-	5

All neonatal deaths are assigned at least one neonatal death classification (PSANZ-NDC), along with a perinatal death classification (PSANZ-PDC). Table 1.25 demonstrates how these classification systems relate to each other. For example, death from extreme prematurity followed spontaneous preterm birth (36) but also antepartum haemorrhage (13) and specific perinatal conditions (13), along with congenital abnormality, perinatal infection, hypertension and maternal conditions. Neurological deaths are common in neonates, but in a least 50 percent of cases, there was an underlying obstetric cause other than hypoxic peripartum death.

Multiple births

Table 1.26: Perinatal related death rates (per 1000 births) and multiple* births 2012

Type of birth	Total births		Fetal deaths						Neonatal deaths			Perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	n=62,425		n=171			n=320			n=178			n=669		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Singleton	60,676	97.2	157	91.8	2.59	285	89.1	4.70	145	81.5	2.41	587	87.7	9.67
Multiple	1,749	2.8	14	8.2	8.00	35	10.9	20.01	33	18.5	19.41	82	12.3	46.88
Multiples (1/2 died)			2	1.2		16	5.0		9	5.1		27	4.0	
Multiples (2/2 died)			12	7.0		18	5.6		18	10.1		48	7.2	
Multiples (1/3 died)			-	-		1	0.3		-	-		1	0.1	
Multiples (2/3 died)			-	-		-	-		-	-		-	-	
Multiples (3/3 died)			-	-		-	-		6	3.4		6	0.9	
Twin	1,692	2.7	14	8.2	8.27	34	10.6	20.09	27	15.2	16.42	75	11.2	44.33
Dichorionic diamniotic			4	2.3		9	2.8		12	6.7		25	3.7	
Monochorionic diamniotic			8	4.7		22	6.9		14	7.9		44	6.6	
Monoamniotic			2	1.2		-	-		-	-		2	0.3	
Unknown			-	-		3	0.9		1	0.6		4	0.6	

* Multiples include twins, triplets and higher-order births.

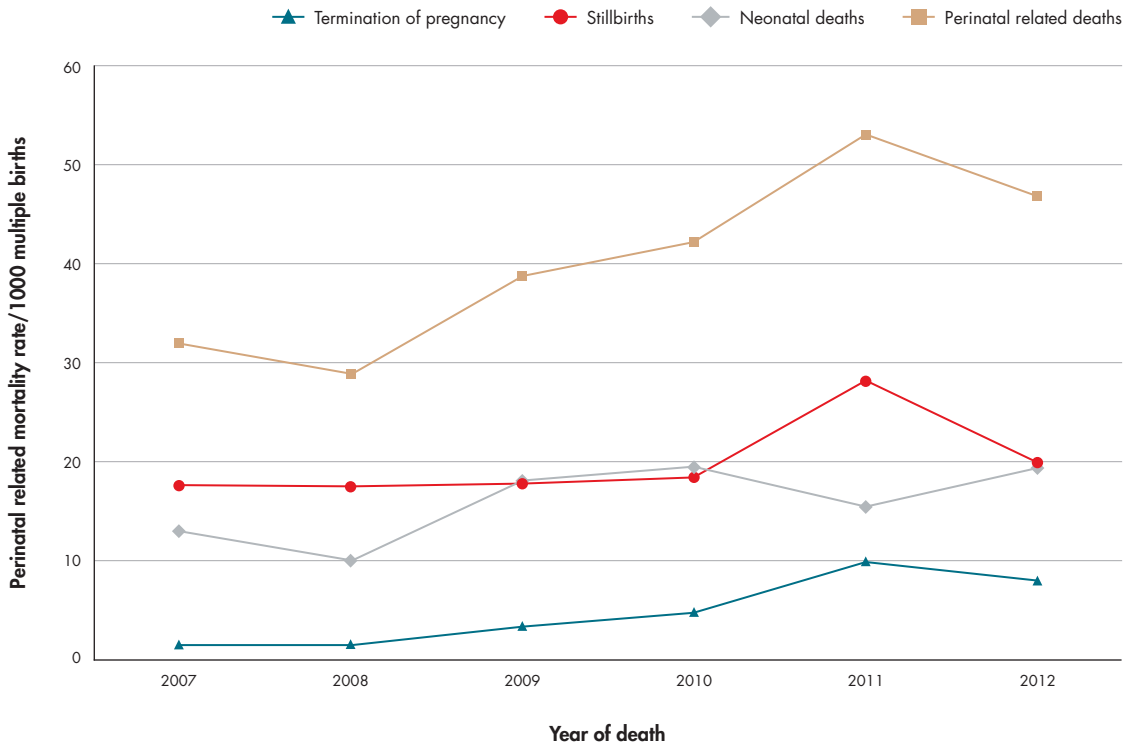
In 2012, 82 perinatal related deaths occurred in multiple pregnancies. The majority of these (75) were twin pregnancies with one twin dying in 27 twin pregnancies and both twins dying in 24 twin pregnancies.

The perinatal related mortality rate in 2012 among babies born in multiple pregnancies was 47/1000 babies or almost 1 baby in every 20 babies born in a multiple pregnancy. This compares to approximately 1 baby in every 100 singleton babies born.

Table 1.27: Perinatal related death rates among babies born in multiple pregnancies 2007–2012

Year of death	Total multiple births	Fetal deaths				Neonatal deaths		Perinatal related deaths	
		Termination of pregnancy		Stillbirths					
		n=53		n=223		n=173		n=449	
		n	Rate	n	Rate	n	Rate	n	Rate
2007	2,033	3	1.48	36	17.71	26	13.04	65	31.97
2008	1,940	3	1.55	34	17.53	19	9.98	56	28.87
2009	1,803	6	3.33	32	17.75	32	18.13	70	38.82
2010	1,896	9	4.75	35	18.46	36	19.44	80	42.19
2011	1,811	18	9.94	51	28.16	27	15.50	96	53.01
2012	1,749	14	8.00	35	20.01	33	19.41	82	46.88

Figure 1.39: Perinatal related death rates (per 1000 births) among babies born in multiple pregnancies 2007–2012



The perinatal related mortality rate, although lower in 2012 than 2011, has increased significantly over the years 2007–2012. This rise was analysed in detail in the seventh annual report of the PMMRC (PMMRC 2013).

Cause of death among multiple pregnancy deaths

The most common causes of death among babies dying in multiple pregnancies is specific perinatal conditions, of which twin–twin transfusion syndrome is the most common. Spontaneous preterm birth is the second most common cause of death in multiple pregnancies, occurring seven times more commonly than in singleton pregnancies.

Multiple pregnancies also have significantly higher perinatal related death rates from congenital abnormality, perinatal infection, antepartum haemorrhage, fetal growth restriction and unexplained antepartum death than singleton pregnancies.

While the risk of mortality is higher at all gestational ages for multiples than singletons, the greatest excess of risk is between 20 and 24 weeks and the cause of death at this gestation is most often spontaneous preterm birth or specific perinatal condition.

Table 1.28: Chorionicity and number of babies lost among twin perinatal related deaths 2007–2012

	2007		2008		2009		2010		2011		2012		Total	
	n=64		n=52		n=59		n=78		n=90		n=75		n=418	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Twin type														
Dichorionic diamniotic	29	45.3	25	48.1	19	32.2	35	44.9	47	52.2	25	33.3	180	43.1
Monochorionic diamniotic	30	46.9	26	50.0	33	55.9	33	42.3	39	43.3	44	58.7	205	49.0
Monoamniotic	2	3.1	-	-	4	6.8	7	9.0	-	-	2	2.7	15	3.6
Unknown	3	4.7	1	1.9	3	5.1	3	3.8	4	4.4	4	5.3	18	4.3
Loss of twin pairs or one twin														
Both twins died	35	54.7	26	49.1	32	52.5	48	60.8	60	66.7	48	66.7	249	59.6
One twin died	29	45.3	26	50.9	27	47.5	30	39.2	30	33.3	27	33.3	169	40.4

It is known that twin babies who share a placenta (monochorionic) contribute disproportionately to twin deaths, generally from twin–twin transfusion syndrome as a result of communicating circulations in the placenta. More than half of perinatal related deaths of monochorionic twins in New Zealand are due to twin–twin transfusion syndrome.

Multiple birth and infertility treatment 2007–2012

Table 1.29: Contribution of fertility treatment to perinatal related mortality by plurality 2007–2012

	Singleton perinatal related deaths		Multiple perinatal related deaths		Perinatal related deaths	
	n=3,692		n=449		n=4,141	
	n	%	n	%	n	%
Clomiphene	36	1.0	15	3.3	51	1.2
Follicle-stimulating hormone (FSH)	1	0.0	5	1.1	6	0.1
In vitro fertilisation (IVF; including ICSI)	81	2.2	60	13.4	141	3.4
Any of clomiphene/FSH/IVF	**117**	**3.2**	**74**	**16.5**	**191**	**4.6**

ICSI = intracytoplasmic sperm injection.

One hundred and ninety-one (4.6 percent) perinatal related deaths in 2007–2012 are known to have been of babies conceived using fertility treatment (Clomiphene, follicle-stimulating hormone (FSH) and/or in vitro fertilisation (IVF)). Fertility treatment is more common among multiple pregnancy deaths (16.5 percent) than singleton pregnancy deaths (3.2 percent).

Fertility treatment in perinatal related deaths, and specifically IVF, is more common among dichorionic diamniotic (non-identical or fraternal twins) than among monochorionic diamniotic twins (identical twins), suggesting that twinning following IVF is due to multiple embryo replacement. A move in New Zealand to a universal policy of single embryo replacement could reduce the number of perinatal deaths of babies in multiple pregnancies.

Vaginal bleeding in pregnancy

Table 1.30: Perinatal related deaths and vaginal bleeding during pregnancy 2012

Vaginal bleeding	Fetal deaths				Neonatal deaths		Perinatal related deaths	
	Termination of pregnancy		Stillbirths					
	n=171		n=320		n=178		n=669	
	n	%	n	%	n	%	n	%
Yes	33	19.3	95	29.7	76	42.7	204	30.5
No	124	72.5	207	64.7	91	51.1	422	63.1
Unknown	14	8.2	18	5.6	11	6.2	43	6.4
Gestation* (weeks)								
<20	24	14.0	44	13.8	39	21.9	107	16.0
≥20	18	10.5	74	23.1	58	32.6	150	22.4

* Multiple bleeds can occur in pregnancy and can occur both before and after 20 weeks.

Antepartum haemorrhage (bleeding at or beyond 20 weeks) continues to be strongly associated with perinatal related death, especially among stillbirths (23.1 percent of stillbirths) and neonatal deaths (34.6 percent of deaths) in 2012.

Vaginal bleeding at any stage in pregnancy is associated with increased risk of an SGA baby and preterm labour, which in turn may increase the risk of fetal compromise in labour. Best practice for vaginal bleeding in pregnancy was outlined on page 75 of the seventh annual report (PMMRC 2013).

Small for gestational age (SGA) infants

Table 1.31: Perinatal related deaths and small for gestational age (customised SGA) 2012 (singleton deaths without congenital abnormalities)

	Fetal deaths							
	Termination of pregnancy		Stillbirths		Neonatal deaths		Perinatal related deaths	
Singleton deaths ≥20 weeks, excluding congenital abnormalities	n	%	n	%	n	%	n	%
	n=35		**n=254**		**n=109**		**n=398**	
SGA	27	77.1	110	43.3	35	32.1	172	43.2
Singleton deaths ≥24 weeks, excluding congenital abnormalities	**n=6**		**n=175**		**n=66**		**n=247**	
SGA	4	66.7	59	33.7	17	25.8	80	32.4

SGA = small for gestational age; birthweight less than 10th customised centile.

Customised birthweight centiles adjust for gender, gestation, ethnicity, maternal age, parity and BMI. SGA has been defined as a customised birthweight less than the 10th centile. Customised birthweight centiles were not calculated if gestation at death was less than 20 weeks, was unknown or if a week or more had elapsed between fetal death and birth (because of the unknown effect of prolonged time in utero following fetal death on birthweight).

Of singleton babies who delivered from 24 weeks without congenital abnormality, 34 percent of those who were stillborn, and 26 percent of those who died in the first 27 days of life, were small by customised birthweight centile. Of these 76 babies in 2012, the primary cause of death was fetal growth restriction in 35 (46 percent), hypertension in 8 (11 percent), and unexplained in 11 (14 percent), with the remaining 22 spread in smaller numbers across all other perinatal death classifications.

The proportion of SGA stillbirths and neonatal deaths of all births from 2007 to 2012 has not changed significantly.

Antenatal identification of small for gestational age (SGA) infants

Table 1.32: Antenatal diagnosis of small for gestational age (customised SGA) singletons among stillbirths and neonatal deaths at 24 weeks gestation or more excluding congenital abnormalities 2007–2012

		Suspected growth restriction									
		No		Yes and confirmed by scan		Yes but normal growth on scan		Yes but no scan performed		Unknown	
	Total	n	%	n	%	n	%	n	%	n	%
SGA stillbirths	**412**	232	56.3	93	22.6	30	7.3	15	3.6	42	10.2
SGA neonatal deaths	**96**	33	34.4	43	44.8	4	4.2	3	3.1	13	13.5

SGA was suspected in the antenatal period in 33 percent of stillborn SGA babies and 52 percent of SGA neonatal deaths of normally formed singleton babies at 24 weeks or more from 2007 to 2012.

Antenatal assessments routinely screen for SGA although identification of SGA is challenging using clinical assessments alone. The use of a customised growth chart is one tool which may improve detection to up to 50 percent of SGA babies antenatally (Roex 2012). Assessment of fetal wellbeing also includes a range of other ongoing assessments, such as fetal movements, and assessment of maternal health and wellbeing.

Once SGA is suspected, there needs to be a consistent pathway for further assessment and plan of care if SGA is identified.

The New Zealand Maternal Fetal Medicine Network guideline for the management of suspected small for gestational age singleton pregnancies after 34 weeks gestation can be found at http://www.healthpoint.co.nz/specialists/new-zealand-maternal-fetal-medicine-network/?solo=otherList&index=3

Maternity care

Antenatal caregiver

Table 1.33: Perinatal related deaths and maternal registration status 2012

Was the mother booked with an LMC?	Fetal deaths				Neonatal deaths		Perinatal related deaths	
	Termination of pregnancy		Stillbirths					
	n=171		n=320		n=178		n=669	
	n	%	n	%	n	%	n	%
Yes	**161**	**94.2**	**299**	**93.4**	**159**	**89.3**	**619**	**92.5**
Self-employed midwife	113	66.1	223	69.7	109	61.2	445	66.5
Hospital	29	17.0	63	19.7	39	21.9	131	19.6
General practitioner	6	3.5	3	0.9	1	0.6	10	1.5
Obstetrician (private)	13	7.6	8	2.5	10	5.6	31	4.6
Unknown LMC	-	-	2	0.6	-	-	2	0.3
No	**10**	**5.8**	**21**	**6.6**	**19**	**10.7**	**50**	**7.5**

These data relate to registration for maternity care (or booking). The proportion of unregistered mothers among mothers of babies who die in the perinatal period has remained unchanged over the years from 2007 to 2012. However, over this period there has been an increase in registration with self-employed midwives and a decrease in antenatal care provided by DHB (hospital) primary services, consistent with the trend among all births.

A comparison of LMC at registration between live births and perinatal related deaths using MAT data alone in 2012 shows a significantly higher registration of live births with a self-employed midwife (81 percent) compared to perinatal related deaths (72 percent). This is an expected finding given that many women experiencing a perinatal death have recognisable risk factors that would determine a need for secondary or tertiary care.

Table 1.34: Gestation at registration by lead maternity carer (LMC) among perinatal related deaths 2012

LMC	Gestation (weeks) at registration										
		<10		10–13		14–19		≥20		Unknown	
	n	n	%	n	%	n	%	n	%	n	%
Self-employed midwife	445	180	40.4	161	36.2	60	13.5	28	6.3	16	3.6
Hospital	131	29	22.1	34	26.0	45	34.4	21	16.0	2	1.5
General practitioner	10	9	90.0	1	10.0	-	-	-	-	-	-
Obstetrician (private)	31	22	71.0	6	19.4	-	-	-	-	3	9.7
Unknown LMC	2	1	50.0	1	50.0	-	-	-	-	-	-

Seventy-one percent of mothers who registered with an LMC were registered before 14 weeks and 39 percent by 10 weeks in 2012. Eleven percent registered at 20 weeks or later. Women who registered with private obstetricians or GPs were the earliest to register, followed by mothers registered with self-employed midwives.

These data compare to 72.0 percent of mothers registered with a self-employed LMC before 14 weeks and 11.4 percent registered at 20 weeks or later in the MAT dataset 2011. Further analysis, including women registered for antenatal care with a DHB maternity service, is necessary to determine whether perinatal mortality was associated with late registration and suboptimal frequency of antenatal care.

Table 1.35: Lead maternity carer (LMC) at registration and birth among stillbirths and neonatal deaths 2012

LMC at registration	Total		LMC at birth									
			Self-employed midwife		Hospital		General practitioner		Obstetrician (private)		Not stated	
	n=458		n=170		n=272		n=1		n=14		n=1	
	n	%	n	%	n	%	n	%	n	%	n	%
Self-employed midwife	332	36.2	167	50.3	165	49.7	-	-	-	-	-	-
Hospital	102	11.1	3	2.9	98	96.1	-	-	-	-	1	1.0
General practitioner	4	0.4	-	-	3	75.0	1	25.0	-	-	-	-
Obstetrician (private)	18	2.0	-	-	4	22.2	-	-	14	77.8	-	-
Unknown LMC	2	0.2	-	-	2	11.1	-	-	-	-	-	-
Total	**458**		**170**	**37.1**	**272**	**59.4**	**1**	**0.2**	**14**	**3.1**	**1**	**0.2**

In 2012, the MAT dataset recorded the registered LMC at birth as a self-employed midwife for 82.5 percent of mothers, a self-employed obstetrician for 5.8 percent, a GP for 1.0 percent and a hospital LMC or no LMC for the remaining 10.7 percent of mothers.

Among stillbirths and neonatal deaths, 37 percent were registered with a self-employed midwife, 3 percent with a private obstetrician and 59 percent with a hospital service at the time of birth.

The changes in caregiver from registration to birth in this context are likely to represent appropriate transfer of at-risk mothers for secondary or tertiary care. It was unusual for transfers to occur from a hospital service to a primary care provider among these perinatal related deaths.

Screening for diabetes in pregnancy

Table 1.36: Screening for diabetes among registered women with no pre-existing diabetes and where stillbirth and neonatal death occurred at or beyond 28 weeks gestation 2012

Screened for diabetes	n=235	
	n	%
Yes	177	75.3
No	48	20.4
Unknown	6	2.6
Declined	4	1.7

Over the five years since the PMMRC started reporting, it has been difficult to accurately estimate the proportion of women screened for diabetes, as these data have often been missing in the PMMRC dataset. However, in 2012, screening status was only unknown in 2.6 percent of eligible cases. As more data have been returned each year, it has become evident that the screening rate may have been higher than initially estimated.

It is not known whether the improvement in screening from 57 percent in 2007 to 75 percent in 2012 is due to the improvement in data collection alone or whether there has also been an increase in penetrance of screening in the population.

Screening for diabetes in pregnancy is recommended for all women between 24 and 28 weeks by the Ministry of Health, RANZCOG and the New Zealand College of Midwives.

Screening for and experience of family violence in pregnancy

Table 1.37: Perinatal related deaths and screening for family violence 2012

	Fetal deaths							
	Termination of pregnancy		Stillbirths		Neonatal deaths		Perinatal related deaths	
	n=171		n=320		n=178		n=669	
	n	%	n	%	n	%	n	%
Experienced family violence								
Yes	5	2.9	6	1.9	6	3.4	17	2.5
No	73	42.7	166	51.9	77	43.3	316	47.2
Not asked	48	28.1	59	18.4	30	16.9	137	20.5
Unknown	45	26.3	89	27.8	65	36.5	199	29.7
Referral to relevant support								
Yes	4	80.0	4	66.7	4	66.7	12	70.6
No	-	-	-	-	1	16.7	1	5.9
Unknown	1	20.0	2	33.3	1	16.7	4	23.5

In 2002, the Ministry of Health published national guidelines for family violence interventions (Ministry of Health 2002).

Data on screening for family violence are not well reported by LMCs to the PMMRC. Unlike data on screening for diabetes, data on screening for family violence have not improved in the past five years. There remain 50 percent of women whose babies died where no data are reported on whether they were screened for or experienced family violence.

Of the 17 disclosures in 2012, 12 were reported to have been referred for support.

There remain 50 percent of women whose babies died where no data are reported on whether they were screened for or experienced family violence.

The focus moving forward is on supporting health professionals (both in DHBs and independent practitioners) to ensure the level of screening increases over time until it becomes routine.

Place of birth and antenatal transfer

Table 1.38: Intended place of birth versus actual place of birth among stillbirths and neonatal deaths 2012

Intended place of birth	Total	Actual place of birth													
		Home		Birthing unit		Hospital level 1		Hospital level 2		Hospital level 3		Other		Unknown	
		n	%	n	%	n	%	n	%	n	%	n	%	n	%
Home	**10**	3	30.0	-	-	1	10.0	5	50.0	1	10.0	-	-	-	-
Birthing unit	**37**	-	-	3	8.1	-	-	5	13.5	28	75.7	1	2.7	-	-
Hospital level 1	**23**	2	8.7	-	-	2	8.7	9	39.1	10	43.5	-	-	-	-
Hospital level 2	**177**	4	2.3	-	-	1	0.6	139	78.5	31	17.5	1	0.6	1	0.6
Hospital level 3	**209**	4	1.9	-	-	-	-	2	1.0	202	96.7	1	0.5	-	-
Other	**1**	-	-	-	-	-	-	-	-	1	100.0	-	-	-	-
Not registered	**31**	8	25.8	-	-	1	3.2	8	25.8	12	38.7	2	6.5	-	-
Unknown	**10**	-	-	-	-	1	10.0	3	30.0	6	60.0	-	-	-	-
Total	**498**	**21**	**4.2**	**3**	**0.6**	**6**	**1.2**	**171**	**34.3**	**291**	**58.4**	**5**	**1.0**	**1**	**0.2**

Transfer from an intended to an actual place of birth was common among stillbirths and neonatal deaths. These transfers were generally from an intended birth at a low-risk facility (at home, birthing unit or level 1 hospital) to a facility with capacity for higher-risk births (level 2 or 3 hospital facility). In 2012, 58 of 70 (83 percent) mothers intending to birth at home, in a birthing unit or a level 1 hospital birthed in level 2 or level 3 hospitals.

Investigation of perinatal related deaths

Table 1.39: Perinatal related deaths and completeness of perinatal death investigations 2012

Perinatal death investigation	Fetal deaths				Neonatal deaths		Perinatal related deaths	
	Termination of pregnancy		Stillbirths					
	n=171		n=330		n=178		n=669	
	n	%	n	%	n	%	n	%
Optimal investigation*	90	52.6	137	42.8	68	38.2	295	44.1
Post-mortem	52	30.4	123	38.4	52	29.2	227	33.9
Karyotype	33	19.3	21	6.6	11	6.2	65	9.7
Clinical examination/investigations confirm diagnosis	11	6.4	9	2.8	10	5.6	30	4.5
Partial investigations only#	66	38.6	125	39.1	86	48.3	277	41.4
No investigation+	12	7.0	53	16.6	21	11.8	86	12.9
Unknown	3	1.8	5	1.6	3	1.7	11	1.6

* Optimal investigation was defined as full post-mortem and/or karyotype, clinical examination or investigations confirming diagnosis.
\# No post-mortem; investigations may have included placental pathology, MRI, ultrasound scan or x-ray.
\+ No post-mortem, placental pathology, MRI, ultrasound scan or x-ray.

Overall, 44 percent of perinatal related deaths were optimally investigated in 2012. Optimal investigation was defined as a post-mortem or a karyotype alone where it confirmed the diagnosis for a chromosomal abnormality. The rates of optimal investigation were 46, 49, 41, 45, 45 percent respectively in 2007–2011.

Rates of offer of post-mortem ranged from 63 percent in Lakes and 69 percent in Northland DHBs to 100 percent in Taranaki, Wairarapa, South Canterbury and Otago. Optimal investigation ranged from 21 percent in Bay of Plenty and 25 percent in Tairawhiti and West Coast DHBs to 86 percent in South Canterbury (Table A19).

Table 1.40: Perinatal related deaths and rate of offer and decline of post-mortem examination 2012

Post-mortem examination offered	Fetal deaths				Neonatal deaths		Perinatal related deaths	
	Termination of pregnancy		Stillbirths					
	n=171		n=320		n=178		n=669	
	n	%	n	%	n	%	n	%
Post-mortem offered and parental consent given	52	30.4	123	38.4	52	29.2	227	33.9
Post-mortem offered and parents declined	85	49.7	180	56.3	102	57.3	367	54.9
Post-mortem not offered	30	17.5	13	4.1	22	12.4	65	9.7
Unknown	4	2.3	4	1.3	2	1.1	10	1.5

Rates of offer and decline of a post-mortem are fairly consistent across the years. In 2012, a post-mortem was offered to 89 percent of parents. A post-mortem was declined following request in 55 percent of cases overall. A post-mortem was apparently not offered in 10 percent of perinatal related deaths (4 percent of stillbirths and 12 percent of neonatal deaths).

From 2007 to 2012, data on the usefulness of the post-mortem performed (as assessed by the PMMRC local coordinators) were collected in three-quarters of cases. Among the 75 percent of post-mortems where an assessment was made, the post-mortem changed the clinical diagnosis in 30 percent of cases, resulting in altered counselling to parents for future pregnancies. In 55 percent of cases, there was no change in diagnosis, and the post-mortem did not change the advice given to parents. In 9 percent of cases, further information was gained, but this did not change the clinical diagnosis. In a further 6 percent of cases, the post-mortem did not demonstrate an obvious cause of death or significant abnormality.

The post-mortem changed the clinical diagnosis in 30 percent of cases, resulting in altered counselling to parents for future pregnancies. In 9 percent of cases, further information was gained, but this did not change the clinical diagnosis.

Contributory factors and potentially avoidable perinatal related deaths

Table 1.41: Contributory factors and potentially avoidable perinatal related deaths 2012

	Fetal deaths							
	Termination of pregnancy		Stillbirths		Neonatal deaths		Perinatal related deaths	
	n=171		n=320		n=178		n=669	
	n	%	n	%	n	%	n	%
Contributory factors								
Present	18	10.5	101	31.6	65	36.5	184	27.5
Absent	153	89.5	217	67.8	112	62.9	482	72.0
Missing data	-	-	2	0.6	1	0.6	3	0.4
Potentially avoidable								
Yes	6	3.5	66	20.6	52	29.2	124	18.5
Contributory factors present but not potentially avoidable	12	7.0	34	19.9	13	7.3	59	8.8
Contributory factors present but avoidability unknown	-	-	1	0.6	-	-	1	0.1

As part of local perinatal mortality review, the multidisciplinary team is asked to assess whether there are organisational and/or management factors, personnel factors and barriers to access and/or engagement with care factors that may have contributed to the perinatal death. If contributory factors are identified, the local reviewing committee is asked to assess whether the perinatal death was potentially avoidable. Assignment of factors is not mutually exclusive either across factors or within a factor. A description of the process for assessment of contributory factors and potentially avoidable death is included in section 1.2 Methodology on page 16, and the revised tool is included as Appendix D. Contributory factors were recorded by local mortality review to be present in 27.5 percent of perinatal related deaths in 2012, and in 31.6 percent of stillbirths and 36.5 percent of neonatal deaths (Table 1.41). In two-thirds of cases where contributory factors were identified, the local review group determined these deaths were potentially avoidable.

Barriers to access and/or engagement with care are recognised most often from the list provided, and of these, infrequent antenatal care, late registration with care and no antenatal care are the most frequent. Lack of recognition of the complexity or seriousness of the mother's condition by the woman or family is also frequently identified as a contributory factor.

The common issues of access and/or engagement with care, including miscommunication of complexity or seriousness of the mother and or baby's condition, need to be addressed by the health system. Women who have been unable to access maternity care are unlikely to feel empowered at this point in their lives to address these factors without assistance.

It is important that an understanding of why women do not access or engage with maternity care is established and solutions found. The optimal means of doing this is for vulnerable women and communities to identify themselves what would support improved access of care for them. Ways of increasing access can then be identified and appropriately addressed.

Substance use was a barrier to access and/or engagement with care in 17 cases in 2012. Alcohol and substance use is discussed further on page 56.

Personnel factors were identified in 8 percent of cases in 2012, especially failure to offer and/or follow recommended best practice.

Table 1.42: Detail of contributory factors among perinatal related deaths 2012

Contributory factors present?	n=669	
	n	%
	184	**27.5**
Organisational/Management factors	**32**	**4.8**
Poor organisational arrangements of staff	3	
Inadequate education and training	4	
Lack of policies, protocols or guidelines	4	
Inadequate numbers of staff	3	
Poor access to senior clinical staff	1	
Failure or delay in emergency response	3	
Delay in procedure *(eg, caesarean section)*	8	
Delayed access to test results or inaccurate results	5	
Equipment *(eg, faulty equipment, inadequate maintenance, inadequate quality or lack of equipment)*	4	
Building and design functionality *(eg, space, privacy, ease of access, lighting, noise, power failure, operating theatre in distant location)*	1	
Other	7	
Personnel factors	**52**	**7.8**
Knowledge and skills of staff were lacking	16	
Delayed emergency response by staff	3	
Failure to maintain competence	1	
Failure of communication between staff	8	
Failure to seek help/supervision	3	
Failure to offer or follow recommended best practice	30	
Lack of recognition of complexity or seriousness of condition by caregiver	14	
Other	2	
Barriers to access and/or engagement with care	**134**	**20.0**
No antenatal care	37	
Infrequent care or late booking	45	
Declined treatment or advice	22	
Obesity impacted on delivery of optimal care *(eg, USS)*	5	
Substance use	17	
Family violence	3	
Lack of recognition of complexity or seriousness of condition	27	
Maternal mental illness	7	
Cultural barriers	2	
Language barriers	6	
Not eligible to access free care	5	
Environment *(eg, isolated, long transfer, weather prevented transport)*	13	
Other	10	
Not stated	1	

USS = ultrasound scan.

Failure to offer or follow recommended best practice continues to be the most commonly recognised personnel contributory factor in perinatal related deaths.

The PMMRC support the development of national guidelines for maternity care, which should be evidence based, developed by a multidisciplinary team and implemented universally.

Contributory factors and potentially avoidable perinatal related death and PSANZ-PDC

Figure 1.40: Contributory factors and potentially avoidable perinatal related death by perinatal death classification (PSANZ-PDC) 2012

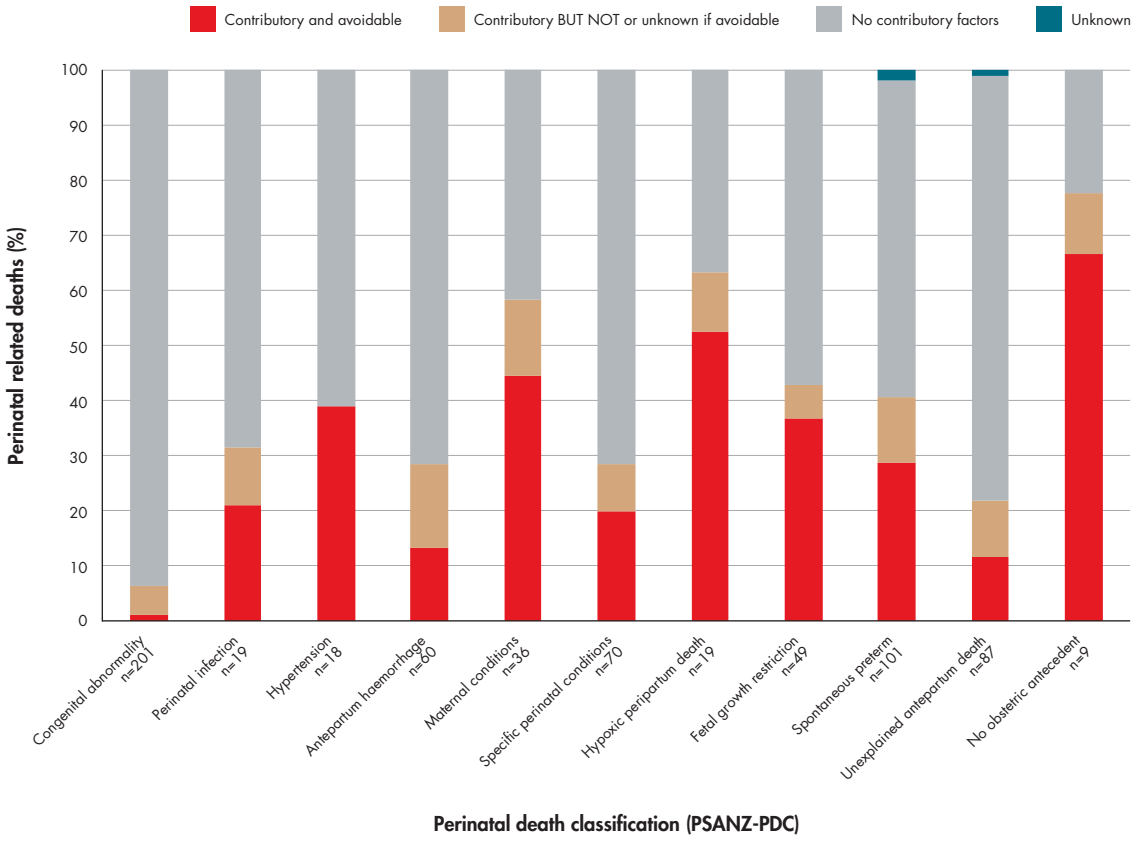
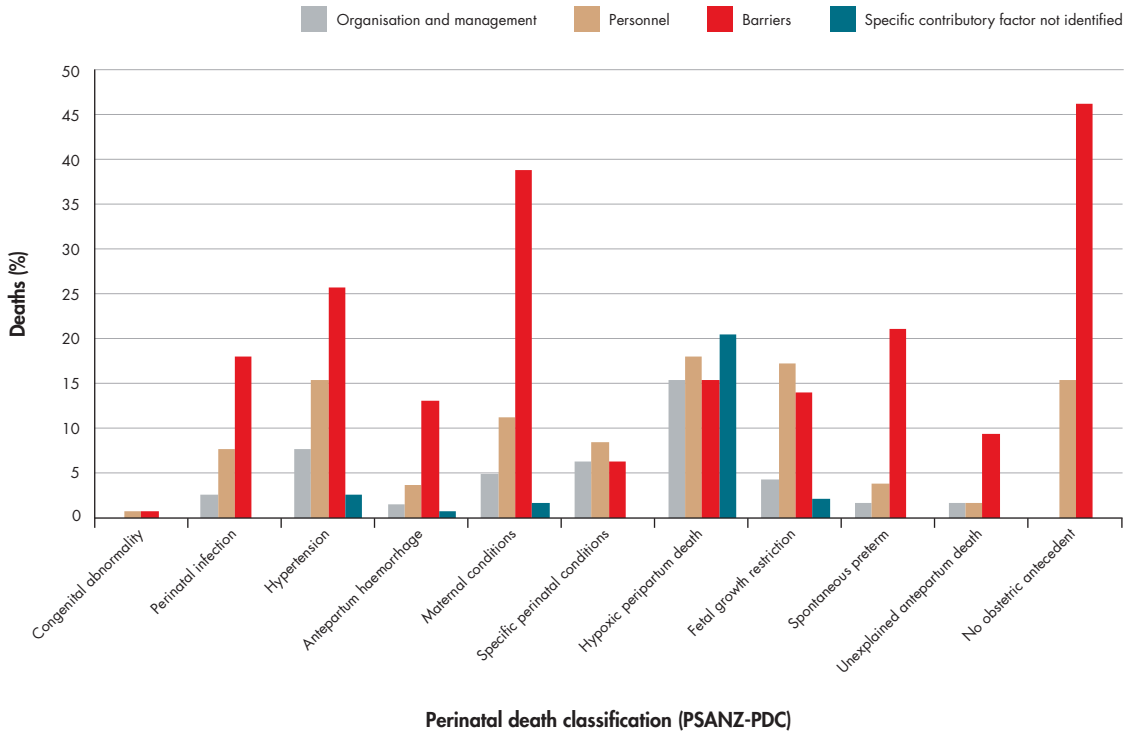


Figure 1.40 shows the proportion of perinatal related deaths where contributory factors were present (red and tan bars), whether the death was potentially avoidable (red bars) or whether there were no contributory factors identified (grey bars) or data were unavailable (blue bars) by perinatal death classification (PSANZ-PDC). While numbers within some PSANZ-PDC categories are small, the proportions with contributory factors present and where deaths were determined to be potentially avoidable differ markedly by cause of death. Consistently higher proportions of potentially avoidable deaths are found among deaths due to hypertension, maternal conditions (diabetes), hypoxic peripartum deaths, fetal growth restriction and deaths with no obstetric antecedent (SUDI). However, because there are so many deaths due to spontaneous preterm birth, the largest number of potentially avoidable deaths fall in this PSANZ-PDC category.

These data suggest that quality improvement initiatives should be directed towards improving the management of hypertension and diabetes in pregnancy, improving fetal surveillance in labour and surveillance of growth and management of SGA in pregnancy, and prevention of SUDI.

Figure 1.41: 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) 2011–2012



In 2011 and 2012, local review committees were asked to determine, specifically, which of the contributory factors identified made the perinatal related death potentially avoidable.

In some cases assessed as potentially avoidable, more than one contributory factor was identified. When this occurred, the death was included in both or all three contributory factor categories.

Figure 1.41 further demonstrates the importance of addressing issues of access and/or engagement with the maternity service for vulnerable groups because this is the main contributory factor identified in many causes of perinatal death. Personnel issues were also identified among more than 15 percent of hypertensive deaths, hypoxic peripartum deaths, deaths from SGA and deaths with no obstetric antecedent.

These data would suggest that quality improvement initiatives to reduce mortality from hypertension, diabetes and SUDI should focus on barriers to access and/or engagement with care. Quality improvement is also required in the management of hypertensive disease, recognition of SGA and fetal surveillance in labour.

Contributory factors and potentially avoidable perinatal related death and maternal ethnicity

Figure 1.42: Contributory factors and potentially avoidable perinatal related death by maternal ethnicity (prioritised) (95% CIs surround the estimate of the proportion of cases within each ethnicity where death was potentially avoidable) 2009–2012

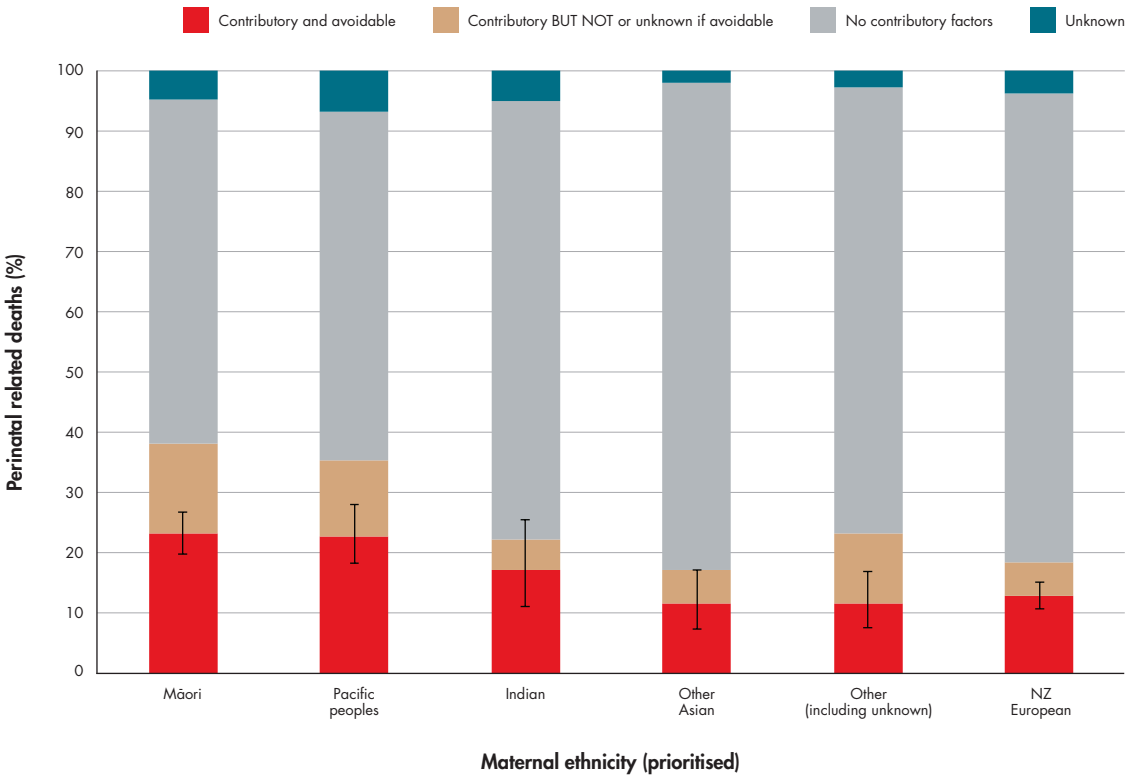


Figure 1.42 illustrates that potentially avoidable perinatal related deaths (red bars with 95 percent confidence intervals displayed) were more frequent among perinatal related deaths of Māori and Pacific mothers (23 percent of deaths) than among New Zealand European, Other Asian (excluding Indian) and Other ethnicity mothers in 2009–2012.

Figure 1.43: Main contributory factor(s) in potentially avoidable perinatal related deaths (as a percentage of all deaths) by maternal prioritised ethnicity (with 95% CIs) 2011–2012

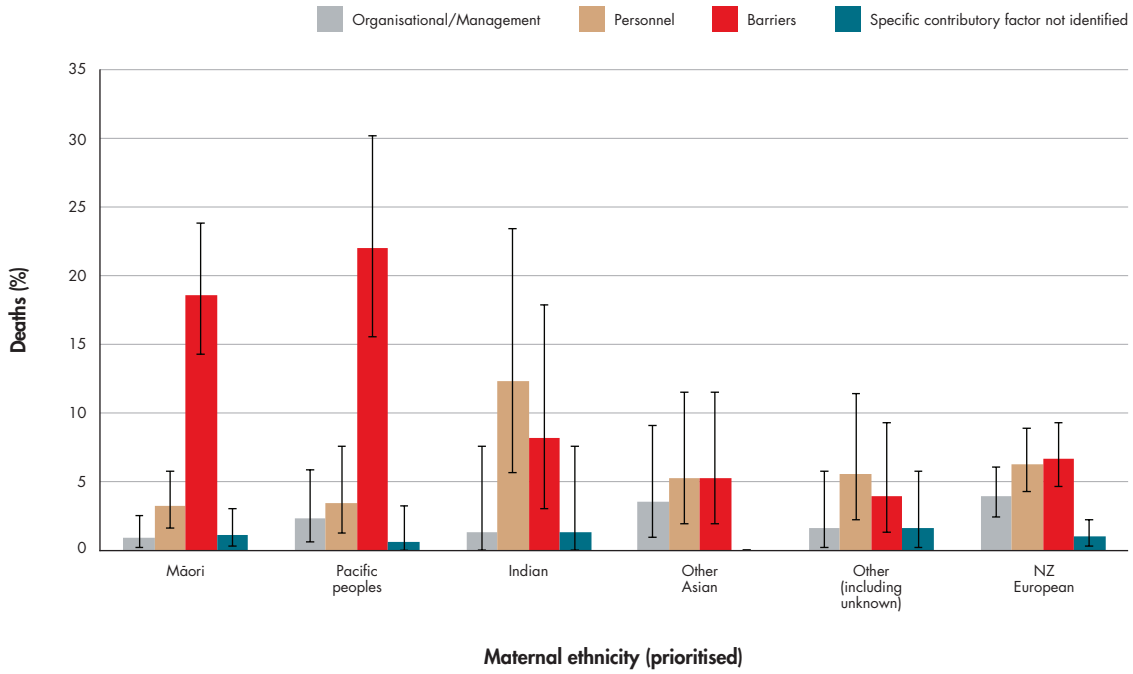


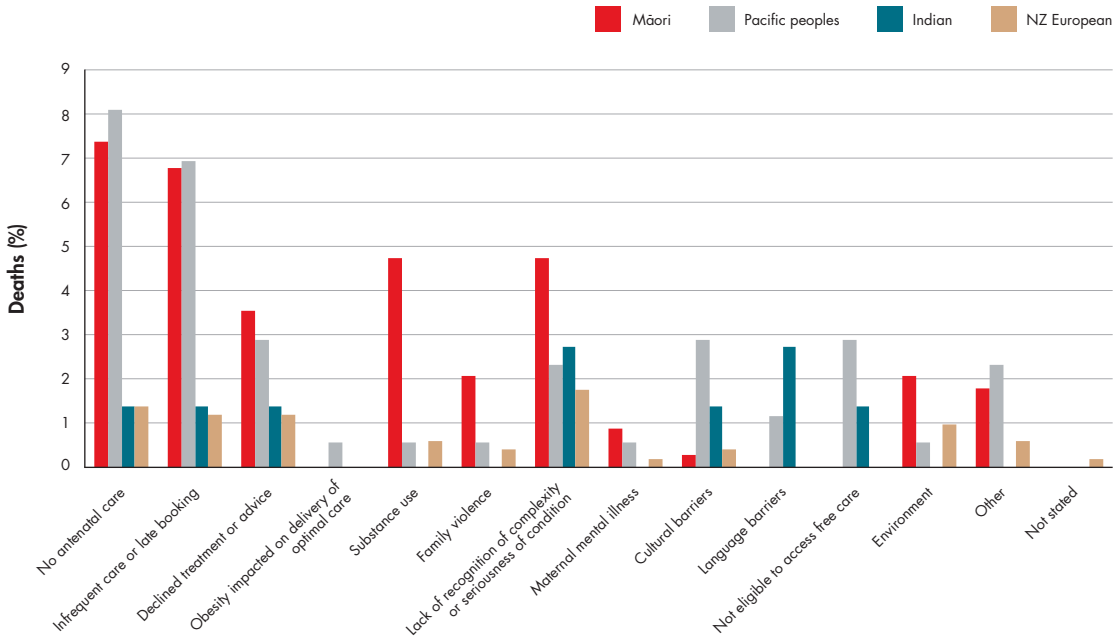
Figure 1.43 shows that the main contributory factors identified as responsible for potentially avoidable perinatal related deaths vary by prioritised ethnicity.

If more than one main contributory factor might have made the death potentially avoidable, then all are included (and so the total percentage for each ethnicity, if the percentage contributions from organisation and management factors, personnel factors, barriers factors and 'not stated' are added together, may sum to more than the total percentage of potentially avoidable deaths).

Barriers to access and/or engagement with care are significantly more common among Māori and Pacific mothers than mothers of New Zealand European, Other Asian and Other ethnicities. Personnel factors appear to be more commonly reported as the main contributory factor among mothers of Indian, Other Asian, Other and New Zealand European ethnicities than among Māori and Pacific peoples, although this difference is not statistically significant.

Barriers to access and/or engagement with care and ethnicity

Figure 1.44: Specific barriers to access and/or engagement with care in potentially avoidable perinatal related deaths (as a percentage of all perinatal related deaths) by maternal ethnicity (Māori, Pacific peoples, Indian and New Zealand European) 2011–2012



Specific types of barrier in potentially avoidable deaths are included in Figure 1.44 if barriers were a main contributory factor in potentially avoidable death. More than one type of barrier to access and/or engagement with care may have been specified. The proportion of deaths where barriers to access and/or engagement with care were identified as a main contributory factor to potentially avoidable perinatal death is 11.4 percent (of all perinatal related deaths) (19 percent among Māori deaths, 22 percent among Pacific, 8 percent among Indian and 7 percent among New Zealand European).

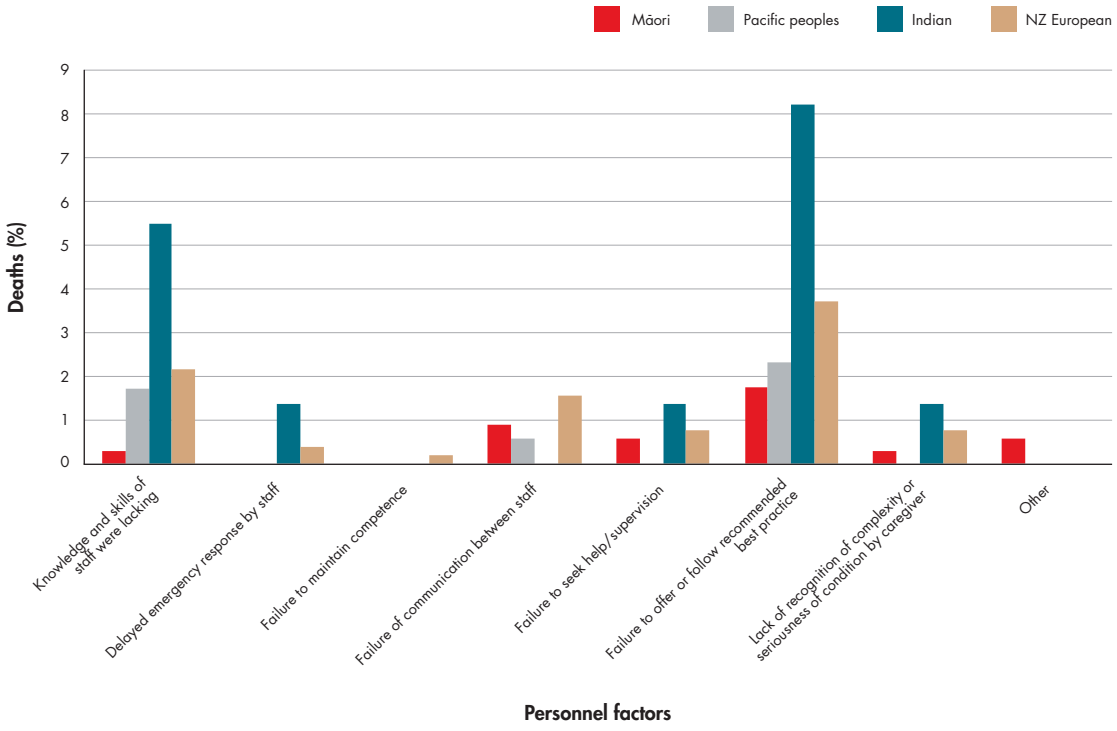
Figure 1.44 illustrates that the most frequent barriers identified in perinatal deaths of Māori and Pacific mothers are 'no antenatal care' and 'infrequent or late booking for antenatal care'. These were reported in approximately 7 percent of deaths, meaning that 1 in 14 Māori and Pacific women whose babies died had a barrier to antenatal care that may have contributed to the baby's death. This finding supports the Ministry of Health National Maternity Monitoring Group requirement for DHBs to improve early registration among at-risk groups in New Zealand (NMMG 2013).

There are also higher rates of 'substance use' and 'lack of recognition of complexity or seriousness of condition' barriers leading to potentially avoidable death among Māori mothers.

Personnel factors and ethnicity

The proportion of potentially avoidable deaths due to personnel is 5.3 percent of all perinatal related deaths (3 percent among Māori, 3 percent among Pacific, 12 percent among Indian and 6 percent among New Zealand European mothers). In 2011–2012, there were 71 cases where personnel factors contributed to potentially avoidable deaths and the specific factors are shown in Figure 1.45.

Figure 1.45: Specific personnel factors in potentially avoidable perinatal related deaths (as a percentage of all perinatal related deaths) by maternal ethnicity (Māori, Pacific peoples, Indian and New Zealand European) 2011–2012



The proportion of perinatal related deaths due to failure to offer or follow recommended best practice was significantly more common among Indian (8 percent) than among Māori (2 percent) or Pacific (2 percent) mothers ($p<0.05$). The proportion of perinatal related deaths due to knowledge and skills of staff lacking was significantly higher among Indian (5 percent) than Māori (0.3 percent) ($p<0.05$), but not significantly different from Pacific or New Zealand European mothers. Among Indian mothers whose babies died, failure to offer or follow recommended best practice contributed to the death of 1 in 12 perinatal deaths and lack of knowledge and skills of staff contributed to the death of 1 in 18 perinatal deaths.

There were no statistically significant differences between Māori and Pacific or New Zealand European mothers, although this may be due to small numbers in the analyses.

The number of potentially avoidable deaths due to organisation and management factors was too small in 2011–2012 (34 cases) for further analysis.

Contributory factors and potentially avoidable perinatal related death and deprivation quintile (NZDep2006)

Figure 1.46: Contributory factors and potentially avoidable perinatal related death by deprivation quintile (NZDep2006) 2009–2012

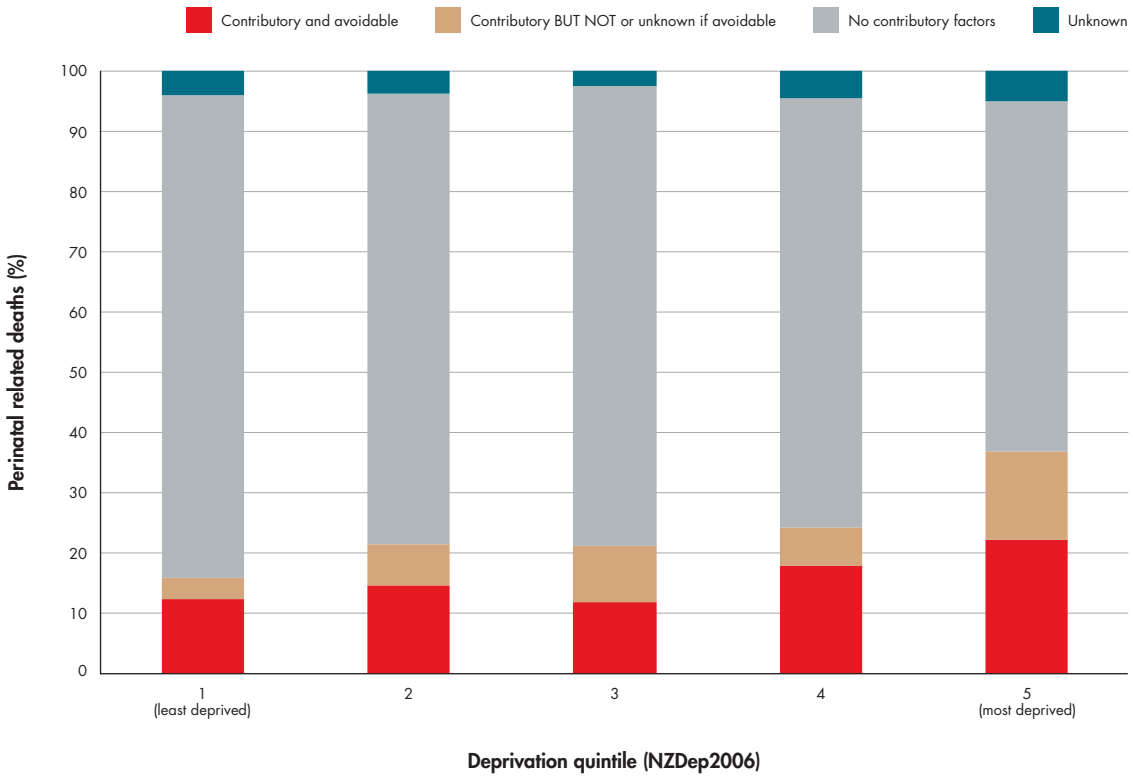


Figure 1.46 looks at whether contributory factors and potentially avoidable death vary by maternal deprivation quintile (NZDep2006). There is a significant linear trend for increasing potentially avoidable perinatal related deaths with increasing deprivation quintile from 1 (least deprived) to 5 (most deprived) ($p<0.0001$).

Figure 1.47: Main contributory factor(s) in potentially avoidable perinatal related deaths (as a percentage of all deaths) by deprivation quintile (NZDep2006) (with 95% CIs) 2011–2012

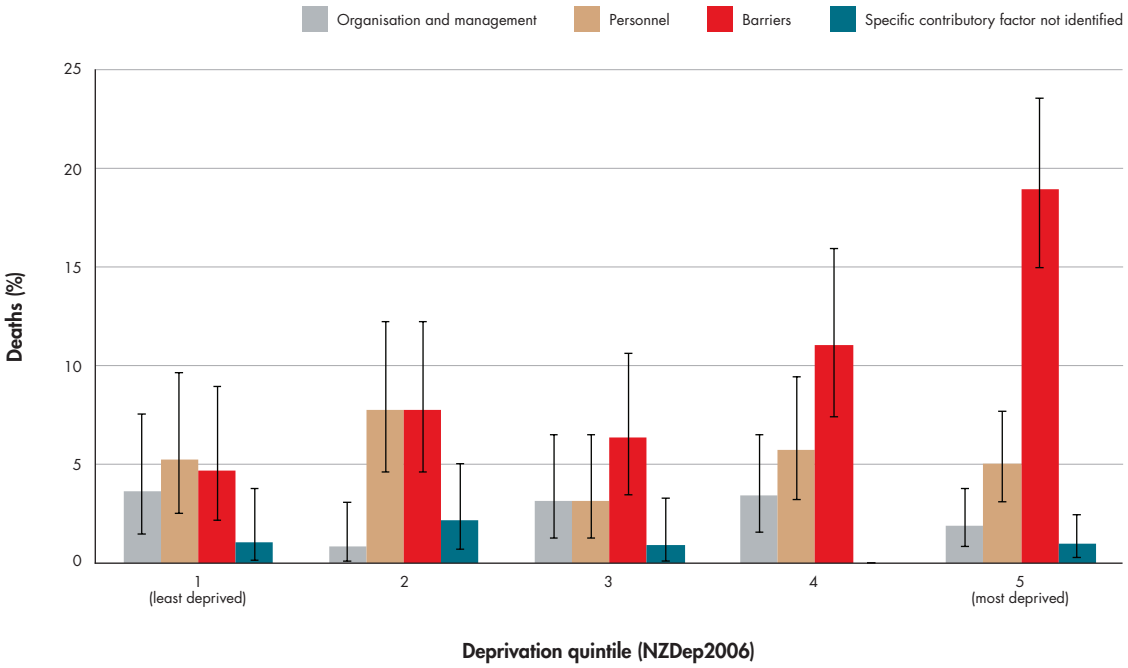


Figure 1.47 illustrates that there is little change in the proportion of cases where organisation and/or management and personnel factors were the main contributing factors in potentially avoidable death with increasing deprivation. However, there is an increase in the rate of barriers as the main contributory factor in potentially avoidable perinatal death with increasing deprivation. Barriers to access and/or engagement with care were reported as the main contributing factor in a potentially avoidable death in approximately 18 percent of perinatal related deaths in women residing in the highest deprivation quintile areas.

In light of the findings from multivariate analysis, showing that deprivation decile is an independent risk factor for neonatal death after birth at 20–27 weeks gestation, these data would suggest that barriers to access and/or engagement with care are an important area to address.

Maternal outcome

Table 1.43 reports the health outcome of the mothers whose babies died in the perinatal period in 2012.

Table 1.43: Perinatal related deaths and maternal outcome 2012

Maternal outcome	Fetal deaths				Neonatal deaths		Perinatal related deaths	
	Termination of pregnancy		Stillbirths					
	n=171		n=320		n=178		n=669	
	n	%	n	%	n	%	n	%
Alive and generally well	168	98.2	313	97.8	174	97.8	655	97.9
Alive but with serious morbidity	3	1.8	4	1.3	2	1.1	9	1.3
Maternal death	-	-	3	0.9	2	1.1	5	0.7

There were five maternal deaths associated with perinatal related deaths in 2012, including deaths from motor vehicle accidents, amniotic fluid embolism and maternal pre-existing medical disease. Maternal deaths are discussed further in section 2. Nine mothers whose babies died suffered serious morbidity as a consequence of pregnancy, including postpartum haemorrhage, cardiac conditions, uterine rupture, obstetric and non-obstetric sepsis, pre-eclampsia, puerperal psychosis and malignancy.

Special Topic 2012: Unexplained Antepartum Death at Term

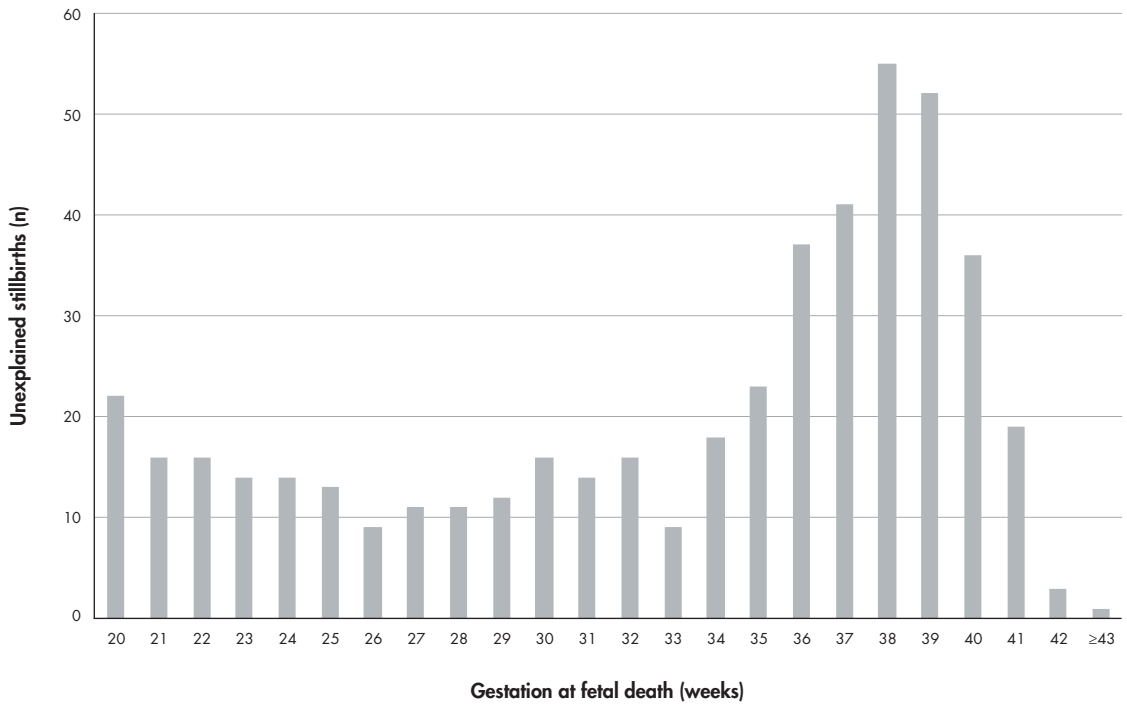
Description of unexplained antepartum death at term

The term 'unexplained antepartum death at term' is synonymous with the term 'unexplained term stillbirth' and they may be used interchangeably throughout this section.

This special topic was identified for analysis in 2012 because 'Unexplained' is the most commonly defined category, using the PSANZ-PDC classification, for stillbirths in New Zealand at the current time, accounting for 26.2 percent of all stillbirths from 2007 to 2012, and for 36.6 percent of stillbirths born at term.

This section includes all stillbirths from 2007 to 2012 in New Zealand where a baby died in utero at or beyond 37 weeks and where the cause of death was unexplained (PSANZ-PDC 10). The numbers in this section may differ slightly from other sections where unexplained term stillbirths are discussed because the definition in this instance excludes babies who died before 37 weeks but were subsequently born at or beyond 37 weeks. This definition excludes 73 babies from 2007 to 2012, 26 (35 percent) of whom were babies in multiple pregnancies who died between 12 and 36 weeks of gestation, 22 singletons with unknown gestation at death, 22 singletons who died at 36 weeks and 3 singletons who died between 28 and 35 weeks. This definition was chosen to describe a more homogeneous group.

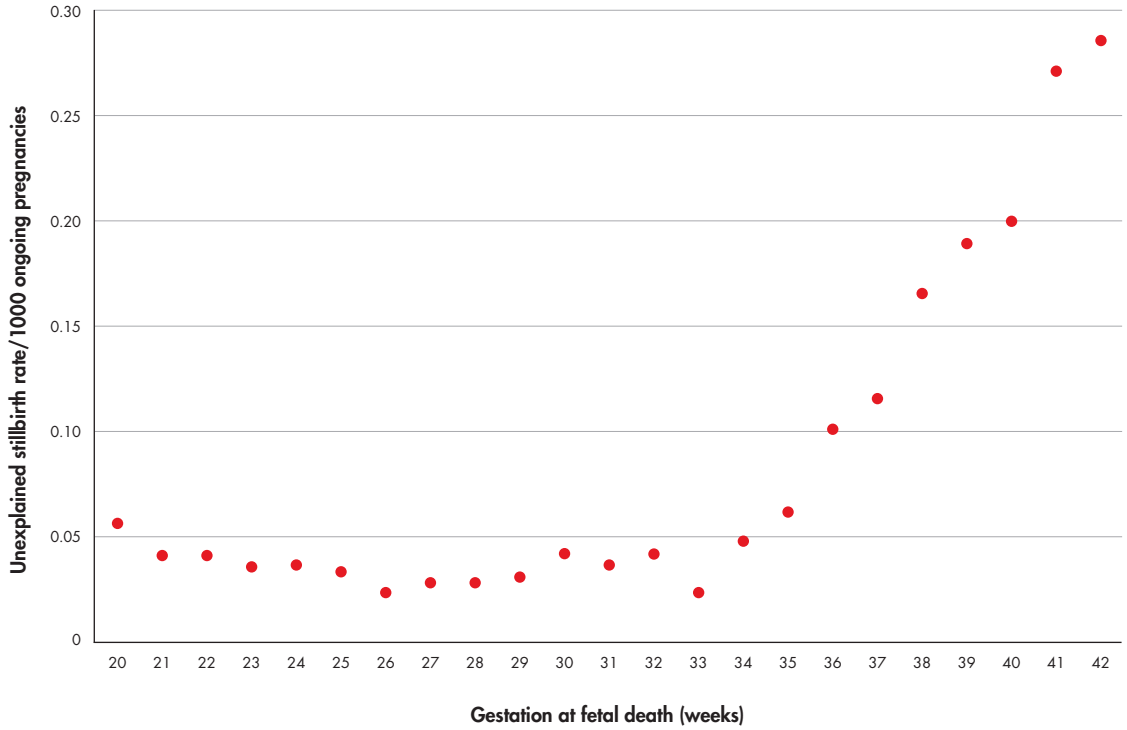
Figure 1.48: Burden of unexplained stillbirth by gestation at fetal death 2007–2012



Unexplained stillbirth is the most commonly used category for stillbirths in New Zealand, accounting for 26 percent of all stillbirths and for 37 percent of stillbirths at term.

Figure 1.48 shows the absolute number of deaths classified as unexplained by gestation at fetal death (20 weeks and above) in the six-year period 2007–2012. Stillbirths prior to 20 weeks where the baby was born at 20 or more weeks are not included in this figure.

Figure 1.49: Risk of unexplained stillbirth by gestation at fetal death (from 20 weeks) (per 1000 ongoing pregnancies) 2007–2012



There is a significant increase in unexplained stillbirth from 37 to 42 weeks as a proportion of ongoing pregnancies (chi-squared test for linear trend $p<0.001$). At 40 weeks, the risk of unexplained stillbirth is approximately 1 in 5000 ongoing pregnancies, and at 42 weeks, it is approximately 1 in 3500 ongoing pregnancies.

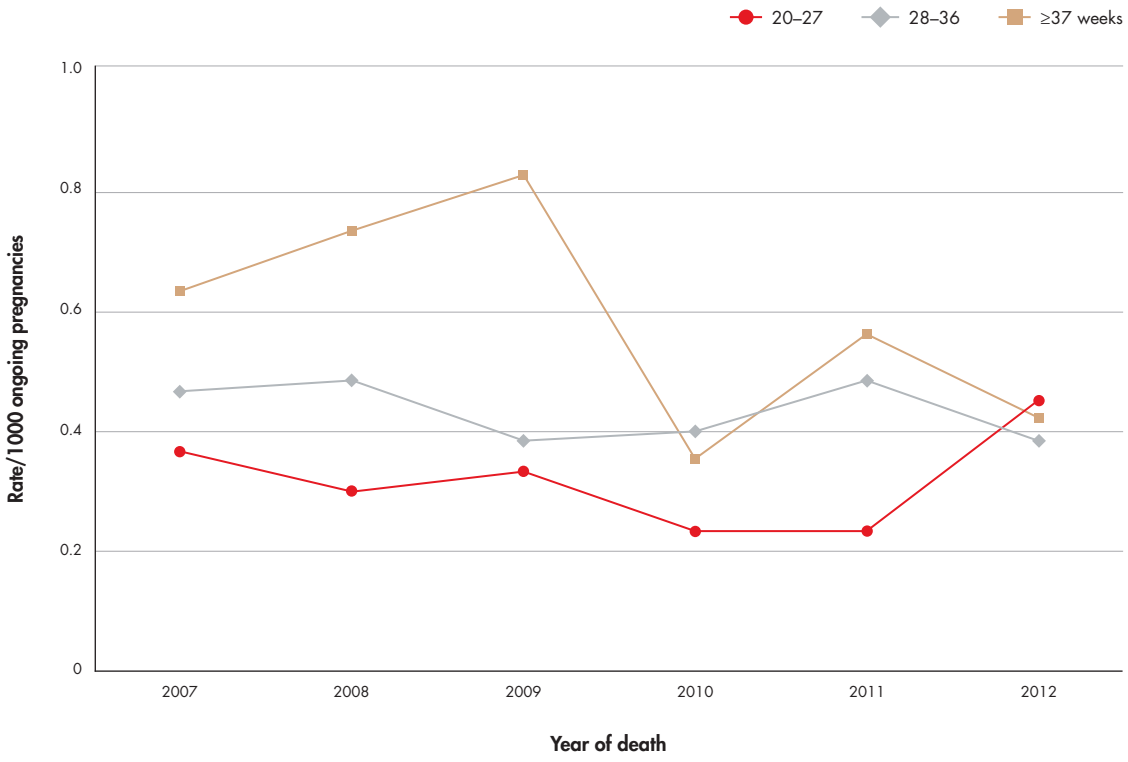
Table 1.44: Unexplained antepartum death at term by PSANZ-PDC subcategory 2007–2012

	PSANZ-PDC	2007	2008	2009	2010	2011	2012	Total
10.1	Reduced vascular perfusion on Doppler and/or histopathology	7	9	8	1	6	5	36
10.2	Chronic villitis	2	-	1	-	2	2	7
10.3	No placental pathology	10	7	9	6	5	3	40
10.4	No examination of placenta	5	10	11	5	2	3	36
10.8	Other specified placental pathology	14	16	17	9	17	10	83
10.9	Unspecified or not known if placenta examined	-	2	2	-	-	1	5
Total		38	44	48	21	32	24	207
	Term births	**60,550**	**60,582**	**58,671**	**59,882**	**57,617**	**57,380**	**354,682**
Rate	**Per 1,000 term births**	0.63	0.73	0.82	0.35	0.56	0.42	0.58

There has been a significant reduction in unexplained antepartum death at term from 2007 to 2012 (chi-squared test of trend p=0.015), but no significant reduction in any specific PSANZ-PDC sub-category.

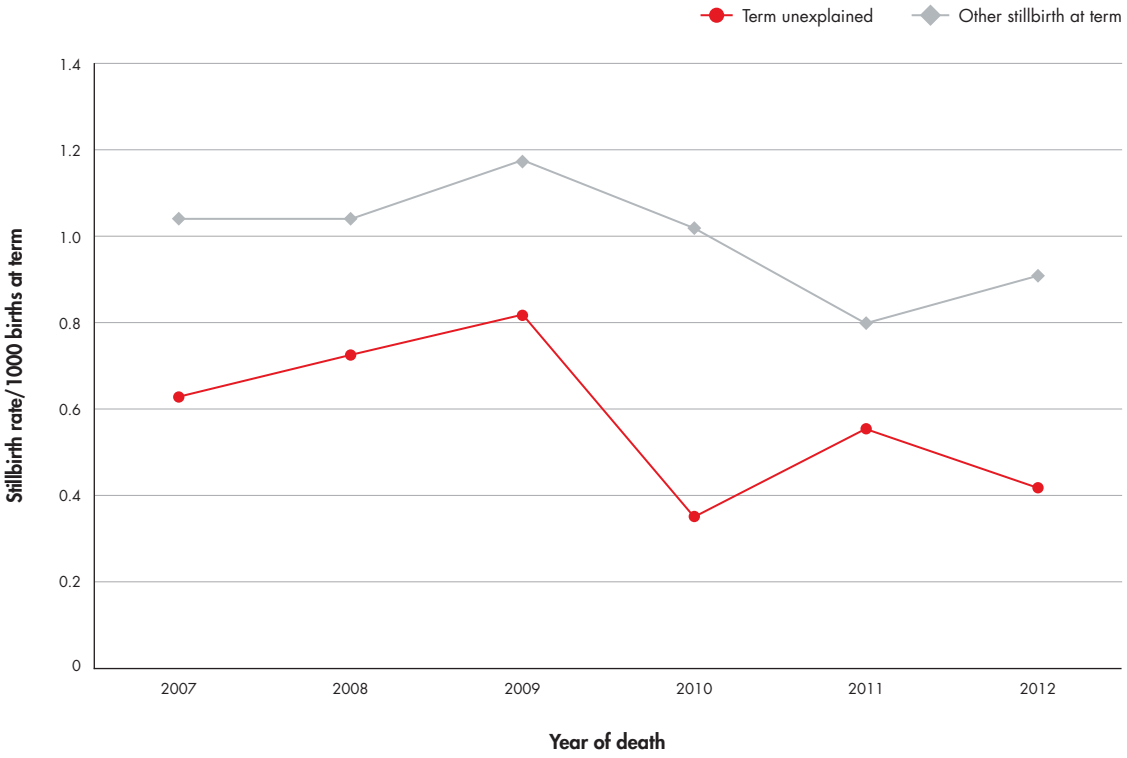
It is unlikely that the reduction in unexplained stillbirth at term is due to improved classification over time as there has been no coincidental increase in any other PSANZ-PDC category over the same time period.

Figure 1.50: Unexplained antepartum death rates (per 1000 ongoing pregnancies) by gestation at fetal death 2007–2012



There has been a significant reduction in the proportion of births in the population at 41 or more weeks from 2007 to 2012 that might explain the reduction in post-term unexplained stillbirth (for example, due to a higher tendency to induce at-risk babies post term).

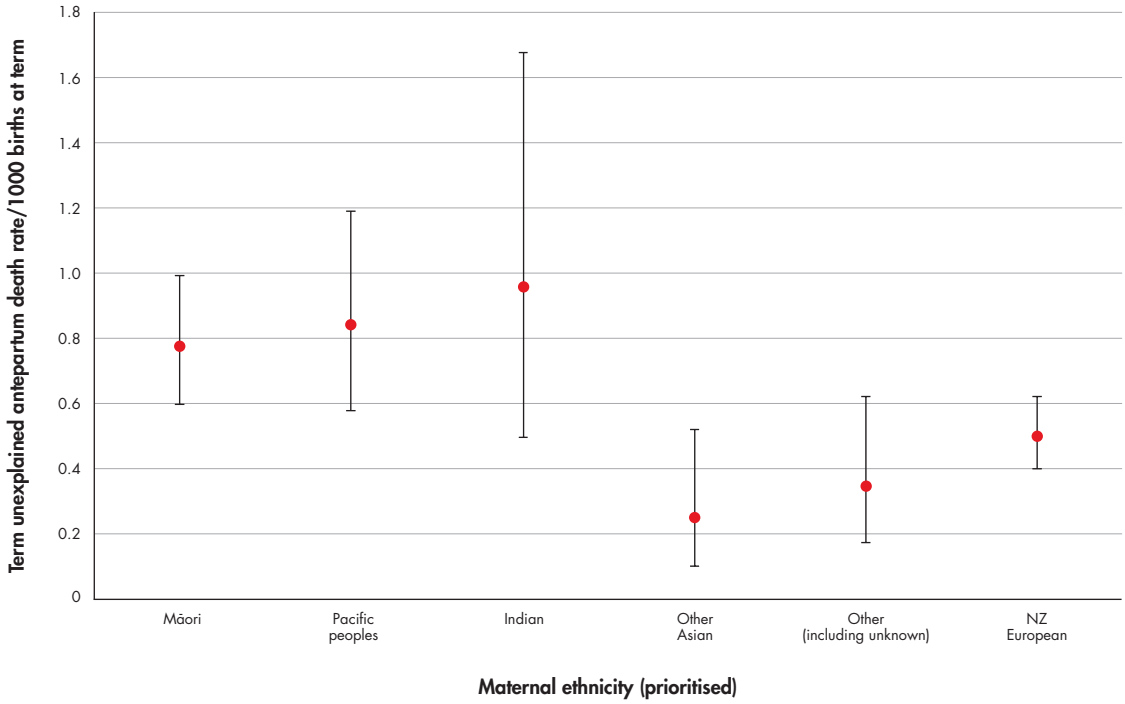
Figure 1.51: Unexplained antepartum death, and other causes of stillbirth at term, rates (per 1000 births at term) 2007–2012



There is a non-significant decrease in antepartum deaths at term of known causes (chi-squared test of trend p=0.15) of similar magnitude to the reduction in unexplained antepartum deaths at term.

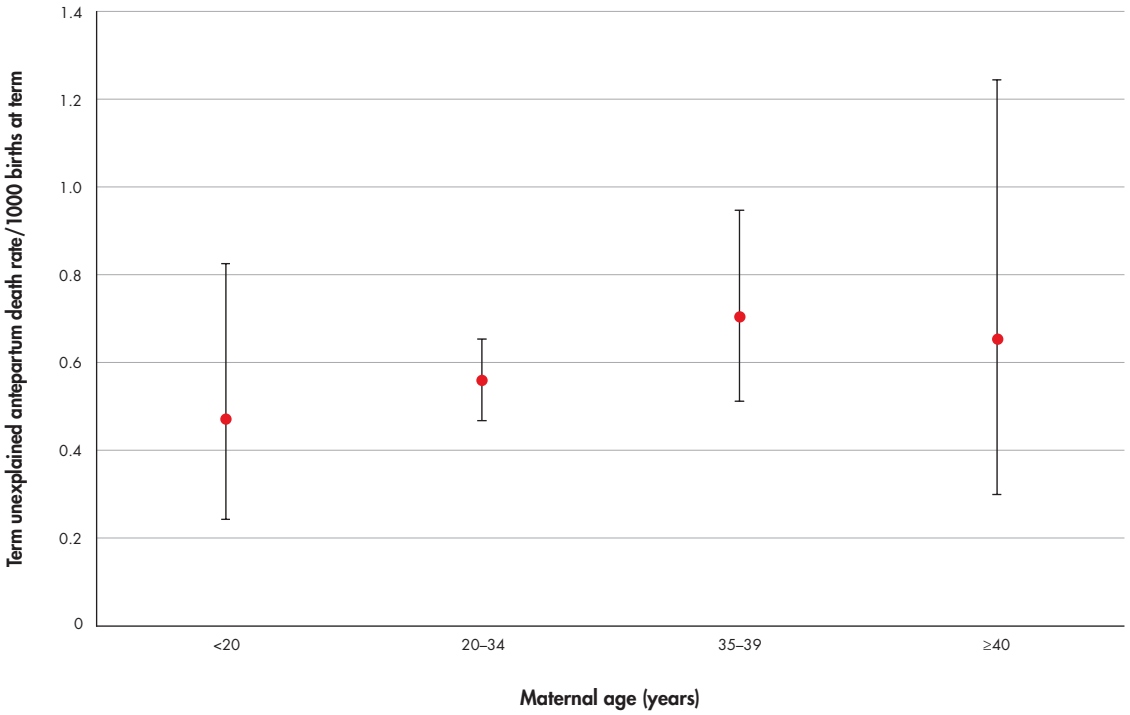
Epidemiology of unexplained antepartum death at term

Figure 1.52: Term unexplained antepartum death rate (per 1000 term births) and maternal prioritised ethnicity 2007–2012



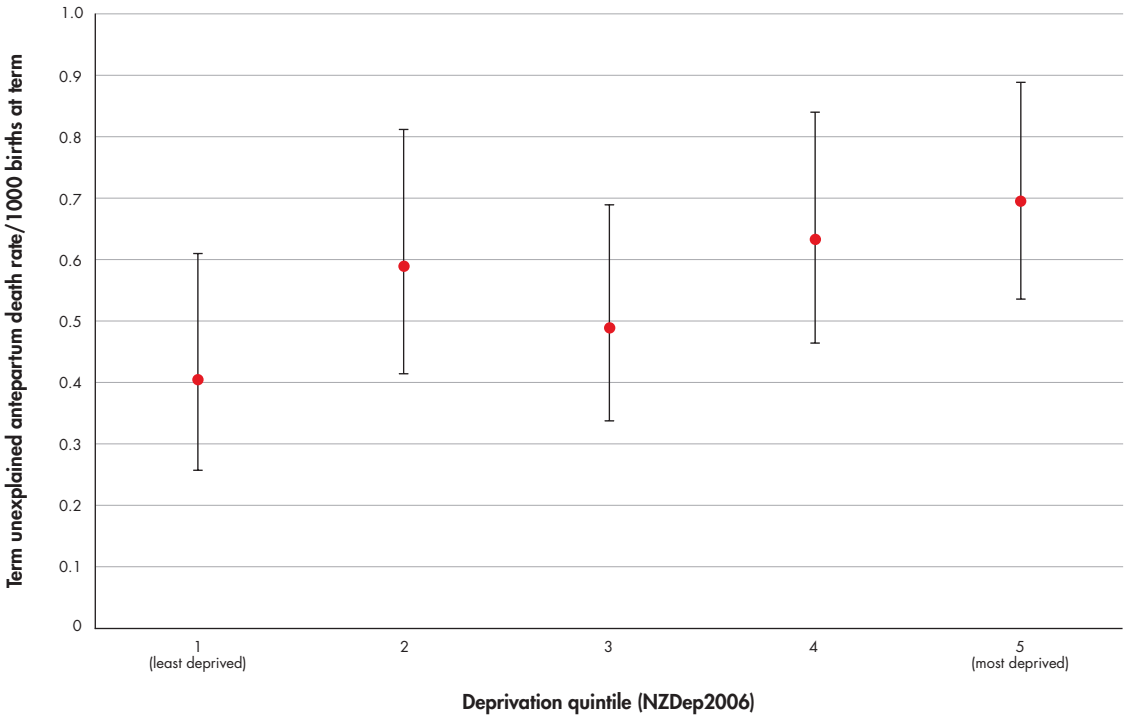
There are significant differences in the rate of unexplained antepartum death at term by ethnicity. Māori and Pacific mothers have significantly higher rates than mothers of Other Asian ethnicity and non-significantly higher rates than Other and New Zealand European mothers. It is also likely that Indian rates are similar to those of Pacific mothers although the confidence intervals are wide in keeping with the small numbers of cases and births to Indian mothers.

Figure 1.53: Term unexplained antepartum death rate (per 1000 term births) and maternal age 2007–2012



There is no statistically significant association between maternal age and unexplained stillbirth at term.

Figure 1.54: Term unexplained antepartum death rate (per 1000 term births) and deprivation quintile (NZDep2006) 2007–2012



There is a statistically significant increase in unexplained antepartum death at term with increasing deprivation quintile (NZDep2006) (chi-squared test for linear trend p=0.03).

Table 1.45: Body mass index (BMI), antenatal care and parity among unexplained antepartum deaths and live births at term (PMMRC data and comparison using MAT data* only) 2007–2012

	PMMRC 2007–2012		Restricted to MAT data 2008–2012				
	Unexplained stillbirth at term		Unexplained stillbirth at term		Live births (term)		
	n=207		n=130		n=255,314		
	n	%	n	%	n	%	p#
Maternal BMI (kg/m²)							
<18.50	4	1.9	2	1.5	7,216	2.8	
18.50–24.99	64	30.9	53	40.8	119,670	46.9	
25.00–29.99	47	22.7	39	30.0	70,619	27.7	
30.00–34.99	30	14.5	21	16.2	32,106	12.6	0.085
35.00–39.99	17	8.2	10	7.7	14,420	5.6	
≥40	10	4.8	4	3.1	7,893	3.1	
Unknown	35	16.9	1	0.8	3,390	1.3	
Current smoking							
Yes	53	25.6	26	20.0	42,082	16.5	0.31
No	148	71.5	104	80.0	210,227	82.3	
Unknown	6	2.9	-	-	3,005	1.2	
LMC at booking							
Not registered	4	1.9	-	-	-	-	
Self-employed midwife	146	70.5	145	89.5	230,772	90.4	
Obstetrician (private)	9	4.3	14	8.6	16,578	6.5	0.75
Hospital	43	20.8	1	0.6	202	0.1	
General practitioner	3	1.4	2	1.2	4,781	1.9	
Unknown	2	1.0	-	-	2,981	1.2	
Gestation first antenatal visit (weeks)							
<10	56	27.1	66	50.8	146,844	57.5	
10–13	42	20.3					0.086
14–19	33	15.9	64	49.2	105,481	41.3	
≥20	40	19.3					
Unknown	36	17.4	-	-	2,989	1.2	
Parity							
Nulliparous	78	37.7	57	43.8	102,773	40.3	
Parity 1–3	101	48.8	66	50.8	137,392	53.8	0.69
Parity ≥4	19	9.2	7	5.4	12,014	4.7	
Missing	9	4.3	-	-	3,135	1.2	

* This table includes data from the national MAT dataset for all births and for perinatal deaths where there was a match with the MAT dataset for 2008–2012 excluding women with No or Other LMC recorded in the national dataset (ie, mothers with a DHB primary maternity service provider).

\# Statistical test compares MAT data only; missing data excluded from chi-squared tests.

Table 1.45 includes data collected by the PMMRC (left shaded column) and data exclusively from the MAT (national) dataset for PMMRC identified deaths (left unshaded column) and live births (right unshaded column). The data have been analysed in this way because there were differences between the PMMRC-collected data for perinatal related deaths and data for these mother/babies in the MAT dataset, and because missing data in the MAT dataset are not random, and so it was considered that while this analysis excludes some babies, it reduces potential bias.

The data in Table 1.45 seem to suggest that mothers whose babies have unexplained antepartum deaths at term are more likely to be overweight or obese than mothers of live births at term as recorded in the MAT dataset 2008–2012; however, the association is not statistically significant.

There was no significant association between unexplained antepartum death at term and smoking, LMC at booking, gestation at first antenatal visit, or parity.

Table 1.46: Small for gestational age (customised SGA), smoking, alcohol and other substances among unexplained and other stillbirths at term 2007–2012

	Unexplained stillbirth at term		Other stillbirth at term	
	n=207		n=354	
	n	%	n	%
Customised birthweight centiles				
Small for gestational age	33	15.9	146	41.2
Appropriate for gestational age	156	75.4	174	49.2
Large for gestational age	13	6.3	29	8.2
Not able to be calculated	5	2.4	5	1.4
Alcohol or substance use				
Yes	19	9.2	35	9.9
Alcohol consumed in pregnancy	11	5.3	24	6.8
Marijuana	13	6.3	11	3.1
No	152	73.4	277	78.2
Unknown	36	17.4	42	11.9

SGA (by customised birthweight centile) was a significantly less common finding among term unexplained stillbirth than among other causes of term stillbirth. This is as expected, because if these babies were profoundly growth retarded, they would have been assigned to PSANZ-PDC 8 (fetal growth restriction). National data on the occurrence of customised SGA at term are not currently available.

The frequency of use of alcohol and other substances was not significantly different to other term stillbirths.

Table 1.47: Perinatal investigations and placental pathology among unexplained antepartum deaths and other stillbirths at term 2007–2012

	Unexplained stillbirth at term		Other stillbirth at term	
	n=207		n=354	
	n	%	n	%
Perinatal investigations				
Optimal perinatal investigations	81	39.1	171	48.3
Partial perinatal investigations	81	39.1	126	35.6
Inadequate perinatal investigations	36	17.4	45	12.7
Unknown	9	4.3	12	3.4
Post-mortem offer and consent rate				
Post-mortem offered and consent given	87	42.0	163	46.0
Post-mortem offered and declined	106	51.2	165	46.6
Post-mortem not offered	8	3.9	18	5.1
Unknown	6	2.9	8	2.3
Placental examination at birth				
Normal	97	39.0	157	34.4
Some abnormalities	76	30.5	155	34.0
Retroplacental clot	4	1.6	36	7.9
Gritty/Calcified	38	15.3	66	14.5
Not examined	10	4.0	10	2.2
Unknown	24	9.6	32	7.0
Placental pathology performed				
Yes	155	74.9	263	74.3
No	37	17.9	65	18.4
Unknown	15	7.2	26	7.3

Unexplained term stillbirths were less likely to have been fully investigated than other term stillbirths, though this difference was not statistically significant. Thirty-nine percent were optimally investigated and 39 percent had partial investigation.

Placental pathology was performed in 74 percent of unexplained and other term stillbirths.

Only 39 percent of term unexplained stillbirths were optimally investigated, and 25 percent did not have placental pathology performed.

New Zealand data showed that a post-mortem changed the clinical diagnosis in 30 percent of perinatal deaths, and in 9 percent of cases, further information was gained, but this did not change the clinical diagnosis (page 89).

Placental examination has been shown to be even more valuable than post-mortem with one study finding cause of death could be explained in 48 percent of perinatal deaths by placental examination alone (Manning et al 2013).

Some placental pathologies explain stillbirth and have high rates of recurrence. These include perivillous fibrin deposition and severe histiocytic intervillositis. Other significant placental causes of stillbirth include severe chronic villitis (also known as villitis of unknown etiology), fetal thrombotic vasculopathy, decidual vasculopathy, extensive placental infarction and severe chorioamnionitis.

Table 1.48: Cord anomalies at external examination among unexplained antepartum deaths and other stillbirths at term 2007–2012

	Unexplained stillbirth at term		Other stillbirth at term	
	n=207		n=354	
	n	%	n	%
Umbilical cord examined				
Yes	181	87.4	313	88.4
No	6	2.9	12	3.4
Unknown	20	9.7	29	8.2
Abnormality found				
Yes	107	51.7	185	52.3
True knot	7	3.4	15	4.2
Loose knot	1	0.5	2	0.6
Tight knot	3	1.4	8	2.3
Missing data	3	1.4	5	1.4
Cord round neck	44	21.3	86	24.3
Loose	20	9.7	18	5.1
Tightly	22	10.6	54	15.3
Missing data	2	1.0	14	4.0
Cord round limbs or body	23	11.1	35	9.9
Loose	13	6.3	13	3.7
Tightly	7	3.4	15	4.2
Missing data	3	1.4	7	2.0
Marginal/Velamentous insertion	-	-	3	0.8
Abnormal cord thickness	19	9.2	38	10.7
Thick cord	6	2.9	13	3.7
Thin cord	13	6.3	25	7.1
Meconium stained cord	47	22.7	64	18.1
Tear in cord	-	-	2	0.6
Two vessel cord	3	1.4	11	3.1
No	63	30.4	118	33.3
Unknown	11	5.3	10	2.8

The only significant differences in proportions of cord anomalies found between unexplained antepartum death and other stillbirths at term was a higher rate of cord tightly around the neck in other term stillbirths.

Table 1.49: Contributory factors and potentially avoidable perinatal related death of unexplained antepartum deaths and other stillbirths at term 2009–2012

	Unexplained stillbirth at term		Other stillbirth at term	
	n=125		n=228	
	n	%	n	%
Contributory factors				
Present	40	32.0	97	42.5
Absent	76	60.8	116	50.9
Missing data	9	7.2	15	6.6
Potentially avoidable	25	20.0	82	36.0

Of note, unexplained antepartum deaths were less likely to be identified as potentially avoidable (20 percent) than other stillbirths at term (36 percent).

Audit of unexplained antepartum death at term 2011

Thirty-two babies who died at term in 2011 were identified from the PMMRC database and confirmed as unexplained antepartum deaths (PSANZ-PDC 10). The maternal clinical notes from these babies were requested from the relevant DHBs and LMCs and reviewed. These clinical notes were also part of the 2011 audit of data accuracy and completeness, described in section 1.2 Methodology.

A data form was developed to record extra details of the investigations offered around the time of discovery of the antepartum death. The data collection was informed by the PMMRC Perinatal Death Investigations Algorithm recommended investigations for stillbirth, which were considered to be the 'gold standard' (*http://www.hqsc.govt.nz/assets/PMMRC/Resources/How-to-investigate-perinatal-death-Jan-2014.pdf*).

Consent to placental histology among unexplained antepartum deaths at term 2011

Table 1.50: Consent to post-mortem and placental histology among unexplained antepartum deaths at term 2011

	Term unexplained stillbirth	
	n=32	
	n	%
Accepted post-mortem and placental histology	16	50
Accepted limited post-mortem and placental histology	2	6
Declined post-mortem but accepted placental histology	12	38
Declined post-mortem and declined placental histology	2	6

Fifty percent of parents consented to both post-mortem and placental histology. Forty-four percent of parents consented for placental histology only, although an offer of post-mortem was not documented in two of these cases. Parents of two babies consented to skeletal survey and placental histology. Parents of two babies did not consent to any of these examinations.

Consent to post-mortem by health professional discussing post-mortem

Table 1.51: Consent to post-mortem by health professional discussing post-mortem among unexplained antepartum deaths at term 2011

Health professional discussing post-mortem	n	Consent given	
		n	%
Obstetric consultant	14	8	57
Obstetric registrar/junior doctor	12	10	83
Registered midwife	15	8	53

In some cases, more than one health professional approached parents. The highest rate of consent to post-mortem followed discussion by obstetric registrars and other doctors in training (83 percent), but this rate was not statistically significantly higher than for other groups.

Adequacy of affiliated post-mortem investigations

The PMMRC Perinatal Death Investigations Algorithm recommends the investigations in Table 1.52 for stillbirth.

Each set of notes was reviewed to determine which investigations had been performed.

There were high rates of uptake for the following perinatal death investigations: maternal and family history, microbiological swabs of vagina, baby and placenta, examination of the baby and maternal blood tests (see Figure 1.55). Formal ultrasound assessment of amniotic fluid volume and for fetal abnormalities was undertaken in one-third of cases, but due to the high number of informal bedside scans, 97 percent of women overall received an ultrasound scan at discovery of stillbirth. Amniocentesis was offered or performed in 25 percent of cases overall. However, of the six women identified with an indication for this investigation (that is, possibility of fetal abnormality detected antenatally or maternal infection), three received an amniocentesis as recommended. Sending a specimen for karyotype occurred in only 47 percent of cases, despite it being a recommended core investigation in unexplained stillbirth. Clinical photographs of the baby occurred in just over half of cases.

Table 1.52: PSANZ recommended investigations for perinatal death

Core investigations	
At diagnosis of fetal death	**Following birth**
Maternal history	**Baby**
Take full maternal history	External examination
Ultrasound scan	Clinical photographs
Fetal abnormalities	Surface swabs
Amniotic fluid volume	X-ray/ultrasound
Amniocentesis	Post-mortem examination
Microbiological cultures	**Cord blood**
Chromosomal analysis	Full blood count
Swabs	Cord gases
Low vaginal/peri-anal culture	**Placenta and cord**
Maternal blood tests	Macroscopic examination of placenta and cord
Full blood count and platelets	Microbiological cultures (swab between chorion and amnion)
Group and antibody screen (if not already done)	Cord and placental section for chromosomal analysis
Kleihauer	Placental histopathology
HbA1c	
Rubella and syphilis serology (if not already done)	
Thrombophilia tests	
Anticardiolipin antibodies	
Lupus anticoagulant	

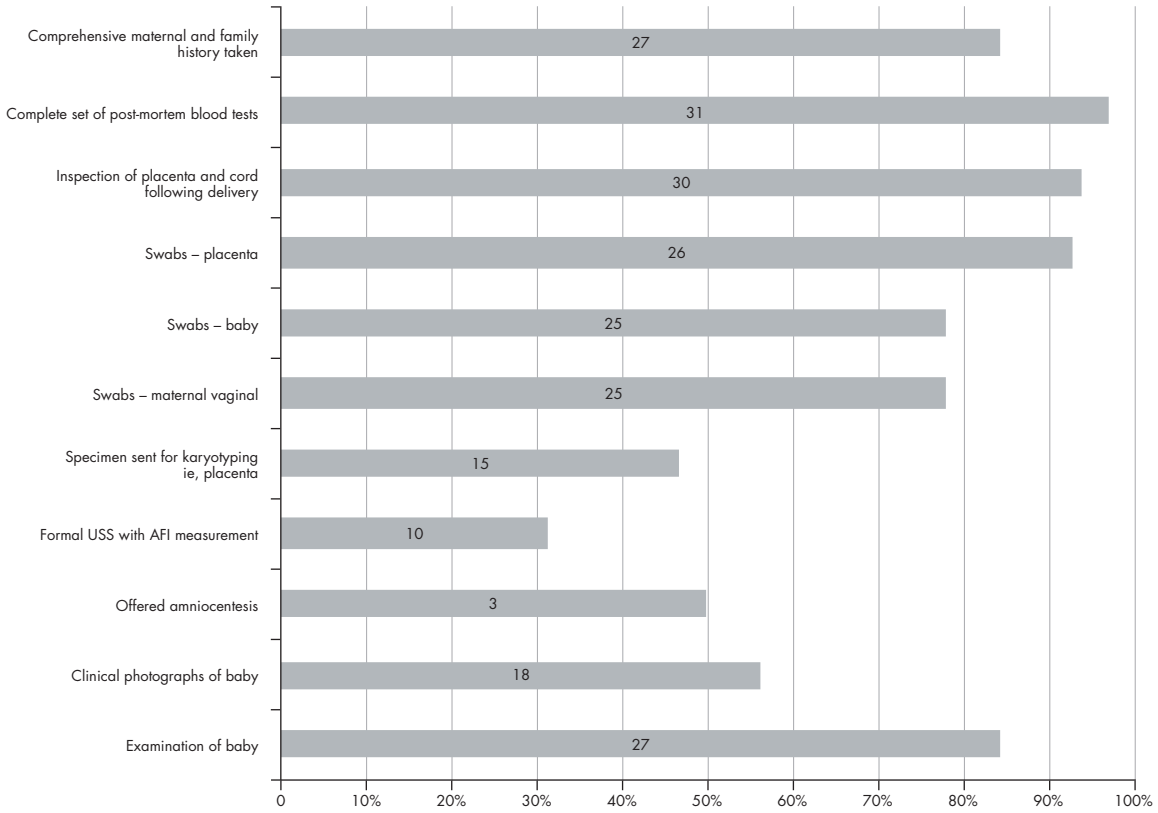
Notes

- Amniocentesis will be performed infrequently.
- All blood investigations will be necessary in most cases (eg, extreme preterm delivery, unexplained stillbirth, suspected cord accident).
- In pregnancies that are terminated or where the baby dies with major congenital abnormalities a full range of blood tests and swabs are not necessary; however, all baby investigations are required.
- Chromosome analysis (cord and placental section) should be done in:
  - unexplained stillbirth
  - women with recurrent miscarriage or IVF pregnancies
  - fetal abnormalities (no previous karyotype)
  - previous abnormal child in family
  - preterm births after discussion with maternal-fetal medicine specialist/obstetrician
  - other cases as requested by obstetrician, paediatrician, geneticist, maternal-fetal medicine specialist.

The uptake of perinatal death related investigation among unexplained stillbirths at term was generally high.

There is potential for improvement in (1) sending a specimen for karyotype (2) formal ultrasound assessment of the amniotic fluid volume and for fetal anomaly prior to birth, which may provide an indication to perform an amniocentesis and (3) clinical photographs of the baby.

Figure 1.55: Audit of term unexplained antepartum death and completeness of perinatal death investigations 2011



USS = ultrasound scan.

AFI = amniotic fluid index.

Adequacy of post-mortem examination report

The post-mortem and placental histopathology reports were audited, with advice from a perinatal pathologist, for their adequacy and thoroughness.

In 15/16 cases the post-mortem report met the audit standard. In one isolated case, the post-mortem report did not meet the audit criteria. In two cases, a limited post-mortem was consented to, which involved a skeletal survey only.

Adequacy of placental histopathology

In 29/30 cases (97 percent) the placental histopathology report met the audit standard. In one isolated case, the report fell short of the audit standard.

The PMMRC booklet *How to Investigate a Perinatal Death* (January 2014) provides detailed information and guidelines for clinicians on the investigation of perinatal death. This includes templates for core perinatal death investigations, placental examination, clinical photographs and clinical examination of the baby. This booklet is at: *http://www.hqsc.govt.nz/our-programmes/mrc/pmmrc/publications-and-resources/*

Special Topic 2012: Term Intrapartum Related Death

Description of term intrapartum related death

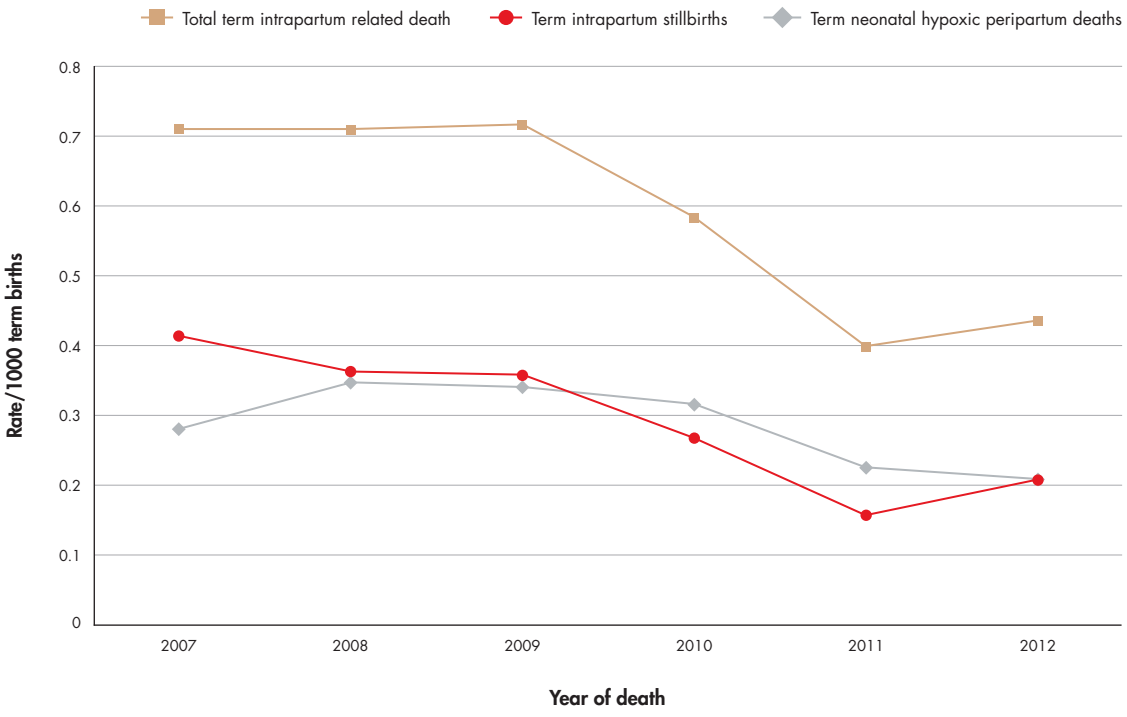
Term intrapartum deaths were chosen for specific analysis as they have been found by the PMMRC and in other published reports to have a high rate of contributory factors and potentially avoidable deaths. In previous years numbers have been inadequate for in-depth analysis.

Term intrapartum stillbirths and hypoxic peripartum deaths of neonates (PSANZ-PDC 7), excluding deaths of babies with congenital abnormalities, have been grouped together as '**term intrapartum related death**'. Hypoxic peripartum deaths (PSANZ-PDC 7) are deaths that were thought to be due to hypoxia in labour, whether the baby died intrapartum or as a neonate, and whether or not there were additional risk factors identified (that is, additional PSANZ-PDC codes).

From 2007–2012, there were 211 term intrapartum stillbirths or hypoxic peripartum neonatal deaths. Of these deaths, 109 (51.7 percent) were stillborn and 102 (48.3 percent) were neonatal deaths.

This represents 5.1 percent of all perinatal related deaths and 22.1 percent of perinatal related deaths of babies born at term.

Figure 1.56: Rate of term intrapartum related death (per 1000 term births) 2007–2012



There has been a significant reduction in total term intrapartum related deaths from 2007 to 2012 (chi-squared test for linear trend p=0.0037), and specifically in term intrapartum stillbirths (chi-squared test for trend p=0.0047).

Table 1.53: Perinatal death classification (PSANZ-PDC) among term intrapartum related deaths 2007–2012

Perinatal death classification (PSANZ-PDC)	Primary PSANZ-PDC		Associated PSANZ-PDC 1		Associated PSANZ-PDC 2		Assigned PSANZ-PDCs*	
	n=211		n=211		n=211		n=211	
	n	%	n	%	n	%	n	%
Perinatal infection	10	4.7	5	2.4	-	-	15	7.1
Hypertension	5	2.4	1	0.5	-	-	6	2.8
Antepartum haemorrhage	15	7.1	4	1.9	-	-	19	9.0
Maternal conditions	4	1.9	7	3.3	-	-	11	5.2
Specific perinatal condition	9	4.3	5	2.4	-	-	14	6.6
Hypoxic peripartum death	144	68.2	30	14.2	3	1.4	177	83.9
Fetal growth restriction	21	10.0	11	5.2	2	0.9	34	16.1
Unexplained antepartum	3	1.4	-	-	-	-	3	1.4

* Adds to more than 100% as categories are not mutually exclusive.

Eighty-four percent of intrapartum related deaths (177 babies) at term from 2007 to 2012 had a perinatal death classification of hypoxic peripartum death (asphyxial death). There were also 16 percent (34 babies) with fetal growth restriction meeting the criteria as a cause of death and 50 (24 percent) in total had a customised birthweight centile of less than 10 percent and so would be classified as customised SGA.

Table 1.54: Neonatal death classification (PSANZ-NDC) among term intrapartum related (neonatal) deaths 2007–2012

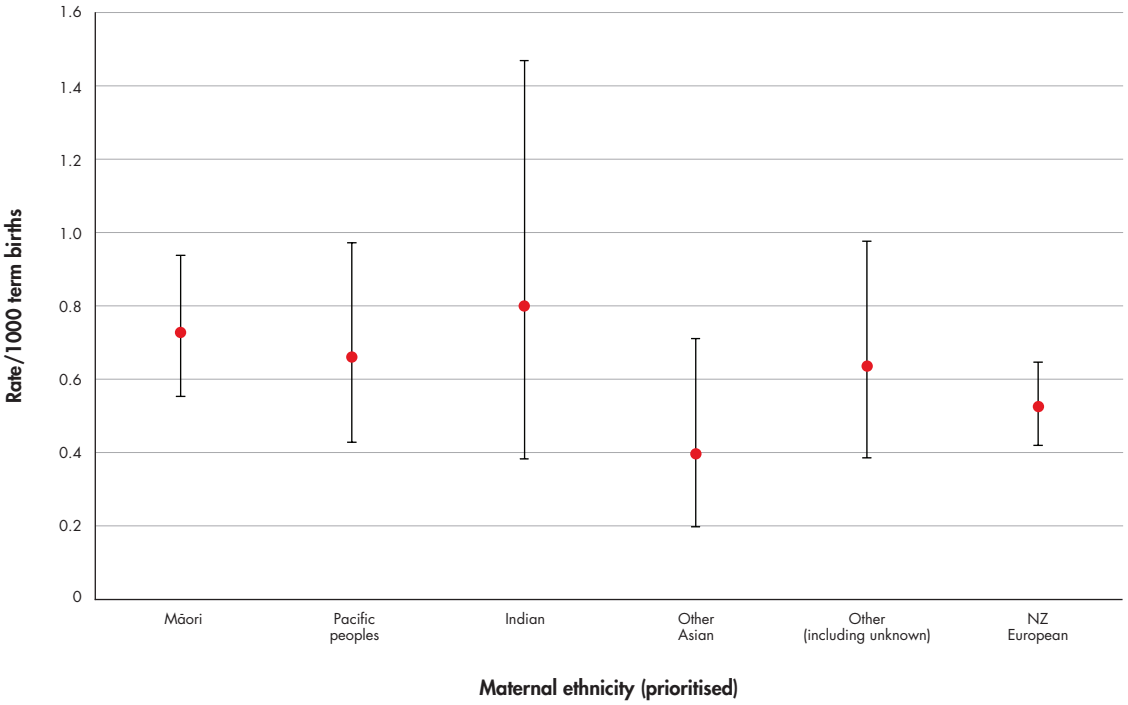
Neonatal death classification (PSANZ-NDC)	Primary PSANZ-NDC		Associated PSANZ-NDC 1		Associated PSANZ-NDC 2		Assigned PSANZ-NDCs*	
	n=102		n=102		n=102		n=102	
	n	%	n	%	n	%	n	%
Extreme prematurity	-	-	-	-	-	-	-	-
Cardio-respiratory disorders	1	1.0	14	13.7	-	-	15	14.7
Infection	2	2.0	5	4.9	-	-	7	6.9
Neurological	99	97.1	2	2.0	-	-	101	99.0
Gastrointestinal	-	-	-	-	-	-	-	-
Other	-	-	3	2.9	-	-	3	2.9

* Adds to more than 100% as categories are not mutually exclusive.

Of babies who died in the first month after birth fulfilling the criteria for intrapartum related death, all but one had a neurological death classification code, and it was the primary code in 97 percent of deaths.

Epidemiology of term intrapartum related death

Figure 1.57: Intrapartum related death at term and maternal ethnicity 2007–2012



There are no statistically significant differences in rate of term intrapartum related death by ethnicity.

Figure 1.58: Intrapartum related death at term (numbers) and gestation at birth 2007–2012

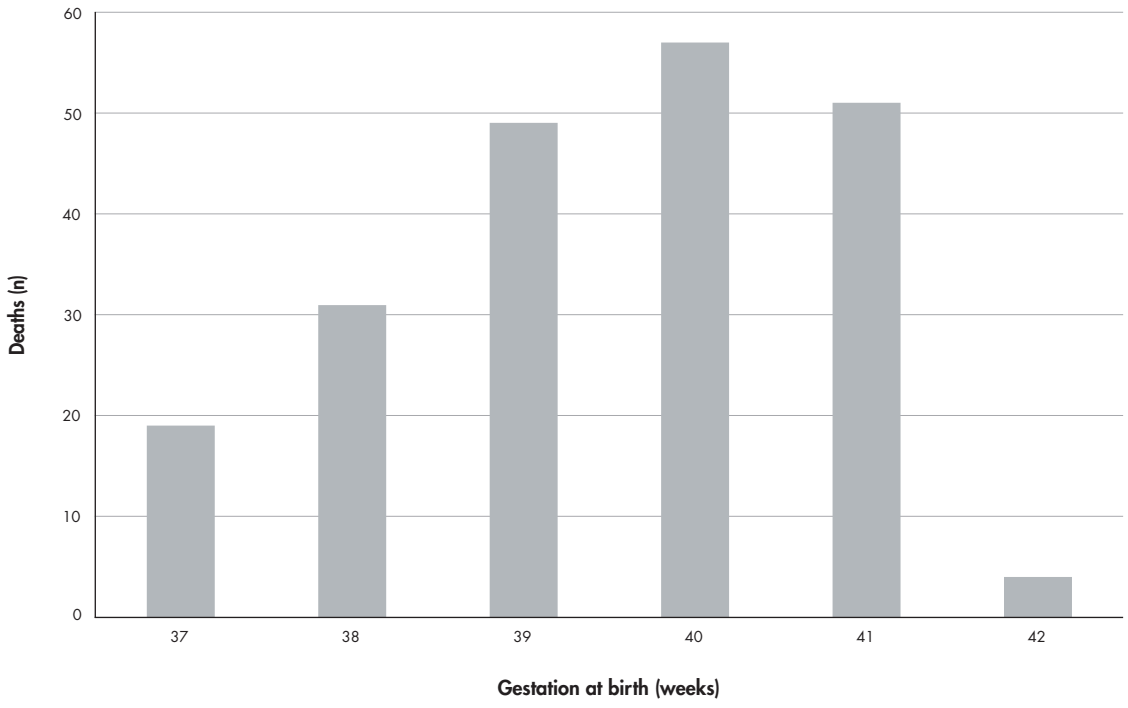


Figure 1.59: Intrapartum related death rates at term as a proportion of births at each gestation (37–42 weeks) 2007–2012

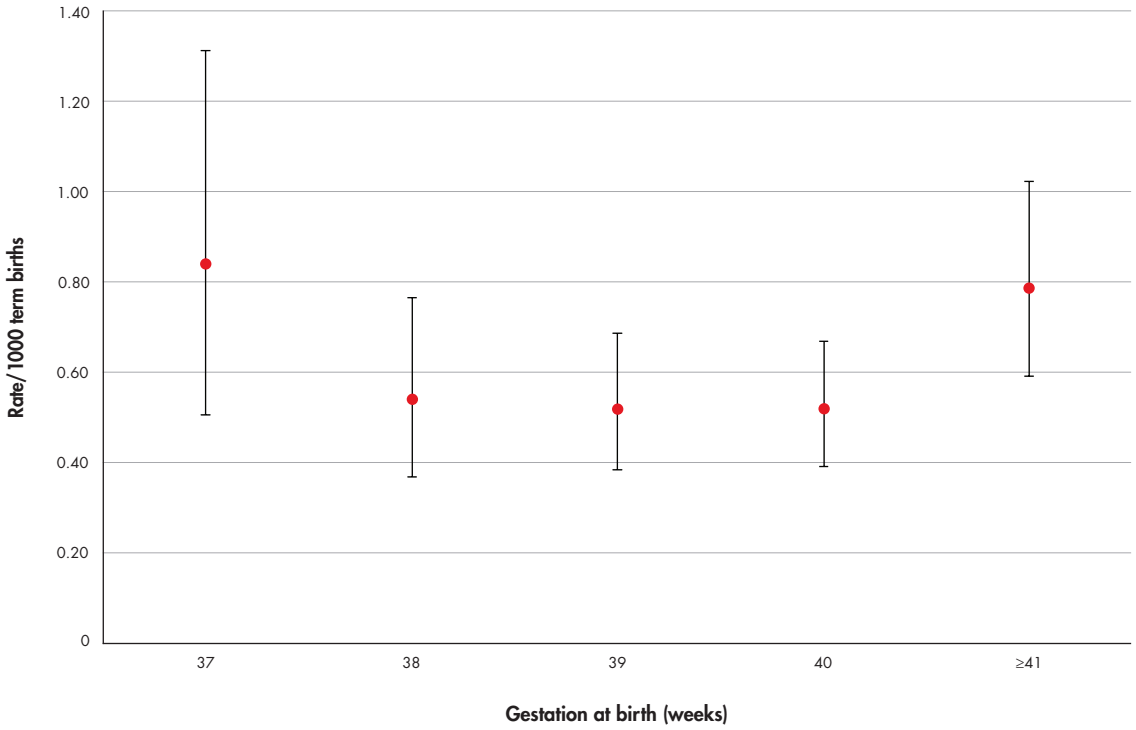
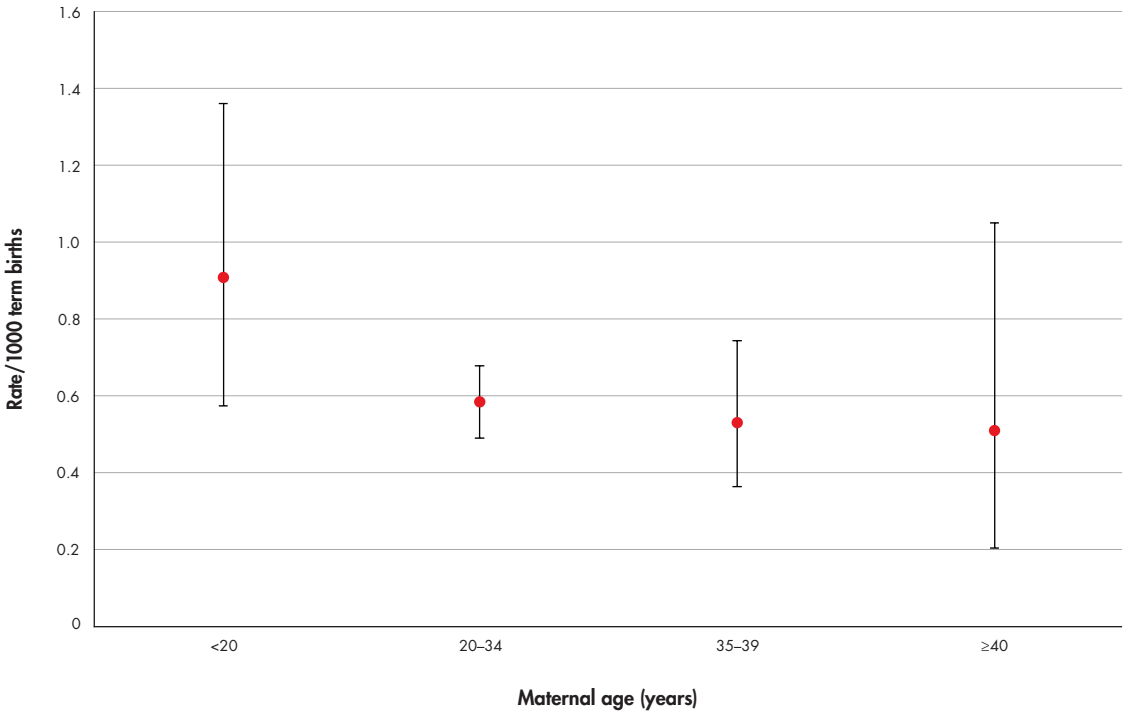


Figure 1.58 and Figure 1.59 show the association between gestation and term intrapartum related death. The largest numbers of intrapartum related deaths occur at 39–41 weeks, when most births are occurring. There appears to be a 'U-shaped' association with higher risk at both extremes of term; however, the apparent association is not statistically significant.

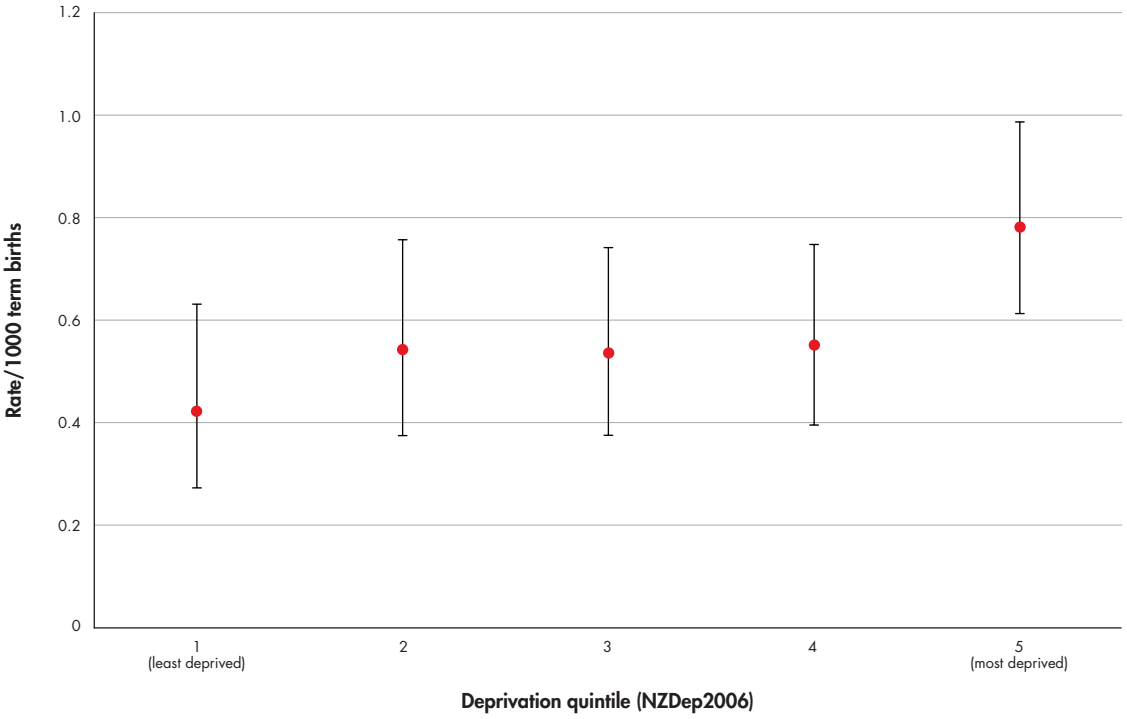
There has been a significant reduction in the proportion of births in the New Zealand population at 41 or more weeks from 2007 to 2012 that might explain some of the reduction in term peripartum related deaths (for example, due to a higher tendency to induce post term), as these babies are believed to be more vulnerable in labour.

Figure 1.60: Intrapartum related death at term and maternal age 2007–2012



There is no statistically significant association between maternal age and intrapartum related death at term, although there may be an increase among teenage mothers which is not currently significant due to small numbers.

Figure 1.61: Intrapartum related death at term and deprivation quintile (NZDep2006) 2007–2012



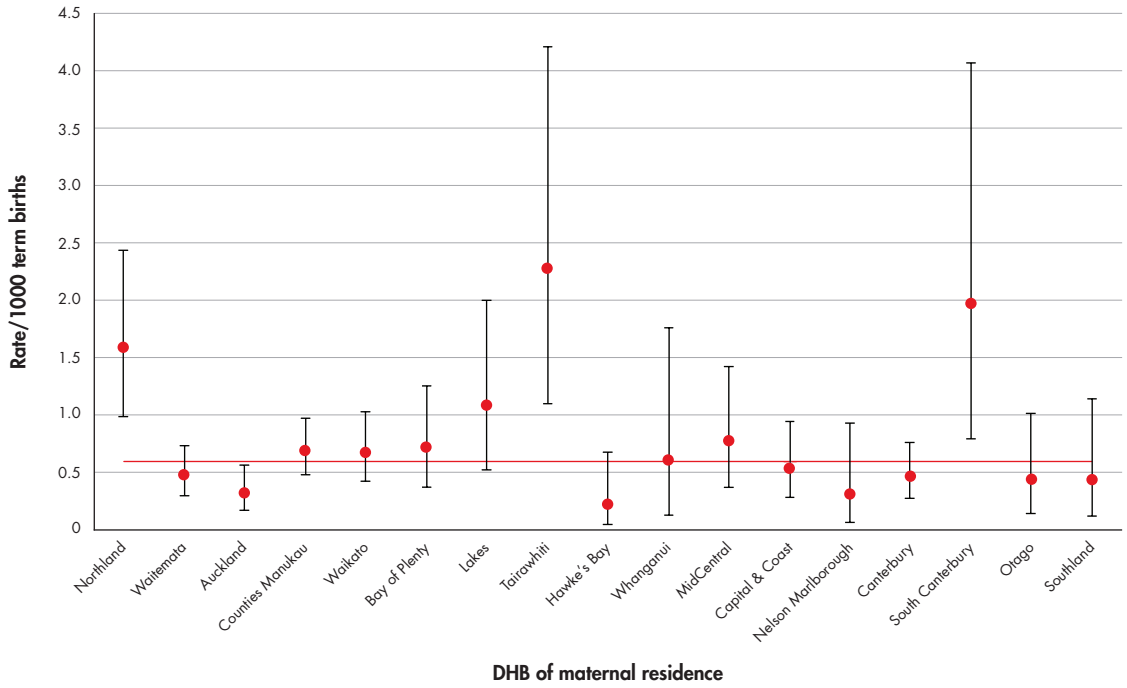
There is a significant linear association between increasing deprivation quintile (NZDep2006) and term intrapartum related death (chi-squared test for linear trend p=0.0075).

Table 1.55: Intrapartum related deaths at term by DHB of maternal residence 2007–2012

DHB of maternal residence	Term births	Intrapartum related deaths at term	Rate (/1000 term births)
Northland	13,191	21	1.59
Waitemata	44,002	21	0.48
Auckland	37,111	12	0.32
Counties Manukau	49,001	34	0.69
Waikato	31,021	21	0.68
Bay of Plenty	16,639	12	0.72
Lakes	9,170	10	1.09
Tairawhiti	4,374	10	2.29
Taranaki	8,907	2	0.22
Hawke's Bay	12,941	3	0.23
Whanganui	4,975	3	0.60
MidCentral	12,929	10	0.77
Wairarapa	3,011	1	0.33
Capital & Coast	22,072	12	0.54
Hutt Valley	11,958	2	0.17
Nelson Marlborough	9,418	3	0.32
West Coast	2,394	1	0.42
Canterbury	35,957	17	0.47
South Canterbury	3,547	7	1.97
Otago	11,523	5	0.43
Southland	8,998	4	0.44
Other*	1,543	-	-
New Zealand	354,682	211	0.59

* Other includes Overseas, Unknown and Other.

Figure 1.62: Intrapartum related death at term and DHB of maternal residence* 2007–2012



* Excludes any DHB with fewer than 3 cases.

Significantly higher rates of term intrapartum related death were reported among residents of Northland, Tairawhiti and South Canterbury DHBs.

The PMMRC recommends that Northland, Tairawhiti and South Canterbury DHBs review all cases of intrapartum related death at term in their area to identify opportunities for improvement.

Table 1.56: Sentinel events in/prior to labour among intrapartum related deaths at term 2007–2012

	Intrapartum related death at term	
	n=211	
	n	%
Sentinel event (defined by PSANZ-PDC classifications below)*	**62**	**29.4**
Uterine rupture (PSANZ-PDC 7.11)	6	2.8
Cord prolapse (PSANZ-PDC 7.12)	13	6.2
Placental abruption (PSANZ-PDC 4.1)	17	8.1
Vasa praevia (PSANZ-PDC 4.3)	1	0.5
Shoulder dystocia (PSANZ-PDC 7.13)	6	2.8
Other intrapartum complications (PSANZ-PDC 7.18)	22	10.4

* Events are not mutually exclusive.

Among intrapartum related deaths, 29 percent experienced a sentinel or acute event, most commonly placental abruption or cord prolapse of those named.

Table 1.57: Actual by intended place of birth for intrapartum related deaths at term 2007–2012

Actual place of birth	Intended place of birth																
	Total	Home		Birthing unit		Hospital level 1		Hospital level 2		Hospital level 3		Not registered		Unknown		Not registered/ Unknown	
		n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Home	**13**	6	46.2	1	7.7	-	-	1	7.7	2	15.4	1	7.7	2	15.4	3	23.1
Birthing unit	**12**	-	-	12	100.0	-	-	-	-	-	-	-	-	-	-	-	-
Hospital level 1	**7**	1	14.3	-	-	6	85.7	-	-	-	-	-	-	-	-	-	-
Hospital level 2	**96**	7	7.3	3	3.1	7	7.3	77	80.2	-	-	1	1.0	1	1.0	2	2.1
Hospital level 3	**82**	4	4.9	11	13.4	8	9.8	2	2.4	55	67.1	-	-	2	2.4	2	2.4
Other	**1**	-	-	-	-	1	100.0	-	-	-	-	-	-	-	-	-	-
Total	**211**	**18**	**8.5**	**27**	**12.8**	**22**	**10.4**	**80**	**37.9**	**57**	**27.0**	**2**	**0.9**	**5**	**2.4**	**7**	**3.3**

Table 1.58: Clinical details of birth among intrapartum related deaths at term 2007–2012

	Intrapartum related death at term	
	n=211	
	n	%
LMC at birth		
Not registered	7	3.3
Self-employed midwife	129	61.1
Hospital midwife	29	13.7
Hospital clinic/obstetrician	44	20.9
Obstetrician (private)	2	0.9
Induction of labour	28	13.3
Augmentation of labour	46	21.8
Labour in water	40	19.0
Water birth	6	2.8
Mode of birth		
Normal vaginal delivery	102	48.3
Vaginal breech	12	5.7
Operative vaginal delivery	28	13.3
Caesarean section	69	32.7
Elective caesarean	-	-
Acute caesarean	66	31.3
Unknown	3	1.4
Operative vaginal attempted before caesarean	4	1.9
Gender		
Male	104	49.3
Female	107	50.7
Customised birthweight centile		
Small for gestational age	50	23.7
Appropriate for gestational age	137	64.9
Large for gestational age	22	10.4
Could not assign centile	2	0.9

Of the 12 women with birth of a vaginal breech at term, nine were registered with an LMC. The breech presentation was identified prior to labour in two, with appropriate referral to an obstetrician and attempt at external cephalic version (ECV). Six women birthed in a level 3 or 2 unit, two in a level 1 unit, one birthed in the ambulance during transfer to secondary care and three at home. Of the three home births, two were planned and one woman was unattended at birth.

Table 1.59: Perinatal death investigations among intrapartum related deaths at term 2007–2012

	Intrapartum related death at term	
	n=211	
	n	%
Optimal perinatal investigations	103	48.8
Partial perinatal investigations	54	25.6
Inadequate perinatal investigations	47	22.3
Unknown	7	3.3

Table 1.60: Contributory factors and potentially avoidable perinatal death among intrapartum related deaths at term 2009–2012

	Intrapartum related death at term	
	n=125	
	n	%
Potentially avoidable	70	56.0
Contributory factors present but not potentially avoidable	11	8.8
Contributory factors present but avoidability unknown	3	2.4
No contributory factors	13	22.4
Missing data	13	10.4

Local perinatal related death review indicated that of the 125 deaths reviewed, 56 percent were considered to be potentially avoidable (compared to 18 percent of perinatal deaths overall – Table 1.41). In 2011 and 2012, data were collected on which of the contributory factors were important in potentially avoidable deaths. Of the 33 potentially avoidable term intrapartum related deaths in 2011 and 2012, organisation and management factors, personnel factors and barriers to access and/or engagement with care were each identified in approximately one-third of deaths (8, 11 and 10 cases).

Table 1.61: Organisation/Management contributory factors among intrapartum related deaths at term 2009–2012

	Intrapartum related death at term	
	n=125	
	n	%
Organisational/Management factors	**37**	**29.6**
Poor organisational arrangements of staff	7	5.6
Inadequate education and training	11	8.8
Lack of policies, protocols or guidelines	10	8.0
Inadequate numbers of staff	2	1.6
Poor access to senior clinical staff	5	4.0
Failure or delay in emergency response	11	8.8
Delay in procedure *(eg, caesarean section)*	12	9.6
Delayed access to test results or inaccurate results	2	1.6
Equipment *(eg, faulty equipment, inadequate maintenance, inadequate quality or lack of equipment)*	3	2.4
Building and design functionality *(eg, space, privacy, ease of access, lighting, noise, power failure, operating theatre in distant location)*	-	-
Other	5	4.0

Table 1.62: Personnel contributory factors among intrapartum related deaths at term 2009–2012

	Intrapartum related death at term	
	n=125	
	n	%
Personnel factors	**56**	**44.8**
Knowledge and skills of staff were lacking	21	16.8
Delayed emergency response by staff	10	8.0
Failure to maintain competence	6	4.8
Failure of communication between staff	16	12.8
Failure to seek help/supervision	9	7.2
Failure to offer or follow recommended best practice	33	26.4
Lack of recognition of complexity or seriousness of condition by caregiver	9	7.2

Feedback from local review committees identified the following themes related to personnel contributory factors among intrapartum related deaths at term for the period 2009–2012:

- a lack of recognition of increased risks either antenatally or during labour (for example, hypertension, suspected ruptured membranes, reduced fetal movements, risks associated with obesity, the increased vulnerability of babies who may be SGA during labour)
- a delay calling for assistance

- a lack of recognition of abnormal fetal heart patterns during labour
- resuscitation skills.

These themes suggest a need to ensure frequent and continued assessment of the health and wellbeing of both the mother and baby prior to and during labour with an emphasis on risk assessment. Education promoting recognition and action in emergency obstetric care has been a focus within the maternity sector and this should continue.

Risk assessment is dynamic and needs to be frequently re-evaluated, from initial assessment at first contact with a health professional, at registration with an LMC and at regular intervals during maternity care.

Ongoing assessment prior to and during labour informs the plan for labour care (including the method of intrapartum monitoring of maternal and fetal wellbeing) and the need for consultation or transfer of care (as per the referral guidelines).

Maternity workforce education programmes and DHB guidelines should incorporate the third edition of the RANZCOG fetal surveillance guidelines (which are supported by the New Zealand College of Midwives). These are available at: http://www.ranzcog.edu.au/college-statements-guidelines.html

Table 1.63: Barriers to access and/or engagement with care contributory factors among intrapartum related deaths at term 2009–2012

	Intrapartum related death at term	
	n=125	
	n	%
Barriers to access and/or engagement with care	**39**	**31.2**
No antenatal care	3	2.4
Infrequent care or late booking	9	7.2
Declined treatment or advice	3	2.4
Obesity impacted on delivery of optimal care *(eg, USS)*	3	2.4
Substance use	3	2.4
Family violence	1	0.8
Lack of recognition of complexity or seriousness of condition	8	6.4
Maternal mental illness	1	0.8
Cultural barriers	5	4.0
Language barriers	2	1.6
Not eligible to access free care	-	-
Environment *(eg, isolated, long transfer, weather prevented transport)*	14	11.2
Not stated	5	4.0

USS = ultrasound scan.

Comments related to barriers to access and/or engagement with care among intrapartum related deaths at term 2009–2012 most often related to location and the need to transfer mother or baby.

Audit of term intrapartum related death 2011

The clinical notes of the 23 term intrapartum related deaths in 2011 were reviewed. Cases from 2011 were available for review as the clinical notes for these specific babies were requested both for audit of data accuracy in 2011 (see section 1.2 Methodology) and so that they could be included in this special topic analysis.

The aim of the term intrapartum related death audit (of 10 intrapartum stillbirths and 13 neonatal deaths in 2011) was to audit intrapartum care and to determine the adequacy of perinatal death investigations against recognised standards.

The New Zealand College of Midwives has a consensus statement on 'Fetal Monitoring in Labour and Decision Points for Care' published within the *Handbook for Practice*. However, these do not set out frequency of assessments. Therefore, other national and international standards were used to audit intrapartum care. Those chosen were RANZCOG 2nd edition (RANZCOG 2010) and WHO guidelines (WHO 2006b). It should be noted that these documents may not reflect the New Zealand context of care and may not be consistent with local DHB policies.

Maternal observations during labour among the 23 mothers reviewed were documented at the recommended frequency set out by the WHO in 9 cases (39 percent). These are defined as monitoring the maternal pulse, temperature and blood pressure every four hours during active labour. In some of these cases, no maternal observations were documented.

Undertaking routine observations (temperature, pulse, blood pressure and respirations) in themselves should not be considered a measure of good practice unless accompanied by assessment of those observations. There needs to be a full and ongoing assessment of the maternal and baby's health and of the labour using the appropriate tools.

Table 1.64: Audit of term intrapartum related deaths and identification of risk factors prior to labour 2011

Risk factors identified by caregivers antenatally	Intrapartum related deaths at term	
	n=23	
	n	%
No antenatal risk factor present	8	35
Antenatal risk present but not identified	5	22
Antenatal risk present and identified	10	43
Unstable/oblique lie	1	4
Oligohydramnios	1	4
Macrosomia	2	9
Vaginal birth after caesarean (VBAC)	1	4
Prolonged rupture of membranes	2	9
Gestational diabetes	1	4
Prolonged rupture of membranes and VBAC	1	4
Unstable lie, advanced maternal age and prolonged rupture of membranes	1	4
If risk factor(s) identified, what was the fetal surveillance in labour?	**n=10**	
Intermittent auscultation	2	20
Cardiotocography (CTG)	8	80

In the majority of cases (78 percent) there was no antenatal risk factor or risk was present and identified.

RANZCOG intrapartum fetal surveillance clinical guidelines and National Institute for Health and Care Excellence (NICE) guidelines were used as standards for review of cardiotocography (CTG) interpretation, frequency of review and documentation. These standards require documentation of fetal baseline, baseline variability, accelerations, decelerations and overall opinion of normal, suspicious or abnormal CTG.

The standard for intermittent auscultation interpretation, frequency and documentation was from RANZCOG 2nd edition (2010) and NICE guidelines (2010), which recommend that a Doppler ultrasound is used on speaker mode and that auscultation should occur at least every 15–30 minutes in the active phase of the first stage of labour and at least every five minutes in the second stage of labour.

Intermittent auscultation was correctly documented at recommended intervals in 7 of 11 cases where it was used.

Of the 17 mothers monitored by CTG at some point during their labour, 9 had adequate documentation and frequency of documentation of CTG findings.

Available CTGs were independently audited against the RANZCOG 2nd edition fetal surveillance guidelines to assess CTG interpretation. Of the 15 available CTGs, 14 were assessed as abnormal by independent audit. Primary and secondary carer only identified 7 of these 14 CTGs as abnormal with a corresponding plan of care documented.

The number of cases included in this audit was small. Further review of intrapartum surveillance among cases of intrapartum related death is required.

Table 1.65: Audit of term intrapartum related death and post-mortem 2011

	Intrapartum related deaths at term	
	n=23	
	n	%
Investigations		
Post-mortem	14	61
Placental histology	20	87
Skeletal survey	4	17
Which health care professionals discussed and offered post-mortem examination?		
Midwife	10	43
Obstetric house officer	1	4
Obstetric registrar or consultant	9	39
Paediatric registrar or consultant	5	22
No documentation of any post-mortem discussion taking place	3	13
Case referred to Coronial Services	9	39
Documentation of post-mortem counselling		
Complete	1	4
No documentation of details of discussion	10	43
No documentation of any post-mortem discussion taking place	3	13
Case referred to Coronial Services	9	39

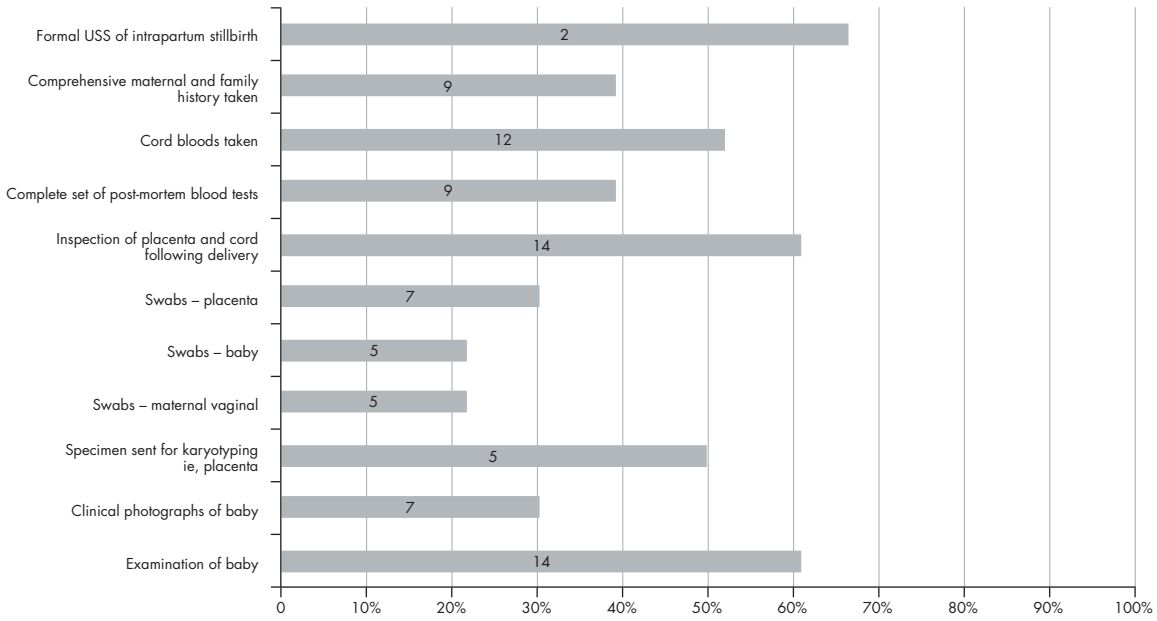
Among the 10 intrapartum stillbirths, three babies had a post-mortem, though counselling was documented in nine cases. Among the 13 neonatal deaths, 11 were investigated by post-mortem (nine at a coroner's request). In the remaining two cases, there was no documentation of any post-mortem discussion having taken place.

A combination of healthcare professionals counselled each family in some cases. The documentation of discussion with the family was detailed in only one case.

Placental histology was undertaken in 87 percent of cases.

The post-mortem and placental histopathology reports were audited for their adequacy and thoroughness, and 100 percent of post-mortem and placental histology reports met the audit standard.

Figure 1.63: Audit of intrapartum related death at term and adequacy of perinatal death investigations 2011



USS = ultrasound scan.

The PSANZ-recommended investigations for perinatal death are given in Table 1.52, and these were used for audit.

There was documentation of a maternal and family history for only 9 of the 23 babies who died.

Of those who had a stillbirth discovered prior to delivery (three cases), all were offered an ultrasound scan to assess liquor volume.

Swabs from the vagina, placenta and baby were completed in fewer than half of deaths. Inspection of the placenta and cord following delivery was documented in 61 percent of cases. A cord or placental specimen was sent for karyotype in 5 of the 10 intrapartum stillbirths. Requesting karyotype from the cord or placenta would not be considered clinically necessary for the neonatal deaths. There was formal documentation of an external examination of 14 of the 23 babies overall, and in 8 of 10 intrapartum stillbirths. Clinical photographs were taken of only seven babies.

Cord gases were obtained in 10 of the 13 neonatal deaths. Cord gases were not obtained from the three neonatal deaths who were homebirths. Obtaining cord gases is often not possible at stillbirth, but was attempted in 2 of the 10 deaths.

Of the 23 mothers, 21 had blood tests for rubella, syphilis and hepatitis B, and 17 had a full blood count. Only 9 had a blood group and Kleihauer. Nine of the 23 mothers (39 percent) received all of the recommended blood investigations. In contrast, 97 percent of mothers of unexplained stillbirths reviewed in 2011 had a complete set of recommended blood tests (Figure 1.55).

Of the 23 women whose babies had a peripartum related death, 6 (26 percent) received all of the recommended maternal investigations (bloods, maternal swabs and comprehensive history) compared to 81 percent of mothers whose babies had unexplained antepartum deaths at term.

Mothers of hypoxic peripartum deaths were infrequently offered the recommended maternal investigations (bloods, maternal swabs and comprehensive history), suggesting possible lack of awareness of the importance and appropriateness of these tests alongside post-mortem examination in this situation.

2 New Zealand Maternal Mortality 2012

2.1 Introduction

A Maternal Mortality Review Working Group (MMRWG) was established in 2006 to develop a process for the national collection of data relating to maternal deaths. The group's aim is to review maternal deaths and identify potentially avoidable causes, with the expectation that this will lead to improvements in care. The terms of reference of the PMMRC require the committee to review 'direct' maternal deaths. The MMRWG also reviews 'indirect' deaths, in particular (but not solely) those related to medical conditions exacerbated by pregnancy and those related to mental health.

The MMRWG chair changed in 2013 from Alastair Haslam (obstetrician and gynaecologist) to Graham Sharpe (anaesthetist). Other members of the working group are Alec Ekeroma (obstetrician and gynaecologist), Alison Eddy (midwife), Claire McLintock (obstetric physician and haematologist), John Walker (anaesthetist), Kate White (forensic pathologist), Lesley Dixon (midwife), Liz McDonald (psychiatrist) and Sue Belgrave (PMMRC Chair, obstetrician and gynaecologist). Vicki Masson (PMMRC national coordinator) provides additional support. Lynn Sadler (epidemiologist) assists with data analysis and interpretation. The MMRWG meets three times a year.

The year 2012 completes the seventh year of maternal death reporting under the auspices of the PMMRC. The number of maternal deaths in each year is small, which limits the analysis. In this report, time trends in maternal mortality in New Zealand have been explored along with analyses that include all years of maternal mortality data.

The MMRWG noted in the 2009 PMMRC report that the Ministry of Health published two publications reporting maternal mortality – *Hospital-based Maternity Events 2006* and *Hospital-based Maternity Events 2007* – summarising data stored in the National Minimum Dataset (NMDS) and maternal mortality data sourced from the Mortality Collection (data from death registrations in New Zealand). Each publication has a section on maternal deaths. These reports and their predecessors have provided information on maternal deaths since the Maternal Mortality Review Committee ceased to exist in 1995. These publications present deaths by year of death registration rather than year of death and only report maternal deaths identified in the Mortality Collection. For these reasons, the publications report different maternal mortality ratios from those reported by the PMMRC. The PMMRC cross-checks cases from these publications to ensure the PMMRC dataset of maternal deaths is as complete as possible. It should be noted that, because the PMMRC ascertainment process collects more cases than are found from routine datasets, the PMMRC estimate of the New Zealand maternal mortality ratio is necessarily higher, and a comparable ratio should be used when comparing New Zealand ratios with international ratios. This point is highlighted and ratios are reported using each ascertainment method in the *Eighth Report of the Confidential Enquiries into Maternal Deaths in the United Kingdom* (CMACE 2011b).

2.2 Definitions

The definitions adopted by the MMRWG are based on the WHO definitions from the International Classification of Diseases (10th edition) (ICD 10) as follows.

Maternal related death: 'death of a woman while pregnant or within 42 days of termination of pregnancy, 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 cause of each death is sub-classified using the Confidential Enquiry into Maternal and Child Health (CEMACH) classification system (Lewis 2007).

- **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.

- **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. All maternal deaths by suicide are included in the New Zealand data as indirect deaths.
- **Coincidental maternal deaths:** deaths from unrelated causes that happen to occur in pregnancy or the puerperium.

These definitions exclude **late maternal deaths**, occurring between 42 days and one year following the birth, even though it is known that some pregnancy related deaths occur in this later period. The MMRWG may consider and review these deaths where they can be identified.

Maternal mortality ratio is the number of maternal related deaths per 100,000 maternities.

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

The variable definition of 'maternities' creates unnecessary confusion when making international comparisons. The WHO recommends 100,000 live births as the most available denominator in countries with limited vital statistics collection. In countries where fetal deaths are also collected, the WHO recommends the denominator be 100,000 live births plus fetal deaths of 20 weeks or greater gestation. The UK uses the number of pregnancies that result in a live birth at any gestation or a stillbirth at or after 24 completed weeks gestation (as only stillbirths at 24 or more weeks gestation are required to be notified by law) (Lewis 2007). Australia reports the number of women who gave birth to either a live or stillborn baby of 20 or more completed weeks gestation or weighing at least 400g at birth (as required to be reported to the National Perinatal Data Collection) (Sullivan et al 2007).

Contributory factors are organisational/management factors (for example, delays in procedures or accessing results, lack of policies, protocols or guidelines, lack of maintenance of equipment), personnel factors (for example, failure to maintain competence) and barriers to accessing/engaging with care (for example, unregistered pregnancies, language barriers, distance from adequate facilities) that the MMRWG considered influenced care in the death reviewed. The subcategories within each group of factors considered are given in the 'PMMRC Classification of Contributory Factors and Potential Avoidability Form' (Appendix D).

A potentially avoidable maternal death is where the absence of the contributory factor(s) may have prevented the death.

More details on the process of development of the tool to assess contributory factors and potentially avoidable death have been published (Farquhar et al 2011).

2.3 Methodology

Since 2006, the PMMRC has requested local coordinators to notify all maternal deaths. Deaths are also brought to the MMRWG's attention by Coronial Services, from media reports or through other means. At the end of each year, known deaths are cross-referenced with the mortality collection at the BDM Registry to ensure the collection is complete. Since July 2007, it has been a statutory requirement that all maternal deaths are notified to Coronial Services.

The MMRWG has developed a data collection tool for maternal deaths. Following notification of a maternal death, the PMMRC national coordinator issues maternal death reporting forms to the appropriate local coordinator, who is then responsible for gathering the relevant clinical information from practitioners involved with the woman's care.

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

From 2006 to 2008, the MMRWG of the PMMRC prospectively assessed whether maternal deaths were potentially avoidable but did not use a tool for identifying contributory factors. In early 2010, an expert panel that included a midwife researcher, an obstetrician and an epidemiologist, one of whom was also a member of the working group, considered each death from 2006 to 2008 and completed the tool for identifying contributory factors. For 2009–2012 deaths, the working group applied the new tool in reviewing the maternal deaths. The findings of the expert panel review of deaths from 2006 to 2008 combined with the committee's reviews for 2009–2012 are presented in this report.

In 2013, a dedicated maternal mortality database was developed by the Otago Data Group. All maternal mortality cases from 2006 have been entered by the national coordinator, thus improving the quality of, and access to, the MMRWG's data. This has resulted in some minor changes in the data tables from previous reports due to improved data checking processes.

2.4 Findings

Maternal Mortality Ratio

Table 2.1: Maternal mortality ratio (per 100,000 maternities) and cause of maternal death 2006–2012

	2006	2007	2008	2009	2010	2011	2012	2006-2012	
								n=77	
	n	n	n	n	n	n	n	n	%
Maternities	60,659	65,602	65,872	63,665	65,124	62,604	62,425	-	-
Direct maternal death	**6**	**5**	**4**	**5**	**1**	**2**	**2**	**25**	**32.5**
Amniotic fluid embolism	3	-	1	4	1	-	1	10	13.0
Postpartum haemorrhage	1	1	1	-	-	-	-	3	3.9
Venous thrombo-embolism	-	1	1*	-	-	1	-	2	2.6
Peripartum cardiomyopathy	-	1	-	-	-	-	-	1	1.3
Pre-eclampsia/Eclampsia	-	2	1	1	-	-	-	4	5.2
Sepsis	2	-	-	-	-	1	1	4	5.2
Indirect maternal death	**7**	**5**	**5**	**9**	**8**	**6**	**8**	**48**	**62.3**
Pre-existing medical condition	2	4	2	1	2	4	4	19	24.7
Sepsis	-	1	-	5	1	-	-	7	9.1
Intracranial haemorrhage	1	-	-	-	1	-	1	3	3.9
Suicide	4	-	3	3	4	2	3	19	24.7
Unclassifiable	**2**	**1**	**-**	**-**	**-**	**1**	**-**	**4**	**5.2**
Total maternal deaths	**15**	**11**	**9**	**14**	**9**	**9**	**10**	**77**	**100.0**
Single-year MMR	24.7	16.8	13.7	22.0	13.8	14.4	16.0	-	-
Three-year rolling MMR	-	-	**06–08** 18.2	**07–09** 17.4	**08–10** 16.4	**09–11** 16.7	**10–12** 14.7	-	-
Coincidental deaths	**1**	**3**	**1**	**-**	**3**	**3**	**5**	**16**	**-**

* Pulmonary embolism and sepsis.
MMR = maternal mortality ratio.

In 2012, 10 deaths within the definition of maternal mortality and a further 5 coincidental deaths of women in pregnancy or within six weeks of birth were reported to the PMMRC. The maternal mortality ratio in New Zealand was therefore 16.0/100,000 maternities (95 percent CI 8.7–29.5/100,000) for the year 2012. The three-year average maternal mortality ratio, calculated to obtain a more robust estimate of the New Zealand ratio given small numbers of deaths per year, for 2010–2012 was 14.7/100,000 maternities (95 percent CI 10.2–21.3/100,000).

The maternal mortality ratios for the years 2010 and 2011 have been adjusted this year, as a result of the inclusion of one further suicide death in each of these years due to late notification. The adjusted maternal mortality ratios for these years were 13.8 and 14.4/100,000 maternities respectively.

In 2012, there were two direct deaths, one due to amniotic fluid embolism and one sepsis, eight indirect deaths, four from pre-existing medical conditions, one intracranial haemorrhage and three suicide deaths. The maternal mortality ratio for direct deaths alone for the most recent five years of data (2008–2012) was 4.38/100,000 maternities (95 percent CI 2.61–7.35/100,000), and for indirect deaths 11.26/100,000 maternities (95 percent CI 8.13–15.59/100,000).

A further five coincidental deaths were reported in 2012 – four motor vehicle accidents and a homicide.

Figure 2.1: Maternal mortality ratios (per 100,000 maternities) (one-year and three-year rolling average) 2006–2012

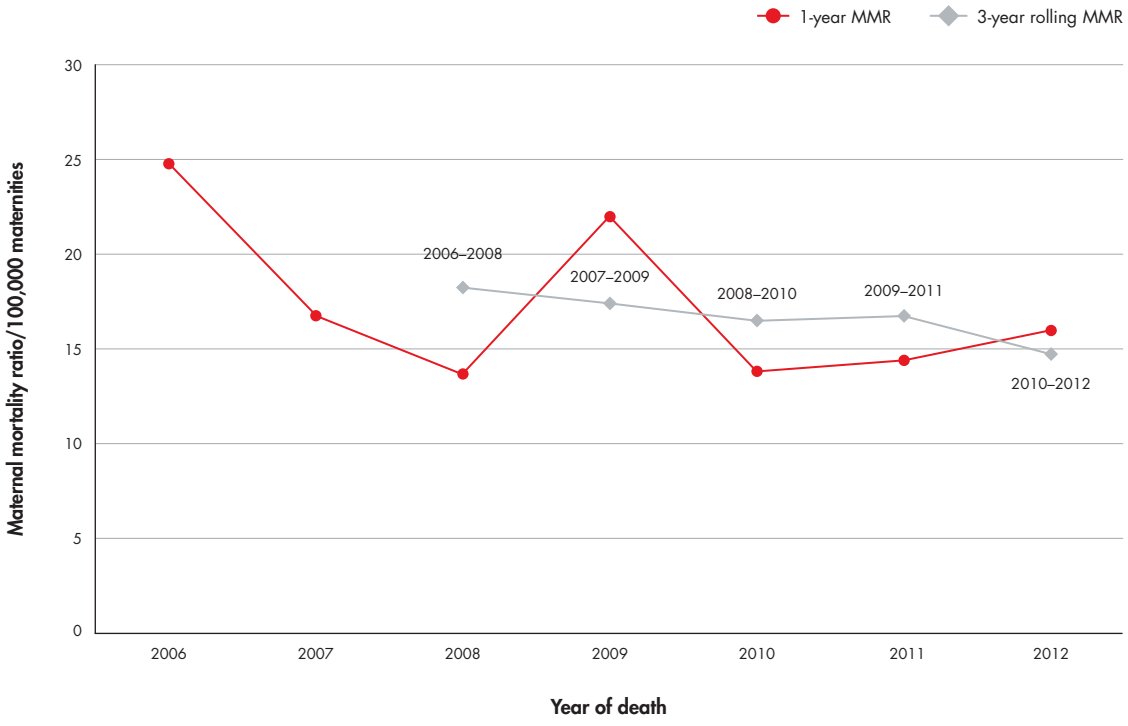


Figure 2.1 demonstrates maternal mortality ratios for each year and three-year rolling average ratios. The three-year rolling average ratios are represented as an estimate plotted at the final year of the three-year period. For example, the three-year ratio for 2006–2008 is plotted for 2008.

International comparisons

It is difficult to compare maternal mortality ratios internationally due to differences in definitions and variations in systems for ascertainment of maternal death. Small differences in the denominator (number of maternities) result in very small changes when calculating the ratio, whereas changes in the numerator (number of deaths) have a substantial impact on the ratio. It has been calculated that countries without dedicated maternal mortality confidential enquiry systems have poorer case ascertainment leading to under-reporting 15–63 percent of cases (Cliffe et al 2008; Donati et al 2011; European Perinatal Health Report 2004). The New Zealand experience is that under-reporting may be as high as 50 percent (Figure 2.2).

Low maternal mortality ratios may therefore be due to a lack of adequate reporting systems in a country to ascertain all maternal deaths. The United States Centers for Disease Control and Prevention only report on direct maternal deaths due to difficulty with case ascertainment of all maternal deaths (Xu et al 2010).

This is important when making comparisons to international maternal mortality ratios, which are generally calculated using routine surveillance data. The in-depth ascertainment of maternal deaths used in the PMMRC process in New Zealand results in a higher degree of accuracy. Anything other than mandatory reporting supported by an efficient surveillance system is likely to result in lower maternal mortality ratios.

The UK reported a maternal mortality ratio based on confidential enquiry data of 11.4/100,000 maternities (4.7/100,000 direct maternal mortality ratio; 6.7 indirect maternal mortality ratio) for the triennium 2006–2008 (CMACE 2011b). The New Zealand maternal mortality ratio for this triennium was significantly higher at 18.2/100,000 maternities with 95 percent CI 12.8–25.5 (7.9/100,000 direct maternal mortality ratio; 8.9/100,000 indirect maternal mortality ratio). No recent data have been reported from the UK.

Publication of a report on maternal deaths in Australia 2006–2010 was planned for 2013, but is not currently available.

Figure 2.2: Maternal mortality ratios (per 100,000 maternities) from routine and mandatory reporting, comparing New Zealand, Australia and the United Kingdom 2003–2012

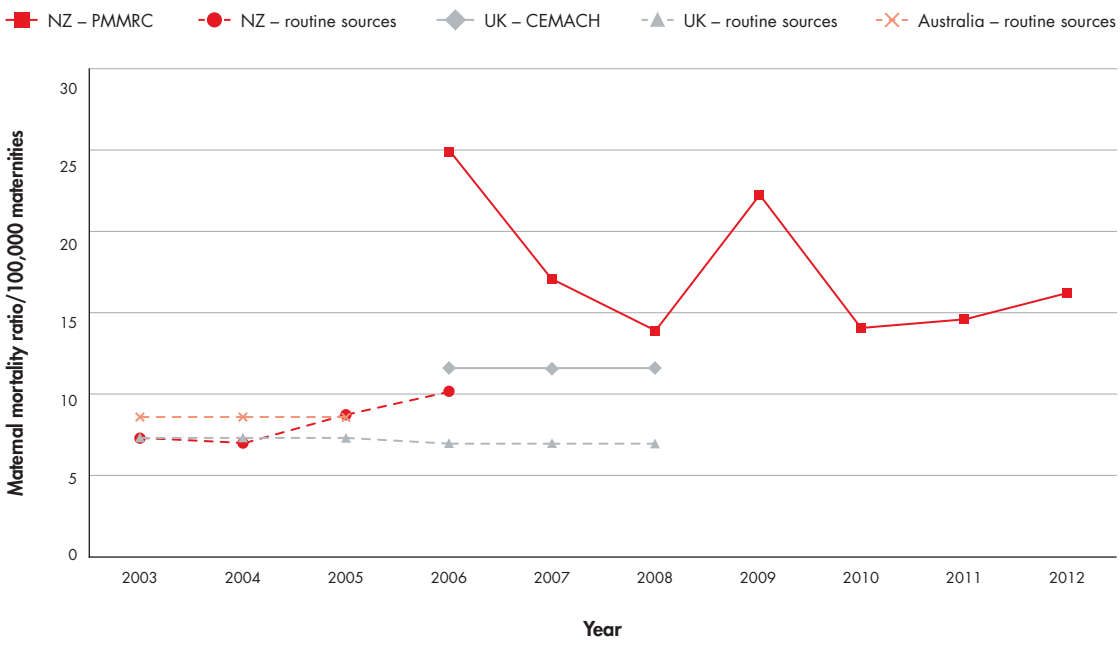


Figure 2.2 illustrates the effect of routine compared to mandatory reporting on national maternal mortality ratios. New Zealand, UK and Australian ratios from routine data reporting are presented as broken lines while ratios based on mandatory reporting are presented as bold lines. Australia does not currently have a system of mandatory reporting and published ratios are likely to underestimate the true ratios (Johnson and Sullivan 2013).

Table 2.2: Reporting of maternal deaths to New Zealand Coronial Services 2006–2012

Year	Maternal deaths	Maternal deaths reported to Coronial Services	
	n	n	%
2006	15	14	93.3
2007	11	8	72.7
2008	9	9	100.0
2009	14	14	100.0
2010	9	9	100.0
2011	9	9	100.0
2012	10	8	80.0

It is a statutory requirement in New Zealand that any death that occurred while the woman concerned was giving birth, or that appears to have been a result of that woman being pregnant or giving birth, are reported to Coronial Services for consideration of the need for further investigation. Since 2007, there has been a specific tick box on the death certificate to remind practitioners of this requirement and to assist in ascertainment of all cases. In 2012, two cases were not reported to Coronial Services at the time of death. Both of these mothers died a considerable time after the initial events which lead to their death.

In the seventh annual report of the PMMRC, published in 2012 (PMMRC 2012), the maternal working group reported the findings of a review of the role of post-mortem in determining cause of maternal death from 2006 to 2011. The review found the clinical diagnosis was confirmed in 64 percent, changed in 19 percent, additional clinical findings in 11 percent, and clinical diagnosis inconclusive in 6 percent. The working group recommended that where a coroner declines jurisdiction in the case of a maternal death, post-mortem should be offered as part of full investigation of cause of death.

Demographic characteristics

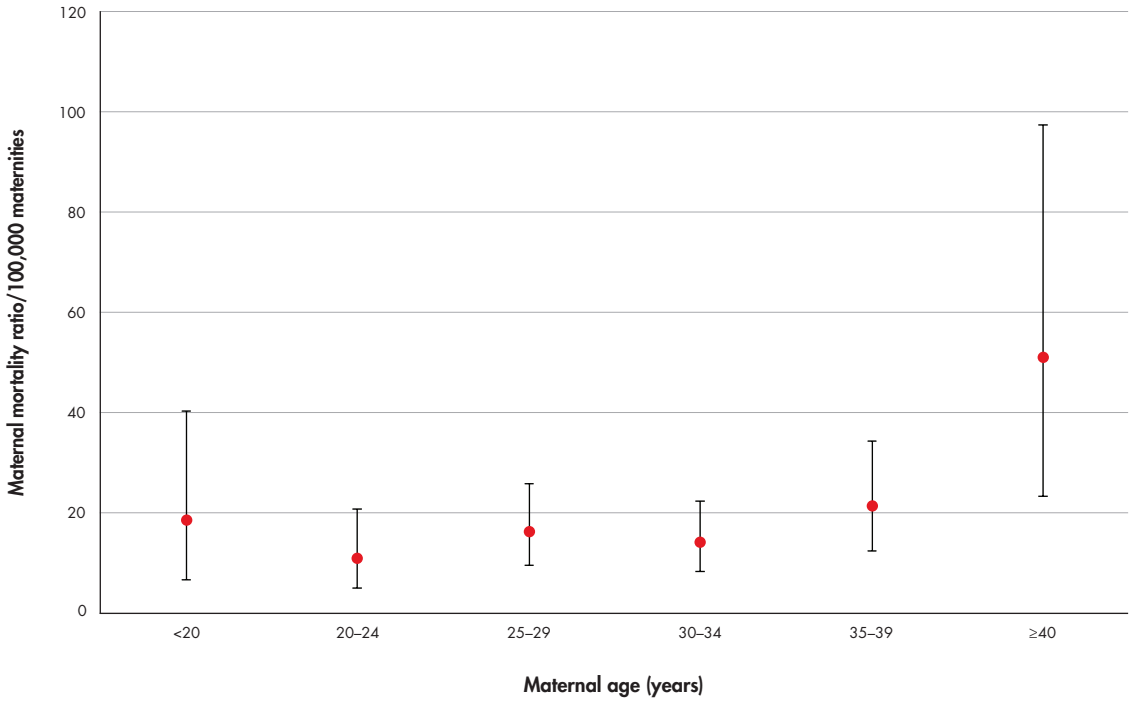
The demographic characteristics section (pages 139–42) and the following section on time and place of death include 2006–2012 data. Numbers of deaths per year in New Zealand are small and so data have been combined to increase the power of the analyses.

Improved data checking following entry of maternal deaths from 2006 to 2012 into the maternal mortality database has resulted in small changes in Table 2.3. For this reason, annual data have been provided to correct previous data tables.

Table 2.3: Demographic characteristics among maternal deaths 2006–2012

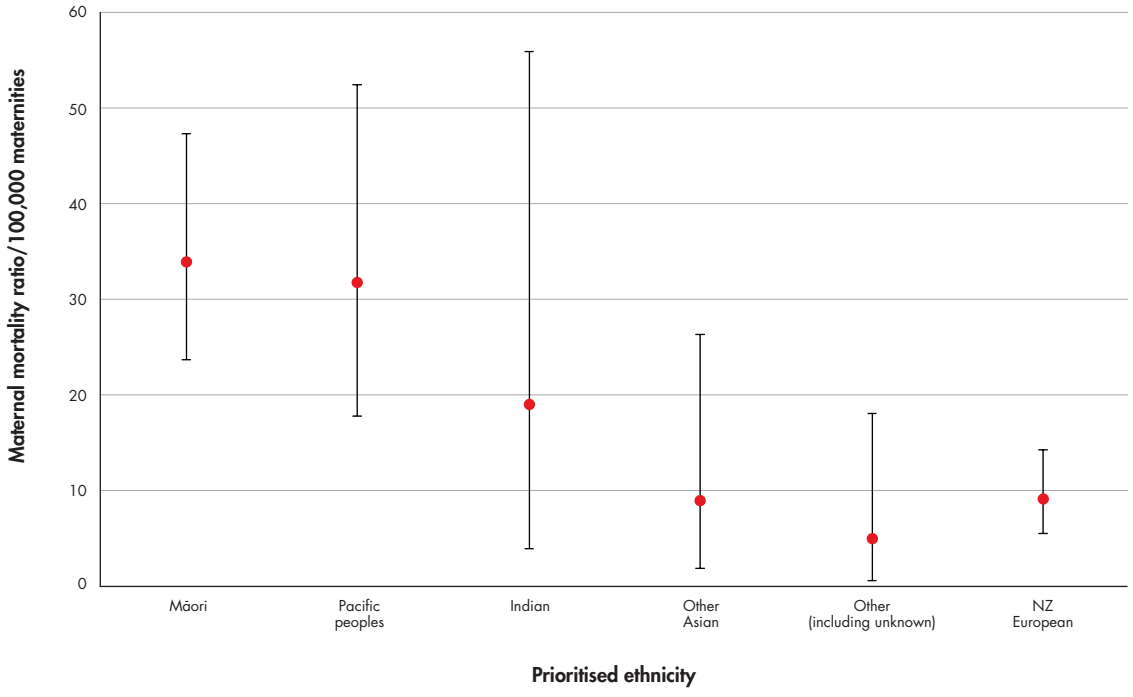
	Maternities		Maternal deaths									Maternal mortality ratio
			2006	2007	2008	2009	2010	2011	2012	2006–2012		
	n=445,943		n=15	n=11	n=9	n=14	n=9	n=9	n=10	n=77		
	n	%	n	n	n	n	n	n	n	n	%	/100,000 maternities
Maternal age (years)												
<20	32,333	7.3	-	-	1	1	1	1	2	6	7.8	18.56
20–24	81,258	18.2	3	2	-	-	-	1	3	9	11.7	11.08
25–29	109,933	24.7	3	1	3	4	3	3	1	18	23.4	16.37
30–34	125,935	28.2	2	5	3	4	1	1	2	18	23.4	14.29
35–39	78,921	17.7	4	2	2	3	2	2	2	17	22.1	21.54
≥40	17,558	3.9	3	1	-	2	2	1	-	9	11.7	51.26
Ethnicity (prioritised)												
Māori	103,116	23.1	9	2	4	4	3	5	8	35	45.5	33.94
Pacific peoples	47,173	10.6	1	2	-	6	3	3	-	15	19.5	31.80
Indian	15,685	3.5	1	1	-	1	-	-	-	3	3.9	19.13
Other Asian	33,302	7.5	-	-	2	1	-	-	-	3	3.9	9.01
Other (including unknown)	39,855	8.9	1	1	-	-	-	-	-	2	2.6	5.02
NZ European	206,812	46.4	3	5	3	2	3	1	2	19	24.7	9.19
Deprivation quintile (NZDep2006)												
1 (least deprived)	71,359	16.0	-	2	1	1	3	-	-	7	9.1	9.81
2	78,615	17.6	-	2	2	-	-	1	1	6	7.8	7.63
3	83,795	18.8	4	-	1	4	1	1	2	13	16.9	15.51
4	93,021	20.9	4	2	4	5	3	2	-	20	26.0	21.50
5 (most deprived)	116,554	26.1	7	5	1	4	2	5	7	31	40.3	26.60
Unknown	2,599	0.6	-	-	-	-	-	-	-	-	-	-

Figure 2.3: Maternal mortality ratio (per 100,000 maternities) by maternal age 2006–2012



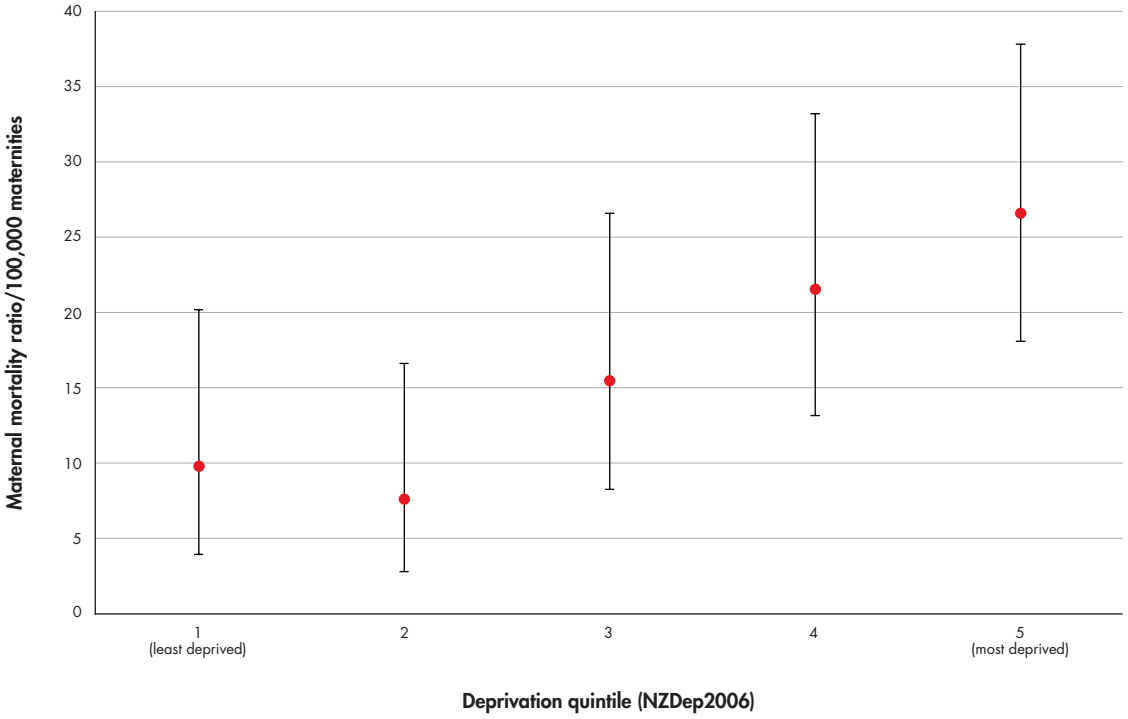
Older mothers have a significantly higher maternal mortality ratio compared to mothers aged 20–34 years, although the confidence interval is wide and the numbers of older mothers who die is small. No mothers aged 40 or older died in 2012.

Figure 2.4: Maternal mortality ratio (per 100,000 maternities) by prioritised ethnicity 2006–2012



The relative maternal mortality ratio for Māori and Pacific mothers compared to Other Asian, New Zealand European and mothers who fall in the 'Other' category is approximately three, indicating that Māori and Pacific mothers are three times more likely to die of direct and indirect causes in pregnancy or in the 42 days following the end of pregnancy.

Figure 2.5: Maternal mortality ratio (per 100,000 maternities) by deprivation quintile (NZDep2006) 2006–2012



The risk of maternal death for women living in the most deprived 20 percent of residential areas is 2.5 times that of those in the least deprived 40 percent. This difference is highly statistically significant (chi-squared test for linear trend p=0.0005).

The associations observed between age and socioeconomic factors and maternal mortality are similar (although the ratios are slightly higher) to those seen in the UK data presented in *Saving Mothers' Lives: 2006–08* (CMACE 2011b).

Table 2.4: Clinical characteristics among maternal deaths 2006–2012

	Maternal deaths	
	n=77	
	n	%
Parity*		
0	20	26.0
1–3	36	46.8
4+	20	26.0
Unknown)	1	1.3
BMI (kg/m²)		
<18.5	3	3.9
18.5–24.99	26	33.8
25–29.99	14	18.2
30–34.99	16	20.8
≥35	15	19.5
Unknown	3	3.9
Current smoker		
Yes	28	36.4
No	46	59.7
Unknown	3	3.9
Family violence history		
Yes	8	10.4
No	39	50.6
Not asked	19	24.7
Unknown	11	14.3

* Defined prior to conception of the index pregnancy.

Over the years 2006–2012, approximately one-quarter of mothers who died were having their first baby, while a further quarter had had more than four prior births. Due to missing data in the MAT dataset for women receiving primary maternity care from a hospital service, it is not possible to calculate an accurate background rate for parity, BMI or smoking. However, it is likely that nulliparous women are underestimated among maternal deaths.

Forty-five (58 percent) of the mothers who died were overweight or obese (BMI ≥25).

The rate of smoking among mothers who died (36 percent) is high compared to previous estimates of smoking among mothers in New Zealand (Table 1.14).

Family violence was known to be present in at least 10 percent of cases of maternal deaths in 2006–2012, and family violence status was unknown in a further 39 percent. Evidence of family violence among deaths from any cause from 2006 to 2008 was reported in 12 percent of cases in the UK in *Saving Mothers' Lives: 2006–08* (CMACE 2011b).

Maternal alcohol and substance use among maternal deaths

Table 2.5: Alcohol and substance use among maternal deaths 2006–2012

	Deaths	Alcohol or substance use		Unknown history		Alcohol		Marijuana		Amphetamine (P)	
	n	n	%	n	%	n	%	n	%	n	%
Total	93	24	25.8	15	16.1	20	21.5	12	12.9	5	5.4
Amniotic fluid embolism	10	1	10.0	1	10.0	1	10.0	-	-	-	-
Other direct	15	3	20.0	-	-	3	20.0	1	6.7	-	-
Pre-existing medical condition	19	5	26.3	3	15.8	4	21.1	3	15.8	1	5.3
Suicide	19	9	47.4	2	10.5	9	47.4	3	15.8	3	15.8
Other indirect	10	1	10.0	-	-	1	10.0	1	10.0	-	-
Unclassifiable	4	1	25.0	1	25.0	1	25.0	1	25.0	1	25.0
Coincidental deaths	16	4	25.0	8	50.0	1	6.3	3	18.8	-	-

Table 2.5 provides available data on alcohol and substance use, relating to pregnancy and the postpartum period, among maternal deaths in the years 2006–2012. At least 10 percent of data were unavailable in all categories, but especially among coincidental deaths where limited information is available. Alcohol or other substances were used by one-quarter of maternal deaths, with alcohol use in 22 percent, marijuana in 13 percent and amphetamines or 'P' in 5 percent. Alcohol or substances were used by half of mothers who died from suicide, alcohol in 50 percent and marijuana and amphetamines/P in 16 percent each. While there are no comparative data for mothers in New Zealand, this appears a high rate.

Table 2.6: Details of place and timing of maternal mortalities 2006–2012

	Maternal deaths	
	n=77	
	n	%
Place of baby's birth		
Community (not in a health care facility)	3	3.9
Hospital	47	61.0
Baby not born at time of mother's death	26	33.8
Unknown	1	1.3
Place of maternal death		
Hospital	49	63.6
Community	28	36.4
Time of death related to pregnancy		
Antepartum (Antepartum/Intrapartum)	26	33.8
Postpartum	51	66.2
	Antepartum maternal death	
	n=26	
	n	%
Gestation at antepartum maternal death (weeks)		
<20	14	53.8
20–27	7	26.9
28–36	4	15.4
37–42	1	3.8
	Postpartum maternal death	
	n=51	
	n	%
Gestation at birth of postpartum maternal death (weeks)		
<20	8	15.7
20–27	6	11.8
28–36	13	25.5
37–42	24	47.1
Postnatal day at postpartum maternal death (days)		
0	13	25.5
1–6	12	23.5
7–13	6	11.8
14–27	10	19.6
28–41	9	17.6
Unknown	1	2.0

Approximately a third of maternal deaths occur during pregnancy, and these are spread across the 40 weeks of pregnancy. The remaining two-thirds are postpartum deaths, one-fifth occurring within the first day and almost one-half within the first week.

Two-thirds of maternal deaths occurred in hospital and one-third in the community.

Baby outcomes in maternal mortalities

Table 2.7: Baby outcomes among maternal deaths 2006–2012

Baby outcome	Maternal deaths		Antepartum/ Intrapartum maternal death		Postpartum maternal death	
	n=77		n=26		n=51	
	n	%	n	%	n	%
Maternal death <20 weeks	22	28.6	14	53.8	8	15.7
Maternal death ≥20 weeks						
Did not deliver	12	15.6	12	46.2	-	-
Stillborn	3	3.9	-	-	3	5.9
Early neonatal death	4	5.2	-	-	4	7.8
Late neonatal death	-	-	-	-	-	-
Alive after one month of age	36	46.8	-	-	36	70.6

Table 2.7 shows the outcomes for babies of mothers who died. Overall, 29 percent of mothers died before 20 weeks and so all of these babies died. Of mothers who died after 20 weeks, approximately two-thirds of babies survived. Of these 55 mothers, 12 died before giving birth, three babies were stillborn and four babies died in the first week of life.

Perimortem caesarean section was undertaken in five deaths as part of the resuscitation of the mother to improve the chance of survival following a collapse from 2006 to 2012. In three cases collapse was due to amniotic fluid embolism and in the remaining two cases the collapse was due to pre-existing medical conditions (cardiac). Three babies were live born, one baby was stillborn and one an early neonatal death. When appropriately applied, perimortem caesarean section can save the life of both the mother and the infant.

Table 2.8: Contributory factors and potentially avoidable maternal death 2006–2012

	Maternal deaths		Direct maternal deaths		Indirect maternal deaths		Unclassifiable	
	n=77		n=25		n=48		n=4	
	n	%	n	%	n	%	n	%
Was death potentially avoidable?								
Yes	26	33.8	8	32.0	18	37.5	-	-
No	47	61.0	17	68.0	30	62.5	-	-
Unknown	4	5.2	-	-	-	-	4	100.0
Contributory factors present	**46**	**59.7**	**15**	**60.0**	**30**	**62.5**	**1**	**25.0**
Organisational/Management factors	**27**	**35.1**	**11**	**44.0**	**16**	**33.3**	**-**	**-**
Poor organisational arrangements of staff	5		3		2		-	
Inadequate education and training	10		6		4		-	
Lack of policies, protocols or guidelines	17		7		10		-	
Inadequate numbers of staff	1		1		-		-	
Poor access to senior clinical staff	2		1		1		-	
Failure or delay in emergency response	4		3		1		-	
Delay in procedure *(eg, caesarean section)*	2		1		1		-	
Inadequate systems/process for sharing of clinical information between services	12		3		9		-	
Delayed access to test results or inaccurate results	1		1		-		-	
Equipment *(eg, faulty equipment, inadequate maintenance, inadequate quality or lack of equipment)*	1		1		-		-	
Building and design functionality *(eg, space, privacy, ease of access, lighting, noise, power failure, operating theatre in distant location)*	3		3		-		-	
Other	5		1		4		-	
Personnel factors	**27**	**35.1**	**10**	**40.0**	**16**	**33.3**	**1**	**25.0**
Knowledge and skills of staff were lacking	13		5		7		1	
Delayed emergency response by staff	8		5		3		-	
Failure to maintain competence	-		-		-		-	
Failure of communication between staff	10		4		6		-	
Failure to seek help/supervision	6		2		4		-	
Failure to offer or follow recommended best practice	4		-		3		1	
Lack of recognition of complexity or seriousness of condition by caregiver	14		4		10		-	
Other	1		1		-		-	

	Maternal deaths		Direct maternal deaths		Indirect maternal deaths		Unclassifiable	
	n=77		n=25		n=48		n=4	
	n	%	n	%	n	%	n	%
Barriers to access and/or engagement with care	**29**	**37.7**	**4**	**16.0**	**25**	**52.1**	**-**	**-**
No antenatal care	3		-		3		-	
Infrequent care or late booking	7		2		5		-	
Declined treatment or advice	9		1		8		-	
Obesity impacted on delivery of optimal care *(eg, USS)*	3		1		2		-	
Substance use	7		-		7		-	
Family violence	4		-		4		-	
Lack of recognition of complexity or seriousness of condition	11		-		11		-	
Maternal mental illness	7		-		7		-	
Cultural barriers	1		-		1		-	
Language barriers	2		-		2		-	
Not eligible to access free care	1		-		1		-	
Environment *(eg, isolated, long transfer, weather prevented transport)*	-		1		-		-	
Other	5		1		4		-	

USS = ultrasound scan.

Thirty-four percent of maternal deaths were identified as potentially avoidable from 2006 to 2012. Contributory factors were identified in 60 percent of maternal deaths in the years 2006–2012. Contributory factors were identified in each of organisational/management, personnel and barriers to access and/or engagement with care in around a third of cases overall, but barriers were less often identified among direct deaths than among indirect.

Similar rates were identified in the Centre for Maternal and Child Enquiries (CMACE) review of maternal deaths for the triennium 2006–2008 which reported substandard care in 61 percent of cases overall, with this contributing significantly to the death in 36 percent of cases.

Key Findings

1 The maternal mortality ratio in New Zealand was 16.0/100,000 maternities (95 percent CI 8.7–29.5/100,000) for the year 2012. The three-year average maternal mortality ratio for 2010–2012 was 14.7/100,000 maternities (95 percent CI 10.2–21.3/100,000).

2 Older mothers (≥40 years) and mothers of Māori and Pacific ethnicity are at increased risk of maternal mortality, and there is increasing risk of maternal mortality with increasing socioeconomic deprivation.

3 Pre-existing medical disease and suicide are the most frequent causes of maternal mortality in New Zealand in 2006–2012.

Recommendations

1 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 clinician and development of a detailed management plan are required.

2 Women with serious pre-existing medical conditions require a multidisciplinary management plan for the pregnancy and birth, and the postpartum period. This plan must be communicated to all relevant caregivers.

Special note

Notifications of maternal deaths to date for 2013 include two women who died of obstetric sepsis. In the past seven years (2006–2012) there have been four women in total who died from obstetric sepsis. An increase in maternal deaths from obstetric sepsis was noted in the UK in the most recent triennial report and advice on prevention published in 2011 (CMACE 2011b, Chapter 7: Sepsis).

Obstetric sepsis is an important cause of maternal mortality and we are aware of an increase in the incidence of severe maternal sepsis in New Zealand. Severe sepsis can develop at any time throughout the postpartum period and disease progression may be rapid. Symptoms may be less distinctive than in the non-pregnant population and a high index of suspicion is required. Common symptoms include a temperature, diarrhoea, vomiting and lethargy. The most common site of infection is the genital tract and genital tract sepsis may present with severe pain and tenderness unrelieved by usual medication. All health professionals should be aware of the symptoms and signs of maternal sepsis and of the rapid, potentially lethal course of severe sepsis and septic shock. Suspicion of significant sepsis should trigger urgent referral for assessment, antibiotic therapy and supportive treatment.

3 Neonatal Encephalopathy 2010–2012

3.1 Methodology

Case definition:

Neonatal encephalopathy (NE): a clinically defined syndrome of disturbed neurological function within the first week of life in the term (≥37 weeks) infant, manifested by difficulty in initiating and maintaining respiration, depression of tone and reflexes, subnormal level of consciousness and often seizures. This dataset includes Sarnat stages 2 or 3 equivalent to moderate and severe only.

Although hypoxia-ischemia is the predominant pathology, reported cases of term infants with neonatal encephalopathy are included in this dataset whatever the cause. Therefore, the full cohort includes a small number of cases where neonatal encephalopathy is associated with hypoglycaemia, congenital abnormality of the central nervous system or infection.

Cases were identified with the assistance of the New Zealand Paediatric Surveillance Unit (NZPSU) and the collection of data facilitated by paediatricians, LMCs and the national coordination service of the PMMRC, as described in detail in the fifth report of the PMMRC (PMMRC 2011).

Denominator data, as used elsewhere in this report, are the birth registration dataset of New Zealand collated by BDM. For calculation of rates, the denominator set was restricted to births at term (as is the numerator).

For further information on data analysis, please refer to section 1.2 Methodology.

3.2 Findings

Two hundred and twenty-seven cases of neonatal encephalopathy have been reported in the three years 2010–2012 (82 in 2012, 67 in 2011 and 78 in 2012) using the surveillance system described. The rate of neonatal encephalopathy as a proportion of all registered births is 1.19/1000 (95 percent CI 1.05–1.36) registered births. The rate can also be reported as 1.30/1000 births at term (≥37 weeks) (95 percent CI 1.14–1.48) as the definition is limited to term births. There are no directly comparable international data, as noted in the fifth report of the PMMRC (PMMRC 2011).

Demography

Table 3.1: Neonatal encephalopathy rate (per 1000 term births) by prioritised maternal ethnicity 2010–2012

Ethnicity	NZ registered births ≥37 weeks		NE cases		Rate (/1000 births) term only	
	n=174,879		n=227			
	n	%	n	%	/1000	95% CI
Māori	39,436	22.6	63	27.8	1.60	1.23–2.04
Pacific peoples	18,794	10.7	36	15.9	1.92	1.34–2.65
Indian	6,516	3.7	15	6.6	2.30	1.29–3.80
Other Asian	15,369	8.8	12	5.3	0.78	0.40–1.36
Other (including unknown)	15,629	8.9	17	7.5	1.09	0.63–1.74
NZ European	79,135	45.3	84	37.0	1.06	0.85–1.31

There is a higher rate of neonatal encephalopathy among babies of Māori, Pacific and Indian mothers compared to Other Asian, Other and New Zealand European mothers. Only the difference between Pacific peoples and New Zealand European is statistically significant at $p<0.05$.

The incidence of neonatal encephalopathy is significantly higher among the babies of Pacific mothers than among the babies of New Zealand European mothers.

Figure 3.1: Neonatal encephalopathy rates (per 1000 term births) by prioritised maternal ethnicity 2010–2012

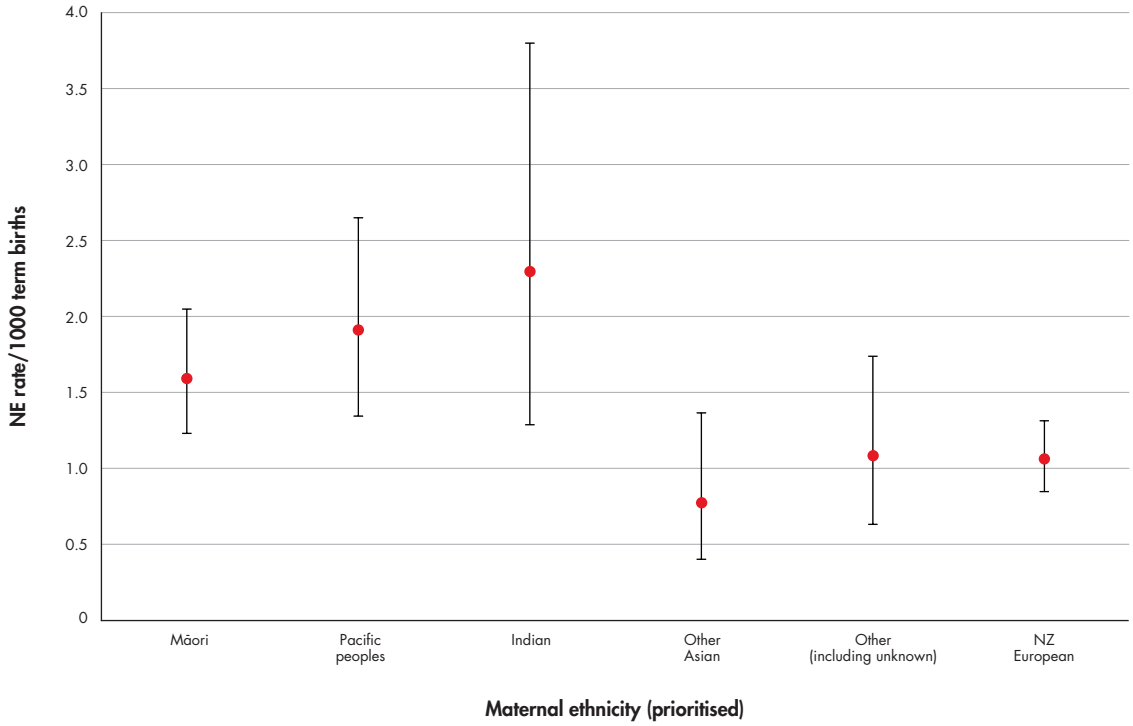


Table 3.2: Neonatal encephalopathy rate (per 1000 term births) by gestation, gender, birthweight and plurality 2010–2012

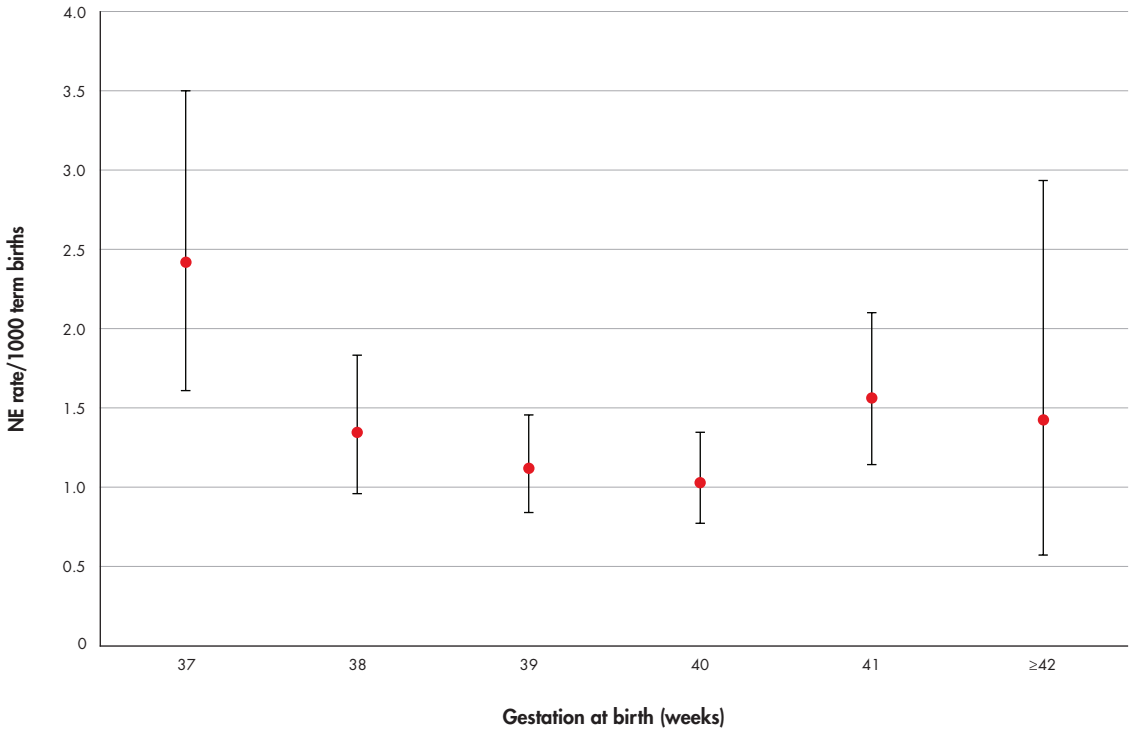
	NZ registered births ≥37 weeks		NE cases		Rate (/1000 term births)	
	n=174,879		n=227			
	n	%	n	%	/1000	95% CI
Gestation at birth (weeks)						
37	11,560	6.6	28	12.3	2.42	1.61–3.50
38	29,020	16.6	39	17.2	1.34	0.96–1.84
39	48,236	27.6	54	23.8	1.12	0.84–1.46
40	52,434	30.0	54	23.8	1.03	0.77–1.34
41	28,708	16.4	45	19.8	1.57	1.14–2.10
≥42	4,921	2.8	7	3.1	1.42	0.57–2.93
Gender						
Male	89,331	51.1	122	53.7	1.37	1.12–1.61
Female	85,548	48.9	105	46.3	1.23	0.99–1.46
Birthweight (g)						
<2,500	3,364	1.9	11	4.8	3.27	1.63–5.85
2,500–3,999	143,034	81.8	183	80.6	1.28	1.09–1.46
4,000–4,499	23,534	13.5	22	9.7	0.93	0.59–1.42
≥4,500	4,889	2.8	11	4.8	2.25	1.12–4.03
Plurality						
Singleton	172,583	98.7	222	97.8	1.29	1.12–1.46
Twins	2,296	1.3	5	2.2	2.18	0.71–5.08

There is no significant association between a baby's gender and the risk of neonatal encephalopathy.

The number of multiple births in the cohort is small but the estimate of rate of neonatal encephalopathy is 70 percent higher than that among singleton term births. This difference is not statistically significant.

The relative risk of neonatal encephalopathy for babies born at term with birthweight under 2500g is 2.6 compared to babies born at term weighing 2500–4499g. This may be due to early gestation or to growth restriction (which is discussed further below). An excess of risk in babies >4500g is possible, but numbers are too small to know whether this difference is significant.

Figure 3.2: Neonatal encephalopathy rates (per 1000 term births) by gestation at birth 2010–2012



The rate of neonatal encephalopathy at 37 weeks is more than twice the rate at 39 and 40 weeks (Figure 3.2). As 37 weeks is at the borderline between term and preterm, it is possible that these babies are different from babies born later, with the reason for their 'early birth' increasing the risk of neonatal encephalopathy. Having said this, the babies diagnosed with neonatal encephalopathy at 37 weeks did not have a higher rate of SGA than babies at later gestations.

Although the difference between the rate at 39–40 weeks compared to 41 weeks and over is not statistically significant, there is a suggestion of an increased risk again as gestation increases.

The rate of neonatal encephalopathy at 37 weeks is more than twice the rate at 39 and 40 weeks, highlighting an increased vulnerability of these less mature babies.

Table 3.3: Neonatal encephalopathy rates (per 1000 term births) by maternal age and deprivation quintile (NZDep2006) 2010–2012

	NZ registered births ≥37 weeks		NE cases		Rate (/1000 term births)	
	n=174,879		n=227			
	n	%	n	%	/1000	95% CI
Maternal age (years)						
<20	11,499	6.6	14	6.2	1.22	0.67–2.04
20–34	126,131	72.1	170	74.9	1.35	1.15–1.55
35–39	30,153	17.2	37	16.3	1.23	0.86–1.69
≥40	7,096	4.1	6	2.6	0.85	0.31–1.84
Deprivation quintile (NZDep2006)						
1 (least deprived)	27,623	15.8	27	11.9	0.98	0.64–1.42
2	30,965	17.7	34	15.0	1.10	0.76–1.53
3	33,624	19.2	45	19.8	1.34	0.98–1.79
4	36,995	21.2	39	17.2	1.05	0.75–1.44
5 (most deprived)	44,931	25.7	81	35.7	1.80	1.43–2.24
Unknown	741	0.4	1	0.4	-	-

There is no significant association seen between maternal age and neonatal encephalopathy.

There is a significant increase in the risk of neonatal encephalopathy with increasing deprivation quintile from least deprived to most deprived (chi-squared test for trend p=0.005) (Figure 3.3).

Figure 3.3: Neonatal encephalopathy rates (per 1000 term births) by deprivation quintile (NZDep2006) 2010–2012

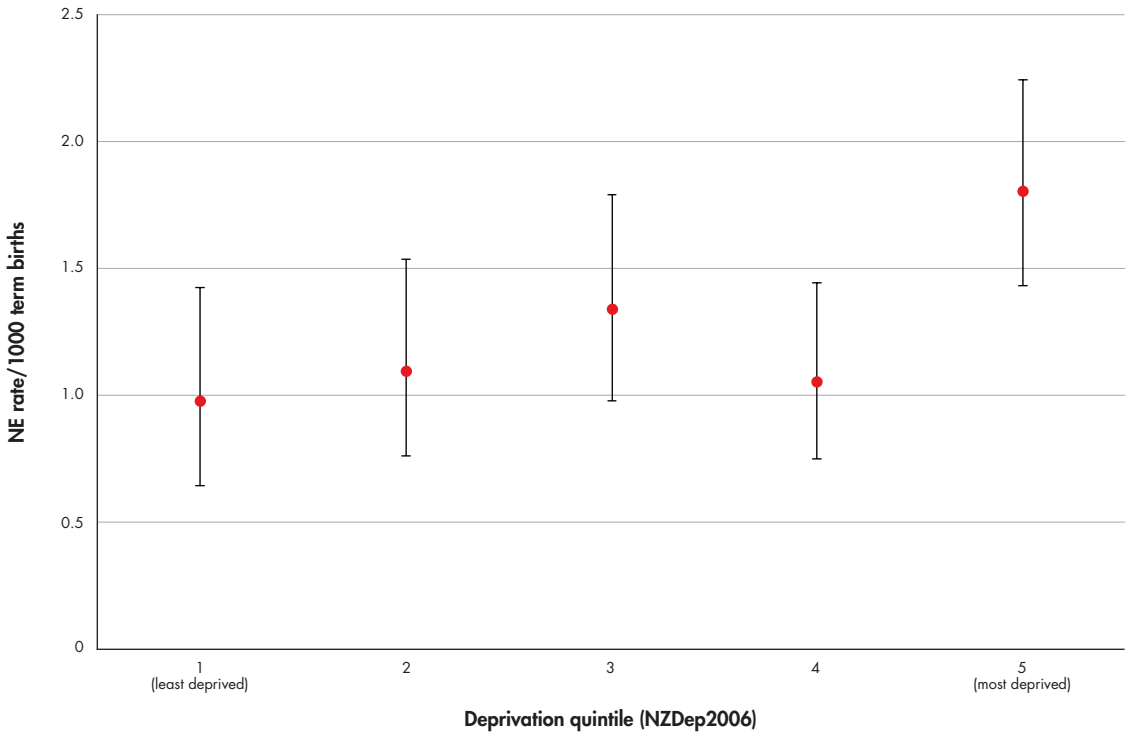
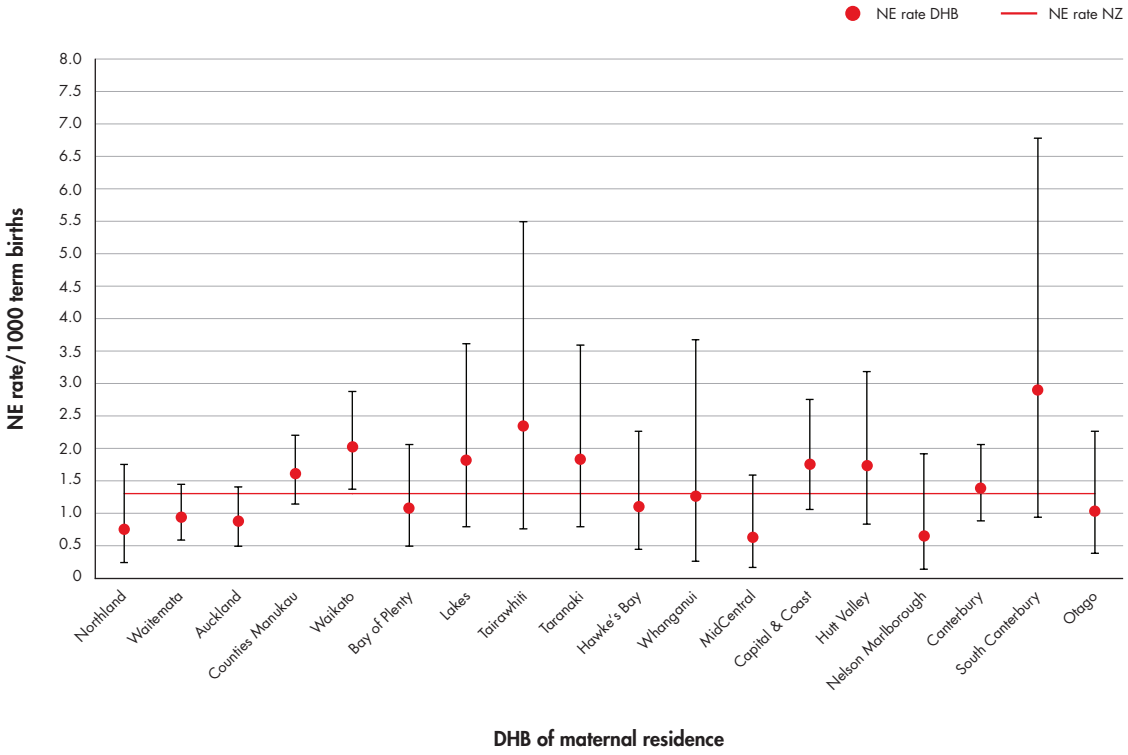


Figure 3.4: Neonatal encephalopathy rates* (per 1000 term births) by DHB of maternal residence (with 95% CIs) compared to New Zealand neonatal encephalopathy rate 2010–2012



* Excludes any DHB with fewer than 3 cases.

Figure 3.4 shows the unadjusted rates of neonatal encephalopathy per 1000 term births by DHB of residence for 2010–2012. The three-year data are presented together to increase the robustness of the estimates, and because there has been no change in rate of neonatal encephalopathy in New Zealand over these years.

The confidence intervals, represented by the error bars above and below the point estimate for each area, span the range of values that are consistent with the point estimate given the size of the population in the area. If these ranges do not include the national rate, represented by the horizontal line, the rate in that area was statistically significantly different from the national rate. Rates were not assigned to areas where fewer than three cases were reported.

There is a statistically significantly higher rate of neonatal encephalopathy among babies of mothers residing in Waikato DHB area. In 2013, the Neonatal Encephalopathy Working Group (NEWG) recommended local review of the apparent higher neonatal encephalopathy rate in Waikato DHB. Waikato DHB has reviewed these cases. Following this they have advised that they plan to institute a review of all cases of neonatal encephalopathy quarterly with a multi-disciplinary group to ensure the identification of any processes requiring changes to practice or systems.

All DHBs should undertake local review of cases of neonatal encephalopathy to identify areas for improvement in care including adequacy of resuscitation and cooling.

Table 3.4: Neonatal encephalopathy rates (per 1000 term births) by DHB of maternal residence 2010–2012

DHB of residence	NZ registered births ≥37 weeks		NE cases		Rate (/1000 term births)	
	n=174,879		n=227			
	n	%	n	%	/1000	95% CI
Northland	6,634	3.8	5	2.2	0.75	0.24–1.76
Waitemata	22,199	12.7	21	9.3	0.95	0.59–1.45
Auckland	18,436	10.5	16	7.0	0.87	0.50–1.41
Counties Manukau	24,196	13.8	39	17.2	1.61	1.15–2.20
Waikato	15,326	8.8	31	13.7	2.02	1.37–2.87
Bay of Plenty	8,269	4.7	9	4.0	1.09	0.50–2.07
Lakes	4,363	2.5	8	3.5	1.83	0.79–3.61
Tairawhiti	2,127	1.2	5	2.2	2.35	0.76–5.49
Taranaki	4,378	2.5	8	3.5	1.83	0.79–3.60
Hawke's Bay	6,338	3.6	7	3.1	1.10	0.44–2.28
Whanganui	2,389	1.4	3	1.3	1.26	0.26–3.67
MidCentral	6,419	3.7	4	1.8	0.62	0.17–1.60
Wairarapa	1,496	0.9	1	0.4	0.67	0.02–3.72
Capital and Coast	10,771	6.2	19	8.4	1.76	1.06–2.75
Hutt Valley	5,782	3.3	10	4.4	1.73	0.83–3.18
Nelson Marlborough	4,592	2.6	3	1.3	0.65	0.13–1.91
West Coast	1,185	0.7	2	0.9	1.69	0.20–6.10
Canterbury	17,351	9.9	24	10.6	1.38	0.89–2.06
South Canterbury	1,722	1.0	5	2.2	2.90	0.94–6.78
Otago	5,763	3.3	6	2.6	1.04	0.38–2.27
Southland	4,469	2.6	1	0.4	0.22	0.01–1.25
Unknown	674	0.4	-	-	-	-

Clinical characteristics

Table 3.5: Neonatal encephalopathy by maternal smoking, parity, body mass index (BMI) and gestation at first antenatal visit 2010–2012

	NE cases	
	n=227	
	n	%
Smoker	53	23.3
Unknown smoking status	3	1.3
Parity		
Nulliparous	127	55.9
Primiparous	56	24.7
Multiparous (≥2)	44	19.4
Maternal BMI (kg/m^2)		
<18.50	2	0.9
18.50–24.99	70	30.8
25.00–29.99	72	31.7
≥30.00	62	27.3
Missing data for height and or weight	21	9.3
Gestation first antenatal visit (weeks)		
≤13	121	53.3
14–19	35	15.4
≥20	33	14.5
Unknown	38	16.7

The smoking rate at birth among mothers of babies with neonatal encephalopathy was 23.3 percent. This is similar to the 25 percent rate among mothers whose babies were perinatal related deaths (25 percent). The national smoking rate in pregnancy in the national maternity dataset was 16.75 percent for 2008–2012. These data suggest an association between maternal smoking and neonatal encephalopathy similar to that with perinatal related death.

Fifty-six percent of mothers of babies with neonatal encephalopathy at term were nulliparous, which is probably higher than the national rate of nulliparity.

At least 58 percent of mothers of babies with neonatal encephalopathy were overweight or obese. At least 49 percent of mothers included in the MAT dataset were overweight or obese.

Analysis of trimester at first antenatal visit is limited by missing data, but shows that at least 30 percent of mothers in this series had their first antenatal visit after the first trimester. The Ministry of Health recommends that mothers register with an LMC prior to 12 weeks gestation.

Table 3.6: Lead maternity carer (LMC) at registration and birth among neonatal encephalopathy cases 2010–2012

LMC at booking	NE cases		LMC at birth											
	n=227		Not registered		General practitioner		Self-employed midwife		Private obstetrician		Hospital-employed midwife		Hospital clinic/ obstetrician	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Not registered	4	1.3	1	25.0	-	-	-	-	-	-	-	-	3	75.0
General practitioner	6	2.7	-	-	1	16.7	1	16.7	-	-	1	16.7	3	50.0
Self-employed midwife	171	77.9	-	-	-	-	129	75.4	-	-	1	0.6	41	24.0
Private obstetrician	6	2.0	-	-	-	-	-	-	6	100.0	-	-	-	-
Hospital-employed midwife	23	8.7	-	-	-	-	1	4.3	-	-	14	60.9	8	34.8
Hospital clinic/ obstetrician	16	6.7	-	-	-	-	-	-	-	-	-	-	16	100.0
Unknown	1	0.7	-	-	-	-	1	100.0	-	-	-	-	-	-
Total	**227**		**1**	**0.4**	**1**	**0.4**	**132**	**58.1**	**6**	**2.6**	**16**	**7.0**	**71**	**31.3**

In the MAT dataset 2010–2012, 79.6 percent of mothers of babies birthing at term were first registered with a self-employed midwife LMC, 13.4 percent with a hospital LMC or unregistered, 5.6 percent with a private obstetrician LMC and 1.4 percent with a GP LMC.

At birth, in the MAT dataset of all births at term in New Zealand in 2010–2012, 78.6 percent were registered with a self-employed midwife LMC, 14.5 percent with a hospital LMC or unregistered, 5.6 percent with a private obstetrician LMC and 1.2 percent with a GP LMC.

The distribution of LMCs at registration is essentially the same for the neonatal encephalopathy dataset as it is for all births; however, the distribution of LMCs at birth differs so that the LMC is more often a hospital LMC. This is presumably due to transfers of care and is likely to have occurred due to perceived increase in risk.

Table 3.7: Actual and intended place of birth among neonatal encephalopathy babies 2010–2012

Intended place of birth	NE cases n=227		Actual place of birth: Home		Birthing unit		Hospital level 1		Hospital level 2		Hospital level 3	
	n	%	n	%	n	%	n	%	n	%	n	%
Home	8	3.5	4	50.0	-	-	-	-	3	37.5	1	12.5
Birthing unit	24	10.6	-	-	9	37.5	-	-	2	8.3	13	54.2
Hospital level 1	15	6.6	-	-	-	-	5	33.3	3	20.0	7	46.7
Hospital level 2	79	34.8	-	-	-	-	1	1.3	76	96.2	2	2.5
Hospital level 3	97	42.7	1	1.0	-	-	1	1.0	1	1.0	94	96.9
Unknown	4	1.8	-	-	-	-	-	-	1	25.0	3	75.0
Total	**227**		**5**	**2.2**	**9**	**4.0**	**7**	**3.1**	**86**	**37.9**	**120**	**52.9**

In 33 cases (15 percent), the birth occurred at a place other than that initially intended. There may be various reasons for this. In 20 cases, transfer occurred in labour; 10 from home or a birthing unit to level 2 or 3 hospitals. Four of the women whose babies had neonatal encephalopathy birthed at home and planned to do so; the other was registered to birth in a hospital but had a precipitous birth at home.

Table 3.8: Small for gestational age (customised SGA) among neonatal encephalopathy babies by survivorship 2010–2012

	NE cases n=227		Deceased n=48		NE survivors n=179	
	n	%	n	%	n	%
Small for gestational age	47	20.7	14	29.2	33	18.4
Appropriate for gestational age	154	67.8	30	62.5	124	69.3
Large for gestational age	26	11.5	4	8.3	22	12.3

Forty-seven neonatal encephalopathy babies (21 percent) were SGA by customised birthweight centile. While the rate of SGA in the overall population using customised centiles is unknown, it is probable that SGA is over-represented in neonatal encephalopathy babies.

Twenty-nine percent of babies who died were SGA compared to 18 percent of survivors. While this difference was not statistically significant (p=0.10), it suggests that small, possibly growth-restricted babies are at higher risk of dying from neonatal encephalopathy. This is consistent with the apparent vulnerability of growth restricted babies to stillbirth and neonatal death.

Table 3.9: Antenatal complications and maternal outcome among neonatal encephalopathy cases 2010–2012

	NE cases	
	n=227	
	n	%
Antenatal complications		
Antepartum haemorrhage (≥20 weeks vaginal bleeding)	27	11.9
Hypertension	29	12.8
Pre-eclampsia	4	1.8
Gestational hypertension	9	4.0
Unspecified hypertension	15	6.6
Trauma	3	1.3
Induction of labour	50	22.0
Maternal outcome		
Deceased	2	0.9
Alive but with serious morbidity	5	2.2
Alive and well	220	96.9

Antepartum haemorrhage or hypertension were present in 53 cases (23 percent), and 22 percent of labours were induced.

There were three cases where trauma was reported – one vehicular and two of physical violence. There were two maternal deaths and five cases of acute severe maternal complication such as massive postpartum haemorrhage, cardiac arrest or rupture of an aneurysm.

Table 3.10: Peripartum complications among neonatal encephalopathy babies 2010–2012

	NE cases	
	n=227	
	n	%
Acute peripartum events	**47**	**20.7**
Cord prolapse	8	3.5
Abruption	16	7.0
Uterine rupture	5	2.2
Shoulder dystocia	13	5.7
Maternal cardiac arrest/Maternal collapse	3	1.3
Vasa praevia	1	0.4
Head entrapment in breech	1	0.4
Liquor		
Blood stained	22	9.7
Meconium	73	32.2
Thick meconium	47	20.7
Thin meconium	26	11.5

Acute serious events peripartum were reported in 47 cases (21 percent) of neonatal encephalopathy. This included any of cord prolapse, placental abruption, uterine rupture, shoulder dystocia, maternal arrest or collapse, vasa praevia and head entrapment at breech birth. In eight of these cases, a prelabour caesarean was performed.

Of these 47 babies with an acute peripartum complication, 40 (85 percent) had either abnormal cord gases or an Apgar score <7 at five minutes.

Table 3.11: Mode of birth and indications for operative birth among neonatal encephalopathy babies 2010–2012

	NE cases	
	n=227	
	n	%
Normal vaginal birth	**96**	**42.3**
Operative vaginal birth	**32**	**14.1**
Forceps	11	4.8
Ventouse	20	8.8
Unknown	1	0.4
Vaginal breech birth	**4**	**1.8**
Caesarean section birth	**95**	**41.9**
Elective (no indication given)	**3**	**1.3**
Prelabour emergency	**23**	**10.1**
Antepartum haemorrhage/Abruption	3	1.3
Suspected fetal distress	15	6.6
Other	4	1.8
Unknown	1	0.4
In labour emergency	**69**	**30.4**
Antepartum haemorrhage/Abruption	4	1.8
Suspected fetal distress	46	20.3
Failure to progress/Cephalopelvic disproportion	7	3.1
Malpresentation	1	0.4
Other	10	4.4
Unknown	1	0.4
Attempt at operative vaginal birth before caesarean	**7**	**3.1**

The operative birth rate among babies with neonatal encephalopathy (56 percent) was higher than expected when compared to the maternity general population. The national caesarean section rate was 23.6 percent in 2010 (Ministry of Health 2012a). The high operative birth rate is consistent with the 21 percent incidence of acute peripartum events, and with the high proportion of babies with abnormal gases or Apgars or both (Table 3.12).

Table 3.12: Immediate newborn wellbeing among neonatal encephalopathy babies 2010–2012

	NE cases	
	n=227	
	n	%
Apgar scores		
Apgar score <5 at 1 minute	180	79.3
Apgar score <7 at 1 minute	203	89.4
Apgar score <7 at 5 minutes	177	78.0
Apgar score <7 at 10 minutes	126	55.5
Apgar score <9 at 10 minutes	166	73.1
Cord blood gases: summary data		
Normal (none of pH ≤7.2, BE ≤-10, lactate ≥6)	21	9.3
Abnormal (any of pH ≤7.2, BE ≤-10, lactate ≥6)	159	70.0
No gases reported	47	20.7
No gases and Apgar <7 at 1 minute	29	12.8
No gases and Apgar ≥7 at 1 minute	17	7.5
No gases and unknown Apgar	1	0.4

Cord gas data were summarised as follows: abnormal gas was defined if either arterial or venous blood gas pH equal to or lower than 7.2, base excess equal to or lower than –10 or lactate of 6 or more. Normal was defined if none of these criteria were met.

Almost 80 percent of neonatal encephalopathy cases had an Apgar score of 0–4 at one minute, and 78 percent had an Apgar score under 7 at five minutes. Cord gas data were unavailable (presumed not taken) in 21 percent of cases and abnormal in at least 70 percent of cases. Among cases without gases, almost two-thirds had Apgar scores under 7 at one minute.

These data suggest that the majority of babies diagnosed with neonatal encephalopathy have evidence of asphyxia present at the time of birth. In some cases, this was associated with an acute peripartum event.

The NEWG are undertaking a multidisciplinary review of those cases in 2010–2011 with abnormal gases and/or Apgar scores, where there was no identifiable peripartum acute event or prelabour caesarean, to establish whether neonatal encephalopathy was potentially avoidable and whether contributory factors might be addressed to prevent this outcome.

Table 3.13: Induced cooling therapy among neonatal encephalopathy babies 2010–2012

	NE cases		NE cases 2010		NE cases 2011		NE cases 2012	
	n=227		n=82		n=67		n=78	
	n	%	n	%	n	%	n	%
Cooling								
Yes	168	74.0	56	68.3	51	76.1	61	78.2
No	59	26.0	26	31.7	16	23.9	17	21.8
	n=168		n=56		n=51		n=61	
Type of cooling								
Total body	165	98.2	54	96.4	51	100.0	60	98.4
Selected head	3	1.8	2	3.6	-	-	1	1.6
Age at cooling								
≤6 hours	145	86.3	49	87.5	42	82.4	54	88.5
>6 hours	19	11.3	7	12.5	5	9.8	7	11.5
Missing or invalid date or time data	4	2.4	-	-	4	7.8	-	-

Seventy-four percent of babies overall were treated with induced cooling, with a non-significant increase in rate from 68 percent in 2010 to 76 percent in 2011 and 78 percent in 2012.

Of all babies with neonatal encephalopathy in this dataset, 88 percent in 2010–2012 had abnormal gases (as previously described) or a five-minute Apgar score less than 7. Of the babies who did receive cooling, 160/168 (95 percent) had abnormal gases or an Apgar score <7 at five minutes. Of the babies not cooled, 39/59 (66 percent) had abnormal gases or an Apgar score <7 at five minutes.

Although there is no international benchmark data to determine the optimal rate of neonatal cooling, the presented data suggest that there may be a small number of babies currently not receiving cooling who might benefit from this therapy.

Eighty-six percent of babies had their cooling commenced within the six-hour window recommended for maximum benefit, and this has not changed significantly from 2010 to 2012. This rate is higher than previously reported as a result of considerable data cleaning to eliminate cases with previously unknown age at cooling.

Of the 19 who received induced cooling beyond the six-hour window, 4 were born at a birthing unit or level 1 hospital.

Quality initiatives are required to improve the recognition of neonatal encephalopathy, and to achieve earlier intervention, including by passive cooling if transport is required.*

* Passive cooling means cooling without specific apparatus, for instance turning off heaters and not wrapping or dressing the baby.

Table 3.14: Neonatal resuscitation and induced cooling therapy among neonatal encephalopathy babies 2010–2012

	NE cases		Induced cooling			
			Yes		No	
	n=227		n=168		n=59	
	n	%	n	%	n	%
Resuscitation at birth						
Yes	209	92.1	164	97.6	45	76.3
No	18	7.9	4	2.4	14	23.7
Type of resuscitation at birth						
Oxygen only	3	1.3	3	1.8	-	-
IPPV with mask	132	58.1	98	58.3	34	57.6
IPPV with ETT	136	59.9	113	67.3	23	39.0
Cardiac massage	94	41.4	75	44.6	19	32.2
Adrenalin	45	19.8	31	18.5	14	23.7

IPPV = intermittent positive pressure ventilation.
ETT = endotracheal tube.

Ninety-two percent of neonatal encephalopathy babies required resuscitation at birth, including ventilation in 60 percent of cases and cardiac massage in 41 percent.

Table 3.15: Contributory factors to unsatisfactory neonatal resuscitation among neonatal encephalopathy babies 2010–2012

	NE cases	
	n=227	
	n	%
Were there any features that caused or contributed to an unsatisfactory neonatal resuscitation?		
Yes	36	15.9
Unsure	19	8.4
No	159	70.0
Missing	13	5.7
If yes, were they:		
Organisational/Management	15	6.6
Personnel or training	19	8.4
Technology or equipment	4	1.8
Environment	6	2.6
Barriers to access and/or engagement with care	6	2.6

The question 'Were there any features that caused or contributed to an unsatisfactory neonatal resuscitation?' was answered by the neonatologist completing the data capture form. This was usually not also the person responsible for neonatal resuscitation.

It was determined that, in 16 percent of cases, resuscitation was less than optimal, and the most common reasons noted for this were organisation and/or management and personnel or training factors.

Table 3.16: Early neonatal management among neonatal encephalopathy babies by induced cooling therapy status 2010–2012

	NE cases		Induced cooling			
			Yes		No	
	n=227		n=168		n=59	
	n	%	n	%	n	%
Respiratory and ventilation management						
Mechanical ventilation	171	75.3	141	83.9	30	50.8
Nitric oxide	42	18.5	34	20.2	8	13.6
Infection						
Positive blood culture	9	4.0	5	3.0	4	6.8
Antibiotics	202	89.0	161	95.8	41	69.5
Anticonvulsant therapy	157	69.2	118	70.2	39	66.1
Phenobarbitone	149	65.6	111	66.1	38	64.4
Phenytoin	33	14.5	22	13.1	11	18.6
Benzodiazepines	48	21.1	36	21.4	12	20.3
Other	5	2.2	4	2.4	1	1.7

Mechanical ventilation was required in 75 percent of babies and nitric oxide in 19 percent. Only nine babies had positive blood cultures, although 89 percent were prescribed prophylactic antibiotics. Anticonvulsants were also commonly used.

Table 3.17: Severity of encephalopathy among neonatal encephalopathy babies 2010–2012

Severity data	NE cases		Deceased		NE survivors	
	n=227		n=48		n=179	
	n	%	n	%	n	%
Sarnat stage						
Moderate	157	69.2	2	1.3	155	98.7
Severe	70	30.8	46	65.7	24	34.3
Deceased	48	21.1	-	-	-	-

Forty-eight babies from the cohort of 227 neonatal encephalopathy babies (21 percent) died prior to discharge. As shown in Table 3.17, one-third of the cohort had severe encephalopathy by Sarnat stage (31 percent) and almost all of the babies who died (46/48) were in this group. Three further babies are known to have died after discharge.

Table 3.18: Severity of encephalopathy and use of induced cooling therapy among neonatal encephalopathy babies 2010–2012

	NE cases		Induced cooling			
			Yes		No	
	n=227		n=168		n=59	
	n	%	n	%	n	%
Sarnat stage						
Moderate	157	69.2	119	75.8	38	24.2
Severe	70	30.8	49	70.0	21	30.0
Deceased						
Yes	48	21.1	27	56.3	21	43.8
No	179	78.9	141	78.8	38	21.2
Age at death (days defined as past midnight)	n=48		n=27		n=21	
0	11	21.6	-	-	11	100.0
1	10	19.6	6	60.0	4	40.0
2	8	15.7	7	87.5	1	12.5
3	7	13.7	5	71.4	2	28.6
4	3	5.9	3	100.0	-	-
5	4	7.8	4	100.0	-	-
6	2	3.9	1	50.0	1	50.0
8	1	2.0	1	100.0	-	-
10	1	2.0	-	-	1	100.0
40	1	2.0	-	-	1	100.0

Use of induced cooling did not vary by Sarnat stage. However, babies who died were less likely to be cooled than babies who survived (p=0.0016). Of the 48 babies who died, 7 (15 percent) did not have abnormal gases or Apgar score <7 at five minutes, suggesting later onset encephalopathy.

The age at which neonatal encephalopathy babies died was related to whether they were cooled. Approximately half of babies not cooled who died, died in the first day (11 babies) while none of the cooled babies died on the first day. This might suggest that these babies, seven of whom were born in tertiary units, were too sick to be cooled.

Table 3.19: Type of birth facility and transfer prior to or in labour among neonatal encephalopathy cases by induced cooling status 2010–2012

Actual place of birth	NE cases		Induced cooling			
			Yes		No	
	n=227		n=168		n=59	
	n	%	n	%	n	%
Type of birth facility						
Home	5	2.2	1	20.0	4	80.0
Birthing unit	9	4.0	8	88.9	1	11.1
Hospital level 1	7	3.1	6	85.7	1	14.3
Hospital level 2	86	37.9	60	69.8	26	30.2
Hospital level 3	120	52.9	93	77.5	27	22.5
Transfer prior to labour	15	6.6	10	66.7	5	33.3
Transfer in labour	20	8.8	13	65.0	7	35.0
Unknown	1	0.4	1	100.0	-	-

Neonatal outcomes

Table 3.20: Examination on discharge of neonatal encephalopathy survivors 2010–2012

Investigations	NE survivors	
	n=179	
	n	%
Examination on discharge		
Normal	86	48.0
Mild or moderate abnormality	53	29.6
Severe abnormality	9	5.0
Not examined	12	6.7
Examined but finding unknown	9	5.0
Missing data	10	5.6

Examination on discharge was reported in 88 percent of cases. It is not clear whether the remainder of babies were not examined or whether this is a documentation or reporting issue. No change has occurred in rate of examination from 2010 to 2012.

Table 3.21: Follow up investigations among neonatal encephalopathy survivors, by induced cooling status 2010–2012

Investigations	NE survivors		Induced cooling			
			Yes		No	
	n=179		n=141		n=38	
	n	%	n	%	n	%
EEG (investigation done)	156	87.2	122	86.5	34	89.5
EEG investigation done at ≤3 days of life*	99	55.3	80	56.7	19	50.0
EEG investigation done at >3 days of life#	23	12.8	11	7.8	12	31.6
EEG investigation done at unknown days of life	34	19.0	31	22.0	3	7.9
No EEG or unknown	23	12.8	19	13.5	4	10.5
Results of EEG at >3 days of life						
Severely abnormal	3	1.7	2	1.4	1	2.6
Mildly abnormal	10	5.6	3	2.1	7	18.4
Normal	10	5.6	6	4.3	4	10.5
MRI (investigation done)	118	65.9	92	65.2	26	68.4
No MRI or unknown	61	34.1	49	34.8	12	31.6
Results of MRI						
Moderately/Severely abnormal	44	24.6	30	21.3	14	36.8
Normal or only mildly abnormal	70	39.1	58	41.1	12	31.6
Unknown result	4	2.2	4	2.8	-	-

* Typically cot-side monitoring such as BRAINZ.
\# Typically formal EEG >3 days only.
EEG = electroencephalogram.
MRI = magnetic resonance imaging (of the brain).

Table 3.21 shows the rates of prognostic investigations performed in this cohort of neonatal encephalopathy babies. The timing of electroencephalography (EEG) investigations was poorly reported, but at most 57 survivors (32 percent) had an EEG after three days of life. Two-thirds of survivors had magnetic resonance imaging (MRI). Seventy-seven percent of survivors had either an MRI or an EEG after three days, leaving 23 percent who would appear to have had neither.

Although some estimate of prognosis is possible based on severity of encephalopathy alone, formal neurological examination after one week of age and investigation with MRI with or without EEG will considerably improve the quality of information that can be provided to the family.

Table 3.22: Neonatal outcome among neonatal encephalopathy survivors 2010–2012

	NE survivors	
	n=179	
	n	%
Feeding on discharge		
Full sucking feeds	141	78.8
Full sucking feeds and support	5	2.8
Feeding support	30	16.8
No sucking feeds, no support	2	1.1
Missing data	1	0.6
Respiratory support on discharge		
No support	163	91.1
Suctioning only	4	2.2
Oxygen only	5	2.8
Suctioning and oxygen	3	1.7
Missing data	4	2.2
Anticonvulsants on discharge	16	8.9
Missing data/Unknown	3	1.7
Ongoing support service involvement	133	74.3
Missing data/Unknown	14	7.8

Seventy-one percent of neonatal encephalopathy survivors were discharged home and the remainder were generally discharged to a lower-level unit or postnatal facility.

At the time of discharge, 20 percent of neonatal encephalopathy babies were requiring at least some tube feeding, 7 percent required respiratory support and 9 percent were receiving anticonvulsants.

Seventy-four percent of neonatal encephalopathy babies were referred for further follow-up, most often for neurodevelopmental therapy, home care and paediatric outpatient clinic.

3.3 Key Points

1 The incidence of neonatal encephalopathy is significantly higher among babies of Pacific mothers than among babies of New Zealand European mothers, and the incidence increases with increasing socioeconomic deprivation.

2 In 2012, 78 percent of babies with moderate and severe neonatal encephalopathy received induced cooling, as recommended, to reduce morbidity.

3.4 Recommendations

1 DHBs should undertake local review of all cases of neonatal encephalopathy to identify areas for improvement in care including adequacy of resuscitation and cooling.

2 The NEWG/PMMRC support the development of a guideline for the investigation and management of neonatal encephalopathy.

4 Australasian Maternity Outcomes Surveillance System (AMOSS) 2010–2012

The Australasian Maternity Outcomes Surveillance System (AMOSS) has now completed three full years of data collection on severe and rare disorders of pregnancy across almost 300 maternity units in New Zealand and Australia. The collection of rare disease data via this methodology improves the accuracy of reporting data which are poorly collected by routine means.

In New Zealand, data collection has been completed for the following conditions:

- influenza requiring admission to intensive care
- eclampsia
- BMI >50.

In New Zealand, we continued gathering data on peripartum hysterectomy and placenta accreta/increta/percreta during 2012, while in Australia, data collection was completed in 2011. A summary of the cases reported in 2010–2012 is provided below.

The denominator used for rates/ratios is births registered in New Zealand in the collection period, as described in section 1.2. This is noted as rate or ratio, as many conditions surveyed may occur prior to 20 weeks, while the denominator is births from 20 weeks.

Table 4.1: New Zealand and Australasian rates/ratios (per 10,000 maternities) of AMOSS notifiable conditions 2010–2012

	Data collection period	NZ registered births n	Cases n	Rate/ratio	Australasian rate/ratio#	95% CI#
Amniotic fluid embolism	2010–2012	190,153	8	0.4	0.4	0.3–0.6
Antenatal pulmonary embolism	2010–2012	190,153	18	0.9	1.2	1.0–1.4
Eclampsia	2010–2011	127,728	25	2.0	2.2	1.8–2.6
Influenza with intensive care admission	2010	65,124	8	1.2	1.9	1.4–2.8
Placenta accreta	2010–2012	190,153	69*	3.6	4.2	3.8–4.8
Peripartum hysterectomy	2010–2012	190,153	86*	4.5	6.0	5.5–6.5
BMI >50kg/m^2	2010	65,124	297	45.6	26.8	24.9–28.7

Rate/ratio per 10,000 maternities.

* Thirty-seven women had placenta accreta and peripartum hysterectomy.

Ellwood D. 2013. *Reducing the Impact of PPH*. Sydney: Health Round Table. Australasian data only available to 2011.

Amniotic fluid embolism is defined by either clinical or pathological/post-mortem diagnosis.

Antenatal pulmonary embolism is defined as all women identified as having a pulmonary embolism that is confirmed using suitable imaging, confirmed at surgery or post-mortem or a clinician has made a diagnosis of pulmonary embolism with signs and symptoms consistent with pulmonary embolism present and the patient has received a course of anticoagulation therapy (>1 week duration).

Eclampsia is defined as any woman having convulsions during pregnancy or in the first 10 days postpartum, together with at least two of the following features within 24 hours of the convulsion(s): hypertension, proteinuria, thrombocytopenia or raised plasma alanine transaminase or aspartate transaminase.

Influenza with intensive care admission is defined as all women admitted to intensive care and subsequently diagnosed with influenza who are (A) pregnant or who have (B) given birth within 42 days of admission to intensive care.

Placenta accreta is defined as all women identified as having placenta accreta (or increta or percreta) either diagnosed by antenatal imaging, at operation or by pathology specimen.

Peripartum hysterectomy is defined as any woman whose pregnancy terminates and who has a hysterectomy in the same clinical episode or within six weeks postpartum when the indication for hysterectomy is related to the pregnancy or the birth.

New AMOSS conditions

New conditions for data collection in 2013 and 2014 include rheumatic heart disease, gestational breast cancer and massive transfusion (≥5 units packed red cells).

Rheumatic heart disease is defined as all women identified with rheumatic heart disease (RHD) diagnosed before or during the index pregnancy, using the following criteria:

- pregnant and confirmed ongoing RHD on latest echo or
- pregnant and an historic echo diagnosis of definite RHD where recent echo details are not available.

Gestational breast cancer is defined as all women identified as having a first diagnosis of breast cancer during current pregnancy or within six weeks of giving birth.

Massive transfusion for obstetric bleeding is defined as all women who receive five or more units of red blood cells within four hours for obstetric haemorrhage.

Publications

The completed AMOSS conditions will be analysed and published in collaboration with the AMOSS Australasian group, and these papers will be referenced and/or included in future PMMRC reports.

5 PMMRC National Coordination Services Report

The PMMRC national coordination services include the following personnel:

Professor Cindy Farquhar – manager
Dr Lynn Sadler – perinatal epidemiologist
Vicki Masson – national coordinator
Ursula Foley – administration support
Nicola Arroll and Dr Sarah Armstrong – research assistants.

The national coordination services are provided to facilitate the PMMRC's collection and analysis of data on both perinatal and maternal mortality and morbidity. The service encompasses the following areas and requirements.

Coordinating perinatal and maternal mortality data collection

- Providing support to LMCs, clinicians and local coordinators to complete the PMMRC data collection following a perinatal or maternal death.
- Coordinating the collection of information to enable the review of maternal deaths by the MMRWG.
- Ensuring the data's integrity by following up on missing data and checking the accuracy of the data provided and the PSANZ classification of cause of death.
- Noting issues for improving data collection and thus assisting with the development and enhancement of the PMMRC information systems.
- Working with the PMMRC, the University of Otago's Mortality Review Data Group and local coordinators to enhance the development of the PMMRC data forms and guidelines.
- Completing audits as directed by the PMMRC.
    - The findings from the 2011 audit of babies that died from 37 weeks gestation, (1) in the intrapartum period and (2) unexplained antenatal deaths, are in this report.
    - Data collection for the 2012 audit has commenced.

Coordinating perinatal and maternal morbidity data collection

- Supporting the Neonatal Encephalopathy and AMOSS Working Groups with their review of perinatal and maternal mortality and morbidity data.
- Coordinating the collection of information to enable the case review of neonatal encephalopathy babies by the NEWG.
- Assisting with developing data collection forms and databases, and promoting neonatal encephalopathy and AMOSS data collection in New Zealand through the PMMRC local coordinators' network.

Training and supporting the PMMRC DHB local coordinators

- Coordinating the annual PMMRC local coordinator workshop to train and support DHB local coordinators.
- Visiting DHBs and the PMMRC local coordinators and providing support and training for their role.
- Providing resources for local DHB review of perinatal related mortality.

Supporting the PMMRC

- Providing a report from the PMMRC database for each PMMRC meeting, noting issues relating to data quality, new clinical issues and any other concerns that have been raised.
- Planning, preparing and providing supporting explanations for the analysis of the perinatal and maternal data in this report.
- Writing a draft of the report and supporting preparation of the report for publication.
- Assisting with planning and preparation for the PMMRC annual conference.

Supporting families and whānau

- Answering queries from families and whānau regarding perinatal and maternal mortality and morbidity.
- Presenting information on the PMMRC findings and its role at conferences and workshops.

The PMMRC national coordinator services have working relationships with:

- Health Quality & Safety Commission Mortality Review Secretariat
- University of Otago's Mortality Review Data Group
- Child and Youth Mortality Review Committee
- Coronial Services of New Zealand
- Perinatal and Reproductive Epidemiology Research Unit, the University of New South Wales.

Appendices

Appendix A: Additional tables

Table A1: New Zealand perinatal mortality rates (per 1000 births) using the international definition 2007–2012

	2007		2008		2009		2010		2011		2012	
	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate
Total births	65,050		65,303		63,153		64,574		62,078		61,892	
Fetal deaths (terminations of pregnancy and stillbirths)*	211	3.2	207	3.2	229	3.6	199	3.1	190	3.1	166	2.7
Terminations of pregnancy	6	0.1	14	0.2	9	0.1	17	0.3	24	0.4	13	0.2
Stillbirths	205	3.2	193	3.0	220	3.5	182	2.8	166	2.7	153	2.5
Early neonatal deaths <7 days	57		67		59		68		64		54	
Late neonatal deaths 7–27 days	28		35		30		31		18		24	
Neonatal deaths <28 days#	85	1.3	102	1.6	89	1.4	99	1.5	82	1.3	78	1.3
Perinatal mortalities+	268	4.1	274	4.2	288	4.6	267	4.1	254	4.1	220	3.6
Perinatal related mortalities^	296	4.6	309	4.7	318	5.0	298	4.6	272	4.4	244	3.9
Perinatal mortalities excluding lethal and terminated fetal abnormalities•	223	3.4	220	3.4	236	3.7	204	3.2	179	2.9	169	2.7
Perinatal related mortalities excluding lethal and terminated fetal abnormalities[5]	237	3.6	240	3.7	252	4.0	221	3.4	188	3.0	179	2.9

* Fetal death rate per 1000 babies born (includes terminations and stillbirths).
\# Neonatal death rate per 1000 live born babies.
\+ Fetal deaths and early neonatal deaths per 1000 babies born.
^ Fetal deaths and early and late neonatal deaths per 1000 babies born.
• Lethal and terminated fetal abnormalities are all perinatal related deaths with PSANZ-PDC of congenital abnormality and neonatal deaths with PSANZ-NDC of congenital abnormality.

Table A2: Perinatal death classification (PSANZ-PDC) specific perinatal related death rates (per 1000 births) 2007–2012

Perinatal death classification (PSANZ-PDC)	2007		2008		2009		2010		2011		2012		Total	
	n=65,602		n=65,872		n=63,665		n=65,124		n=62,604		n=62,425			
	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	n	%
Congenital abnormality	198	3.02	184	2.79	181	2.84	211	3.24	202	3.23	201	3.22	1,177	28.4
Perinatal infection	28	0.43	27	0.41	24	0.38	27	0.41	20	0.32	19	0.30	145	3.5
Hypertension	19	0.29	22	0.33	28	0.44	26	0.40	21	0.34	18	0.29	134	3.2
Antepartum haemorrhage	60	0.91	66	1.00	77	1.21	78	1.20	78	1.25	60	0.96	419	10.1
Maternal conditions	27	0.41	23	0.35	38	0.60	32	0.49	26	0.42	36	0.58	182	4.4
Specific perinatal conditions	57	0.87	71	1.08	76	1.19	69	1.06	73	1.17	70	1.12	416	10.0
Hypoxic peripartum death	32	0.49	34	0.52	28	0.44	20	0.31	20	0.32	19	0.30	153	3.7
Fetal growth restriction	45	0.69	62	0.94	53	0.83	48	0.74	44	0.70	49	0.78	301	7.3
Spontaneous preterm	98	1.49	94	1.43	109	1.71	111	1.70	84	1.34	101	1.62	597	14.4
Unexplained antepartum death	103	1.57	103	1.56	104	1.63	72	1.11	93	1.49	87	1.39	562	13.6
No obstetric antecedent	11	0.17	14	0.21	7	0.11	10	0.15	4	0.06	9	0.14	55	1.3

Table A3: Perinatal death classification (PSANZ-PDC) specific perinatal related death rates (per 1000 births) for Australia (Queensland, Western Australia, South Australia, Tasmania) and New Zealand 2011

	Australia (Queensland, WA, SA, Tas)					New Zealand				
	n=121,037					n=62,604				
	n	%	rate	(95% CI)		n	%	rate	(95% CI)	
Congenital abnormality	320	27.2	2.64	2.37	2.95	202	30.4	3.23	2.81	3.7
Perinatal infection	49	4.2	0.40	0.31	0.54	20	3.0	0.32	0.21	0.49
Hypertension	29	2.5	0.24	0.17	0.34	21	3.2	0.34	0.22	0.51
Antepartum haemorrhage	76	6.5	0.63	0.5	0.79	78	11.7	1.25	1	1.55
Maternal conditions	30	2.5	0.25	0.17	0.35	26	3.9	0.42	0.28	0.61
Specific perinatal conditions	92	7.8	0.76	0.62	0.93	73	11.0	1.17	0.93	1.47
Hypoxic peripartum death	30	2.5	0.25	0.17	0.35	20	3.0	0.32	0.21	0.49
Fetal growth restriction	70	5.9	0.58	0.46	0.73	44	6.6	0.70	0.52	0.94
Spontaneous preterm birth	248	21.1	2.05	1.81	2.32	84	12.6	1.34	1.08	1.66
Unexplained antepartum death	184	15.6	1.52	1.32	1.76	93	14.0	1.49	1.21	1.82
No obstetric antecedent	50	4.2	0.41	0.31	0.54	4	0.6	0.06	0.02	0.16

Table A4: Neonatal death classification (PSANZ-NDC) specific neonatal death rates (per 1000 live births) 2007–2012

Perinatal death classification (PSANZ-PDC)	2007		2008		2009		2010		2011		2012	
	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate	n	Rate
Congenital abnormality	38	0.58	43	0.66	43	0.68	46	0.71	50	0.80	38	0.61
Extreme prematurity	57	0.87	51	0.78	57	0.90	84	1.30	55	0.88	69	1.11
Cardio-respiratory disorders	11	0.17	11	0.17	11	0.17	18	0.28	11	0.18	14	0.23
Infection	14	0.21	21	0.32	12	0.19	19	0.29	15	0.24	15	0.24
Neurological	31	0.48	33	0.50	40	0.63	28	0.43	23	0.37	25	0.40
Gastrointestinal	2	0.03	-	-	8	0.13	5	0.08	2	0.03	3	0.05
Other	14	0.21	17	0.26	11	0.17	10	0.15	8	0.13	14	0.23

Table A5: Intrapartum stillbirth rates (per 1000 births) by gestation excluding congenital abnormalities 2007–2012

Gestation at birth (weeks)	2007			2008			2009			2010			2011			2012		
	n	N	Rate	n	N	Rate	n	N	Rate	n	N	Rate	n	N	Rate	n	N	Rate
24–27	4	65,269	0.06	4	65,469	0.06	7	63,382	0.11	6	64,763	0.09	8	62,237	0.13	5	62,076	0.08
28–36	6	64,987	0.09	5	65,209	0.08	4	63,116	0.06	2	64,497	0.03	4	62,012	0.06	3	61,846	0.05
≥37	25	60,571	0.41	22	60,597	0.36	22	58,699	0.37	16	59,875	0.27	9	57,602	0.16	12	57,372	0.21

Table A6: Perinatal related death rates (per 1000 births) by maternal age 2007–2012

	Total births		Fetal deaths: Termination of pregnancy			Fetal deaths: Stillbirths			Neonatal deaths			Perinatal related deaths		
	n=385,292		n=918			n=2,146			n=1,077			n=4,141		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Maternal age (years)														
<20	27,851	7.2	73	8.0	2.62	205	9.6	7.36	126	11.7	4.57	404	9.8	14.51
20–24	70,548	18.3	143	15.6	2.03	443	20.6	6.28	235	21.8	3.36	821	19.8	11.64
25–29	95,464	24.8	206	22.4	2.16	478	22.3	5.01	257	23.9	2.71	941	22.7	9.86
30–34	107,732	28.0	238	25.9	2.21	512	23.9	4.75	219	20.3	2.05	969	23.4	8.99
35–39	68,354	17.7	200	21.8	2.93	396	18.5	5.79	188	17.5	2.77	784	18.9	11.47
≥40	15,339	4.0	58	6.3	3.78	112	5.2	7.30	51	4.7	3.36	221	5.3	14.41
Unknown	4	0.0	-	-	-	-	-	-	1	0.1	-	1	0.0	-

Table A7: Perinatal death classification (PSANZ-PDC) specific perinatal related death rates (excluding termination of pregnancy) by maternal age (years) 2007–2012

Perinatal death classification (PSANZ-PDC)	Maternal age (years)											
	<20			20–34			35–39			≥40		
	n=27,851			n=273,744			n=68,354			n=15,339		
	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Congenital abnormality*	46	13.9	1.65	267	12.5	0.98	95	16.3	1.39	37	22.7	2.41
Perinatal infection	17	5.1	0.61	93	4.3	0.34	16	2.7	0.23	6	3.7	0.39
Hypertension	3	0.9	0.11	78	3.6	0.28	22	3.8	0.32	8	4.9	0.52
Antepartum haemorrhage	44	13.3	1.58	276	12.9	1.01	66	11.3	0.97	14	8.6	0.91
Maternal conditions	6	1.8	0.22	91	4.2	0.33	30	5.1	0.44	13	8.0	0.85
Specific perinatal condition	27	8.2	0.97	254	11.8	0.93	79	13.5	1.16	22	13.5	1.43
Hypoxic peripartum	16	4.8	0.57	109	5.1	0.40	23	3.9	0.34	5	3.1	0.33
Fetal growth restriction	31	9.4	1.11	196	9.1	0.72	46	7.9	0.67	9	5.5	0.59
Spontaneous preterm	88	26.6	3.16	360	16.8	1.32	89	15.2	1.30	23	14.1	1.50
Unexplained antepartum	44	13.3	1.58	382	17.8	1.40	111	19.0	1.62	25	15.3	1.63
No obstetric antecedent	9	2.7	0.32	38	1.8	0.14	7	1.2	0.10	1	0.6	0.07

* Excludes one maternal age missing.

Table A8: Perinatal related death rates (per 1000 births) by baby ethnicity (prioritised) 2012

	Total births		Fetal deaths						Neonatal deaths			Perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	n=62,425		n=171			n=320			n=178			n=669		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Ethnicity (baby)														
Māori	18,057	28.9	39	22.8	2.16	102	31.9	5.65	55	30.9	3.07	196	29.3	10.85
Pacific peoples	6,994	11.5	16	9.4	2.29	47	14.7	6.72	31	17.4	4.47	94	14.1	13.44
Indian	2,593	3.9	15	8.8	5.78	17	5.3	6.56	9	5.1	3.51	41	6.1	15.81
Other Asian	6,084	8.2	23	13.5	3.78	27	8.4	4.44	10	5.6	1.66	60	9.0	9.86
Other (including unknown)	3,682	6.1	9	5.3	2.44	21	6.6	5.70	14	7.9	3.83	44	6.6	11.95
NZ European	25,015	41.3	69	40.4	2.76	106	33.1	4.24	59	33.1	2.38	234	35.0	9.35

Table A9: Perinatal related death rates (per 1000 births) by maternal and baby ethnicity (prioritised) 2007–2012

	Total births		Fetal deaths						Neonatal deaths			Perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	n=385,292		n=918			n=2,146			n=1,077			n=4,141		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Ethnicity (mother)														
Māori	88,824	23.1	142	15.5	1.60	592	27.6	6.66	352	32.7	4.00	1,086	26.2	12.23
Pacific peoples	41,046	10.7	80	8.7	1.95	324	15.1	7.89	166	15.4	4.08	570	13.8	13.89
Indian	13,759	3.6	56	6.1	4.07	94	4.4	6.83	45	4.2	3.31	195	4.7	14.17
Other Asian	29,766	7.7	105	11.4	3.53	119	5.5	4.00	60	5.6	2.03	284	6.9	9.54
Other (including unknown)	34,260	8.9	85	9.3	2.48	177	8.2	5.17	74	6.9	2.18	336	8.1	9.81
NZ European	177,637	46.1	450	49.0	2.53	840	39.1	4.73	380	35.3	2.15	1,670	40.3	9.40
Ethnicity (baby)														
Māori	112,897	29.3	200	21.8	1.77	722	33.6	6.40	393	36.5	3.51	1,315	31.8	11.65
Pacific peoples	43,024	11.2	82	8.9	1.91	322	15.0	7.48	169	15.7	3.97	573	13.8	13.32
Indian	14,411	3.7	58	6.3	4.02	94	4.4	6.52	49	4.5	3.44	201	4.9	13.95
Other Asian	29,215	7.6	106	11.5	3.63	121	5.6	4.14	55	5.1	1.90	282	6.8	9.65
Other (including unknown)	23,427	6.1	55	6.0	2.35	133	6.2	5.68	48	4.5	2.07	236	5.7	10.07
NZ European	162,318	42.1	417	45.4	2.57	754	35.1	4.65	363	33.7	2.25	1,534	37.0	9.45

Table A10: Perinatal death classification (PSANZ-PDC) specific perinatal related death rates (excluding termination of pregnancy) by maternal ethnicity (prioritised) 2007–2012

Perinatal death classification (PSANZ-PDC)	Māori			Pacific peoples			Indian			Other Asian			Other (including unknown)			NZ European		
	n=88,824			n=41,046			n=13,759			n=29,766			n=34,260			n=177,637		
	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Congenital abnormality	112	11.9	1.26	73	14.9	1.78	14	10.1	1.02	34	19.0	1.14	37	14.7	1.08	176	14.4	0.99
Perinatal infection	36	3.8	0.41	22	4.5	0.54	3	2.2	0.22	10	5.6	0.34	14	5.6	0.41	47	3.9	0.26
Hypertension	25	2.6	0.28	26	5.3	0.63	7	5.0	0.51	6	3.4	0.20	6	2.4	0.18	41	3.4	0.23
Antepartum haemorrhage	131	13.9	1.47	51	10.4	1.24	15	10.8	1.09	24	13.4	0.81	26	10.4	0.76	153	12.5	0.86
Maternal conditions	42	4.4	0.47	38	7.8	0.93	8	5.8	0.58	3	1.7	0.10	9	3.6	0.26	40	3.3	0.23
Specific perinatal conditions	85	9.0	0.96	48	9.8	1.17	18	12.9	1.31	25	14.0	0.84	35	13.9	1.02	171	14.0	0.96
Hypoxic peripartum death	42	4.4	0.47	16	3.3	0.39	5	3.6	0.36	5	2.8	0.17	17	6.8	0.50	68	5.6	0.38
Fetal growth restriction	73	7.7	0.82	39	8.0	0.95	19	13.7	1.38	19	10.6	0.64	22	8.8	0.64	110	9.0	0.62
Spontaneous preterm	212	22.5	2.39	89	18.2	2.17	25	18.0	1.82	24	13.4	0.81	43	17.1	1.26	167	13.7	0.94
Unexplained antepartum death	154	16.3	1.73	77	15.7	1.88	24	17.3	1.74	29	16.2	0.97	42	16.7	1.23	236	19.3	1.33
No obstetric antecedent	32	3.4	0.36	11	2.2	0.27	1	0.7	0.07	-	-	-	-	-	-	11	0.9	0.06

Table A11: Distribution of births by deprivation decile (NZDep2006) 2012

Deprivation decile (NZDep2006)	Total births	
	n=62,425	
	n	%
1 (least deprived)	4,620	7.4
2	5,147	8.2
3	5,251	8.4
4	5,677	9.1
5	5,761	9.2
6	6,332	10.1
7	6,442	10.3
8	6,799	10.9
9	7,627	12.2
10 (most deprived)	8,557	13.7
Unknown	212	0.3

Table A12: Perinatal related deaths by deprivation quintile (NZDep2006) 2007–2012

Deprivation quintile (NZDep2006)	Total births		Fetal deaths						Neonatal deaths			Perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	n=385,292		n=918			n=2,146			n=1,077			n=4,141		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
1 (least deprived)	61,396	15.9	173	18.8	2.82	253	11.8	4.12	116	10.8	1.90	542	13.1	8.83
2	67,953	17.6	186	20.3	2.74	318	14.8	4.68	148	13.7	2.19	652	15.7	9.59
3	72,716	18.9	179	19.5	2.46	362	16.9	4.98	169	15.7	2.34	710	17.1	9.76
4	80,717	20.9	191	20.8	2.37	456	21.2	5.65	225	20.9	2.81	872	21.1	10.80
5 (most deprived)	100,557	26.1	185	20.2	1.84	730	34.0	7.26	406	37.7	4.07	1,321	31.9	13.14
Unknown	1,953	0.5	4	0.4	-	27	1.3	-	13	1.2	-	44	1.1	-

Table A13: Perinatal death classification (PSANZ-PDC) specific perinatal related death rates (per 1000 births) (excluding termination of pregnancy) by deprivation quintile (NZDep2006) 2007–2012

Perinatal death classification (PSANZ-PDC)	Quintile 1 (least deprived)			Quintile 2			Quintile 3			Quintile 4			Quintile 5 (most deprived)		
	n=61,396			n=67,953			n=72,716			n=80,717			n=100,557		
	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Congenital abnormality	66	17.9	1.07	48	10.3	0.71	72	13.6	0.99	102	15.0	1.26	155	13.6	1.54
Perinatal infection	16	4.3	0.26	21	4.5	0.31	28	5.3	0.39	21	3.1	0.26	45	4.0	0.45
Hypertension	7	1.9	0.11	12	2.6	0.18	22	4.1	0.30	22	3.2	0.27	47	4.1	0.47
Antepartum haemorrhage	36	9.8	0.59	57	12.2	0.84	57	10.7	0.78	84	12.3	1.04	161	14.2	1.60
Maternal conditions	9	2.4	0.15	8	1.7	0.12	19	3.6	0.26	29	4.3	0.36	73	6.4	0.73
Specific perinatal conditions	61	16.5	0.99	62	13.3	0.91	76	14.3	1.05	81	11.9	1.00	99	8.7	0.98
Hypoxic peripartum	13	3.5	0.21	30	6.4	0.44	27	5.1	0.37	32	4.7	0.40	47	4.1	0.47
Fetal growth restriction	37	10.0	0.60	41	8.8	0.60	47	8.9	0.65	59	8.7	0.73	97	8.5	0.96
Spontaneous preterm	46	12.5	0.75	84	18.0	1.24	82	15.4	1.13	124	18.2	1.54	211	18.6	2.10
Unexplained antepartum	76	20.6	1.24	94	20.2	1.38	95	17.9	1.31	116	17.0	1.44	174	15.3	1.73
No obstetric antecedent	2	0.5	0.03	9	1.9	0.13	6	1.1	0.08	11	1.6	0.14	27	2.4	0.27

Table A14: Perinatal related death rates (per 1000 births) by DHB of maternal residence 2012

DHB of maternal residence	Total births		Fetal deaths						Neonatal deaths			Perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	n=62,425		n=171			n=320			n=178			n=669		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Northland	2,404	3.9	5	2.9	2.08	18	5.6	7.49	9	5.1	3.78	32	4.8	13.31
Waitemata	8,007	12.8	26	11.1	3.25	34	13.0	4.25	17	6.7	2.14	77	11.0	9.62
Auckland	6,605	10.6	25	18.7	3.79	38	10.9	5.75	23	3.7	3.52	86	11.1	13.02
Counties Manukau	8,800	14.1	30	15.8	3.41	50	16.4	5.68	34	20.7	3.90	114	17.3	12.95
Waikato	5,522	8.8	12	7.6	2.17	30	9.7	5.43	21	11.6	3.83	63	9.6	11.41
Bay of Plenty	2,994	4.8	2	4.7	0.67	15	3.6	5.01	17	3.7	5.71	34	3.9	11.36
Lakes	1,529	2.4	9	1.2	5.89	5	3.0	3.27	5	3.0	3.30	19	2.6	12.43
Tairawhiti	722	1.2	-	1.2	-	3	0.6	4.16	5	1.8	6.95	8	1.1	11.08
Taranaki	1,559	2.5	1	0.6	0.64	5	3.3	3.21	5	2.4	3.22	11	2.4	7.06
Hawke's Bay	2,306	3.7	7	4.7	3.04	11	3.3	4.77	2	6.7	0.87	20	4.5	8.67
Whanganui	856	1.4	2	1.8	2.34	9	1.5	10.51	3	0.6	3.55	14	1.4	16.36
MidCentral	2,196	3.5	11	4.7	5.01	6	3.3	2.73	5	3.7	2.29	22	3.8	10.02
Wairarapa	518	0.8	1	-	1.93	4	0.6	7.72	1	0.6	1.95	6	0.5	11.58
Capital & Coast	3,858	6.2	7	5.8	1.81	21	3.9	5.44	6	6.7	1.57	34	5.1	8.81
Hutt Valley	2,051	3.3	3	3.5	1.46	7	4.5	3.41	4	2.4	1.96	14	3.8	6.83
Nelson Marlborough	1,546	2.5	2	1.8	1.29	6	1.8	3.88	3	0.6	1.95	11	1.5	7.12
West Coast	420	0.7	-	-	-	2	0.9	4.76	2	1.2	4.78	4	0.8	9.52
Canterbury	6,069	9.7	15	7.6	2.47	32	10.3	5.27	8	12.8	1.33	55	10.2	9.06
South Canterbury	630	1.0	3	-	4.76	3	0.3	4.76	1	0.6	1.60	7	0.3	11.11
Otago	2,075	3.3	4	4.1	1.93	10	3.3	4.82	3	3.7	1.46	17	3.6	8.19
Southland	1,563	2.5	6	2.3	3.84	10	2.4	6.40	4	2.4	2.59	20	2.4	12.80
Other*	195	0.3	-	-	-	1	-	5.13	-	0.6	-	1	0.2	5.13

* Other includes Overseas, Unknown and Other.

Table A15: Perinatal related death rates (per 1000 births) by DHB of maternal residence 2007–2012

DHB of maternal residence	Total births		Fetal deaths						Neonatal deaths			Perinatal related deaths		
			Termination of pregnancy			Stillbirths								
	n=385,292		n=918			n=2,146			n=1,077			n=4,141		
	n	%	n	%	Rate	n	%	Rate	n	%	Rate	n	%	Rate
Northland	14,172	3.7	24	2.6	1.69	96	4.5	6.77	51	4.7	3.63	171	4.1	12.07
Waitemata	47,770	12.4	152	16.6	3.18	251	11.7	5.25	90	8.4	1.90	493	11.9	10.32
Auckland	40,134	10.4	141	15.4	3.51	206	9.6	5.13	101	9.4	2.54	448	10.8	11.16
Counties Manukau	53,247	13.8	129	14.1	2.42	366	17.1	6.87	203	18.8	3.85	698	16.9	13.11
Waikato	33,833	8.8	77	8.4	2.28	177	8.2	5.23	116	10.8	3.45	370	8.9	10.94
Bay of Plenty	18,034	4.7	27	2.9	1.50	84	3.9	4.66	68	6.3	3.79	179	4.3	9.93
Lakes	9,871	2.6	19	2.1	1.92	63	2.9	6.38	38	3.5	3.88	120	2.9	12.16
Tairawhiti	4,750	1.2	6	0.7	1.26	24	1.1	5.05	18	1.7	3.81	48	1.2	10.11
Taranaki	9,636	2.5	12	1.3	1.25	55	2.6	5.71	25	2.3	2.61	92	2.2	9.55
Hawke's Bay	14,178	3.7	34	3.7	2.40	74	3.4	5.22	41	3.8	2.91	149	3.6	10.51
Whanganui	5,414	1.4	14	1.5	2.59	41	1.9	7.57	15	1.4	2.80	70	1.7	12.93
MidCentral	14,034	3.6	47	5.1	3.35	79	3.7	5.63	42	3.9	3.02	168	4.1	11.97
Wairarapa	3,247	0.8	8	0.9	2.46	19	0.9	5.85	9	0.8	2.80	36	0.9	11.09
Capital & Coast	24,041	6.2	51	5.6	2.12	114	5.3	4.74	43	4.0	1.80	208	5.0	8.65
Hutt Valley	13,060	3.4	32	3.5	2.45	74	3.4	5.67	30	2.8	2.32	136	3.3	10.41
Nelson Marlborough	10,098	2.6	17	1.9	1.68	41	1.9	4.06	22	2.0	2.19	80	1.9	7.92
West Coast	2,591	0.7	3	0.3	1.16	14	0.7	5.40	14	1.3	5.44	31	0.7	11.96
Canterbury	39,150	10.2	75	8.2	1.92	216	10.1	5.52	100	9.3	2.57	391	9.4	9.99
South Canterbury	3,837	1.0	8	0.9	2.08	21	1.0	5.47	10	0.9	2.63	39	0.9	10.16
Otago	12,631	3.3	24	2.6	1.90	68	3.2	5.38	21	1.9	1.67	113	2.7	8.95
Southland	9,837	2.6	18	2.0	1.83	59	2.7	6.00	17	1.6	1.74	94	2.3	9.56
Other*	1,727	0.4	-	-	-	4	0.2	-	3	0.3	-	7	0.2	-

* Other includes Overseas, Unknown and Other.

Table A16: Perinatal related death risk (per 1000 babies in utero) 2007–2012

	2007			2008			2009			2010			2011			2012		
	Total births	n	Risk	Total births	n	Risk	Total births	n	Risk	Total births	n	Risk	Total births	n	Risk	Total births	n	Risk
Gestation at birth (weeks)																		
20–23	246	263	4.01	316	279	4.24	200	269	4.23	248	293	4.50	257	295	4.71	259	305	4.89
24–27	304	98	1.50	279	98	1.49	281	118	1.86	298	105	1.62	248	87	1.40	255	105	1.69
28–31	539	58	0.89	574	64	0.98	527	65	1.03	551	52	0.81	521	58	0.93	519	50	0.81
32–36	3,912	88	1.36	4,075	81	1.25	3,930	90	1.44	4,116	102	1.59	3,938	86	1.40	3,992	73	1.19
37–40	47,925	136	2.24	48,492	141	2.33	46,950	151	2.57	47,992	126	2.10	46,578	122	2.12	46,680	116	2.02
≥41	12,625	34	2.68	12,090	37	3.05	11,721	31	2.63	11,890	26	2.18	11,039	17	1.54	10,700	20	1.87
Unknown	51	1	-	46	-	-	56	1	-	29	-	-	23	-	-	20	-	-

Table A17: Perinatal related deaths by primary and associated perinatal death classification (PSANZ-PDC) 2012

Perinatal death classification (PSANZ-PDC)	Primary PSANZ-PDC		Associated PSANZ-PDC 1		Associated PSANZ-PDC 2		Assigned PSANZ-PDCs	
	n=669		n=669		n=669		n=669	
	n	%	n	%	n	%	n	%
Congenital abnormality	201	30.0	8	1.2	1	0.1	210	31.4
Perinatal infection	19	2.8	4	0.6	2	0.3	25	3.7
Hypertension	18	2.7	6	0.9	1	0.1	25	3.7
Antepartum haemorrhage	60	9.0	18	2.7	1	0.1	79	11.8
Maternal conditions	36	5.4	12	1.8	1	0.1	49	7.3
Specific perinatal condition	70	10.5	5	0.7	1	0.1	76	11.4
Hypoxic peripartum	19	2.8	14	2.1	-	-	33	4.9
Fetal growth restriction	49	7.3	22	3.3	1	0.1	72	10.8
Spontaneous preterm	101	15.1	44	6.6	3	0.4	148	22.1
Unexplained antepartum	87	13.0	-	-	-	-	87	13.0
No obstetric antecedent	9	1.3	-	-	-	-	9	1.3

Table A18: Neonatal deaths by primary and associated neonatal death classification (PSANZ-NDC) 2012

Neonatal death classification (PSANZ-NDC)	Primary PSANZ-NDC		Associated PSANZ-NDC 1		Associated PSANZ-NDC 2		Assigned PSANZ-NDCs	
	n=178		n=178		n=178		n=178	
	n	%	n	%	n	%	n	%
Congenital abnormality	38	21.3	1	0.6	1	0.6	40	22.5
Extreme prematurity	69	38.8	-	-	-	-	69	38.8
Cardio-respiratory disorders	14	7.9	12	6.7	1	0.6	27	15.2
Infection	15	8.4	5	2.8	1	0.6	21	11.8
Neurological	25	14.0	8	4.5	3	1.7	36	20.2
Gastrointestinal	3	1.7	1	0.6	-	-	4	2.2
Other	14	7.9	2	1.1	-	-	16	9.0

Table A19: Optimal investigation of perinatal related death by DHB of maternal residence 2012

DHB of maternal residence	Perinatal related deaths	Offered post-mortem		Optimal investigation	
	n=669				
	n	n	%	n	%
Northland	32	22	68.8	9	28.1
Waitemata	77	65	84.4	28	36.4
Auckland	86	74	86.0	38	44.2
Counties Manukau	114	107	93.9	46	40.4
Waikato	63	61	96.8	30	47.6
Bay of Plenty	34	31	91.2	7	20.6
Lakes	19	12	63.2	10	52.6
Tairawhiti	8	7	87.5	2	25.0
Taranaki	11	11	100.0	5	45.5
Hawke's Bay	20	18	90.0	6	30.0
Whanganui	14	11	78.6	8	57.1
MidCentral	22	20	90.9	12	54.5
Wairarapa	6	6	100.0	4	66.7
Capital & Coast	34	32	94.1	22	64.7
Hutt Valley	14	13	92.9	10	71.4
Nelson Marlborough	11	10	90.9	6	54.5
West Coast	4	3	75.0	1	25.0
Canterbury	55	49	89.1	33	60.0
South Canterbury	7	7	100.0	6	85.7
Otago	17	17	100.0	6	35.3
Southland	20	17	85.0	6	30.0
Overseas	1	1	100.0	-	-

Table A20: Stillbirth rate (per 1000 ongoing pregnancies) by gestation group and year 2007–2012

	2007		2008		2009		2010		2011		2012		Chi-squared test for trend (p)
Total births	n=65,602		n=65,872		n=63,665		n=65,124		n=62,604		n=62,425		
	n	Risk	n	Risk	n	Risk	n	Risk	n	Risk	n	Risk	
Gestation at birth (weeks)													
20–23	89	1.36	123	1.87	109	1.71	109	1.67	114	1.82	98	1.57	0.50
24–27	54	0.83	46	0.70	59	0.93	44	0.68	36	0.58	51	0.82	0.47
28–31	43	0.66	37	0.57	47	0.74	32	0.50	34	0.55	30	0.48	0.14
32–36	64	0.99	55	0.85	60	0.96	67	1.05	55	0.89	54	0.88	0.74
37–40	97	1.60	99	1.63	112	1.91	77	1.29	82	1.42	78	1.36	0.069
≥41	20	1.58	19	1.57	18	1.54	14	1.18	9	0.82	9	0.84	0.023
Unknown	1	-	-	-	1	-	-	-	-	-	-	-	-

Table A21: Contributory factors and potentially avoidable perinatal related death by perinatal death classification (PSANZ-PDC) 2012

Perinatal death classification (PSANZ-PDC)	Perinatal related deaths	Contributory and avoidable		Contributory BUT NOT or unknown if avoidable		No contributory factors		Unknown	
	n=669								
	n	n	%	n	%	n	%	n	%
Congenital abnormality	201	2	1.0	11	5.5	188	93.5	-	-
Perinatal infection	19	4	21.1	2	10.5	13	68.4	-	-
Hypertension	18	7	38.9	-	-	11	61.1	-	-
Antepartum haemorrhage	60	8	13.3	9	15.0	43	71.7	-	-
Maternal conditions	36	16	44.4	5	13.9	15	41.7	-	-
Specific perinatal conditions	70	14	20.0	6	8.6	50	71.4	-	-
Hypoxic peripartum death	19	10	52.6	2	10.5	7	36.8	-	-
Fetal growth restriction	49	18	36.7	3	6.1	28	57.1	-	-
Spontaneous preterm	101	29	28.7	12	11.9	58	57.4	2	2.0
Unexplained antepartum death	87	10	11.5	9	10.3	67	77.0	1	1.1
No obstetric antecedent	9	6	66.7	1	11.1	2	22.2	-	-

Table A22: Main contributory factor(s) in potentially avoidable perinatal related death by perinatal death classification (PSANZ-PDC) 2011–2012

Perinatal death classification (PSANZ-PDC)	Perinatal related deaths	Organisation/ Management		Personnel		Barriers		Specific contributory factor not identified	
	n	n	%	n	%	n	%	n	%
Congenital abnormality	403	-	-	3	0.7	3	0.7	-	-
Perinatal infection	39	1	2.6	3	7.7	7	17.9	-	-
Hypertension	39	3	7.7	6	15.4	10	25.6	1	2.6
Antepartum haemorrhage	138	2	1.4	5	3.6	18	13.0	1	0.7
Maternal conditions	62	3	4.8	7	11.3	24	38.7	1	1.6
Specific perinatal conditions	143	9	6.3	12	8.4	9	6.3	-	-
Hypoxic peripartum death	39	6	15.4	7	17.9	6	15.4	8	20.5
Fetal growth restriction	93	4	4.3	16	17.2	13	14.0	2	2.2
Spontaneous preterm	185	3	1.6	7	3.8	39	21.1	-	-
Unexplained antepartum death	180	3	1.7	3	1.7	17	9.4	-	-
No obstetric antecedent	13	-	-	2	15.4	6	46.2	-	-

Table A23: Contributory factors and potentially avoidable perinatal related deaths by maternal ethnicity (prioritised) (95% CIs surround the estimate of the proportion of cases within each ethnicity where death was potentially avoidable) 2009–2012

Maternal ethnicity (prioritised)	Perinatal related deaths	Contributory and avoidable			Contributory BUT NOT or unknown if avoidable		No contributory factors		Unknown	
	n=2,763									
	n	n	%	95% CI	n	%	n	%	n	%
Māori	739	172	23.3	19.80–26.75	110	14.9	422	57.1	35	4.7
Pacific peoples	386	88	22.8	18.28–28.09	48	12.4	224	58.0	26	6.7
Indian	140	24	17.1	10.98–25.51	7	5.0	102	72.9	7	5.0
Other Asian	209	24	11.5	7.36–17.09	12	5.7	169	80.9	4	1.9
Other (including unknown)	224	26	11.6	7.58–17.01	26	11.6	166	74.1	6	2.7
NZ European	1,065	137	12.9	10.71–15.02	59	5.5	830	77.9	39	3.7

Table A24: Main contributory factor(s) in potentially avoidable perinatal related deaths by maternal prioritised ethnicity (with 95% CIs) 2011–2012

Maternal ethnicity (prioritised)	Perinatal related deaths	Potentially avoidable											
		Organisation/ Management			Personnel			Barriers			Specific contributory factor not identified		
	n	n	%	95% CI	n	%	95% CI	n	%	95% CI	n	%	95% CI
Māori	339	3	0.9	0.18–2.59	11	3.2	1.62–5.81	63	18.6	14.28–23.78	4	1.2	0.32–3.02
Pacific peoples	173	4	2.3	0.63–5.92	6	3.5	1.27–7.55	38	22.0	15.54–30.15	1	0.6	0.01–3.22
Indian	73	1	1.4	0.03–7.63	9	12.3	5.64–23.40	6	8.2	3.02–17.89	1	1.4	0.03–7.63
Other Asian	113	4	3.5	0.96–9.06	6	5.3	1.95–11.56	6	5.3	1.95–11.56	-	-	-
Other (including unknown)	126	2	1.6	0.19–5.73	7	5.6	2.23–11.45	5	4.0	1.29–9.26	2	1.6	0.19–5.73
NZ European	510	20	3.9	2.40–6.06	32	6.3	4.29–8.86	34	6.7	4.62–9.32	5	1.0	0.32–2.29

Table A25: Contributory factors and potentially avoidable perinatal related deaths by deprivation quintile (NZDep2006) (95% CIs surround the estimate of the proportion of cases within quintile where death was potentially avoidable) 2009–2012

Deprivation quintile (NZDep2006)	Perinatal related deaths	Contributory and avoidable			Contributory BUT NOT or unknown if avoidable		No contributory factors		Unknown	
	n=2,763									
		n	%	95% CI	n	%	n	%	n	%
1 (least deprived)	357	44	12.3	8.96–16.55	13	3.6	286	80.1	14	3.9
2	445	65	14.6	11.27–18.62	31	7.0	332	74.6	17	3.8
3	468	55	11.8	8.85–15.30	44	9.4	357	76.3	12	2.6
4	566	101	17.8	14.36–21.32	36	6.4	403	71.2	26	4.6
5 (most deprived)	895	198	22.1	19.04–25.20	133	14.9	518	57.9	46	5.1
Unknown	32	8	25.0	10.79–49.26	5	15.6	17	53.1	2	6.3

Table A26: Main contributory factor(s) in potentially avoidable perinatal related deaths by deprivation quintile (NZDep2006) (with 95% CIs) 2011–2012

Deprivation quintile (NZDep2006)	Perinatal related deaths	Potentially avoidable											
		Organisation/ Management			Personnel			Barriers			Specific contributory factor not identified		
	n	n	%	95% CI	n	%	95% CI	n	%	95% CI	n	%	95% CI
1 (least deprived)	191	7	3.7	1.47–7.55	10	5.2	2.51–9.63	9	4.7	2.15–8.94	2	1.0	0.13–3.78
2	232	2	0.9	0.10–3.11	18	7.8	4.60–12.26	18	7.8	4.60–12.26	5	2.2	0.70–5.03
3	221	7	3.2	1.27–6.53	7	3.2	1.27–6.53	14	6.3	3.46–10.63	2	0.9	0.11–3.27
4	262	9	3.4	1.57–6.52	15	5.7	3.20–9.44	29	11.1	7.41–15.90	-	-	-
5 (most deprived)	418	8	1.9	0.83–3.77	21	5.0	3.11–7.68	79	18.9	14.96–23.55	4	1.0	0.26–2.45
Unknown	10	1	10.0	-	-	-	-	3	30.0	-	-	-	-

Table A27: Complete primary perinatal death classification (PSANZ-PDC) by type of perinatal related death 2012

Perinatal death classification (PSANZ-PDC)		Fetal deaths							
		Termination of pregnancy		Stillbirths		Neonatal deaths		Perinatal related deaths	
		n=171		n=320		n=178		n=669	
		n	%	n	%	n	%	n	%
	Congenital abnormality								
1.1	Central nervous system	28	16.4	3	0.9	4	2.2	35	5.2
1.2	Cardiovascular system	16	9.4	4	1.3	3	1.7	23	3.4
1.3	Urinary system	8	4.7	-	-	4	2.2	12	1.8
1.4	Gastrointestinal system	1	0.6	1	0.3	2	1.1	4	0.6
1.5	Chromosomal	35	20.5	17	5.3	12	6.7	64	9.6
1.6	Metabolic	-	-	-	-	3	1.7	3	0.4
1.7	Multiple/Non-chromosomal syndromes	21	12.3	5	1.6	3	1.7	29	4.3
1.8	Other congenital abnormality	-	-	-	-	-	-	-	-
1.81	Musculoskeletal	9	5.3	1	0.3	1	0.6	11	1.6
1.82	Respiratory	-	-	-	-	1	0.6	1	0.1
1.83	Diaphragmatic hernia	3	1.8	-	-	3	1.7	6	0.9
1.84	Haematological	1	0.6	-	-	-	-	1	0.1
1.85	Tumours	2	1.2	-	-	-	-	2	0.3
1.88	Other specified congenital abnormality	3	1.8	1	0.3	2	1.1	6	0.9
1.9	Unspecified congenital abnormality	1	0.6	3	0.9	-	-	4	0.6
	Perinatal infections								
2.1	Bacterial	-	-	-	-	-	-	-	-
2.12	E. coli	-	-	-	-	1	0.6	1	0.1
2.13	Listeria monocytogenes	-	-	1	0.3	-	-	1	0.1
2.14	Spirochaetal (eg, Syphilis)	-	-	1	0.3	-	-	1	0.1
2.18	Other bacterial	-	-	2	0.6	1	0.6	3	0.4
2.19	Unspecified bacterial	-	-	1	0.3	2	1.1	3	0.4
2.2	Viral	-	-	-	-	-	-	-	-
2.21	Cytomegalovirus	2	1.2	1	0.3	-	-	3	0.4
2.22	Parvovirus	1	0.6	2	0.6	1	0.6	4	0.6
2.3	Protozoal (eg, Toxoplasma)	-	-	1	0.3	-	-	1	0.1
2.9	Other unspecified organism	-	-	-	-	2	1.1	2	0.3
	Hypertension								
3.1	Chronic hypertension: essential	1	0.6	1	0.3	1	0.6	3	0.4
3.4	Gestational hypertension	1	0.6	1	0.3	-	-	2	0.3

Perinatal death classification (PSANZ-PDC)		Fetal deaths							
		Termination of pregnancy		Stillbirths		Neonatal deaths		Perinatal related deaths	
		n=171		n=320		n=178		n=669	
		n	%	n	%	n	%	n	%
	Hypertension								
3.5	Pre-eclampsia	1	0.6	3	0.9	4	2.2	8	1.2
3.51	Pre-eclampsia: With laboratory evidence of thrombophilia	-	-	1	0.3	-	-	1	0.1
3.6	Pre-eclampsia superimposed on chronic hypertension	2	1.2	2	0.6	-	-	4	0.6
	Antepartum haemorrhage (APH)								
4.1	Placental abruption	2	1.2	18	5.6	9	5.1	29	4.3
4.11	Placental abruption: With laboratory evidence of thrombophilia	-	-	1	0.3	1	0.6	2	0.3
4.2	Placenta praevia	-	-	-	-	1	0.6	1	0.1
4.8	Other APH	1	0.6	2	0.6	1	0.6	4	0.6
4.9	APH of undetermined origin	4	2.3	10	3.1	10	5.6	24	3.6
	Maternal conditions								
5.1	Termination of pregnancy for maternal psychosocial indications	4	2.3	-	-	-	-	4	0.6
5.2	Diabetes/Gestational diabetes	4	2.3	10	3.1	2	1.1	16	2.4
5.3	Maternal injury	-	-	-	-	-	-	-	-
5.31	Maternal injury: Accidental	-	-	2	0.6	1	0.6	3	0.4
5.4	Maternal sepsis	-	-	1	0.3	-	-	1	0.1
5.5	Antiphospholipid syndrome	-	-	-	-	-	-	-	-
5.51	Other maternal thrombophilia (if considered cause of death)	-	-	1	0.3	-	-	1	0.1
5.8	Other specified maternal conditions	2	1.2	5	1.6	4	2.2	11	1.6
	Specific perinatal conditions								
6.1	Twin–twin transfusion	3	1.8	14	4.4	6	3.4	23	3.4
6.2	Fetomaternal haemorrhage	-	-	8	2.5	-	-	8	1.2
6.3	Antepartum cord complications (eg, cord haemorrhage; true knot with evidence of occlusion)	-	-	-	-	-	-	-	-
6.31	Cord haemorrhage	-	-	-	-	2	1.1	2	0.3
6.32	True knot with evidence of occlusion	-	-	1	0.3	-	-	1	0.1
6.38	Other	-	-	5	1.6	1	0.6	6	0.9
6.4	Uterine abnormalities, (eg, bicornuate uterus, cervical incompetence)	5	2.9	5	1.6	4	2.2	14	2.1
6.6	Alloimmune disease	-	-	-	-	-	-	-	-
6.61	Alloimmune disease: Rhesus	-	-	1	0.3	-	-	1	0.1
6.7	Idiopathic hydrops	2	1.2	3	0.9	-	-	5	0.7

Perinatal death classification (PSANZ-PDC)		Fetal deaths							
		Termination of pregnancy		Stillbirths		Neonatal deaths		Perinatal related deaths	
		n=171		n=320		n=178		n=669	
		n	%	n	%	n	%	n	%
	Specific perinatal conditions								
6.8	Other specific perinatal conditions (includes iatrogenic conditions such as rupture of membranes after amniocentesis, termination of pregnancy for suspected but unconfirmed congenital abnormality)	-	-	-	-	-	-	-	-
6.81	Rupture of membranes after amniocentesis	-	-	1	0.3	1	0.6	2	0.3
6.88	Other	-	-	4	1.3	4	2.2	8	1.2
	Hypoxic peripartum death								
7.1	With intrapartum complications	-	-	-	-	-	-	-	-
7.11	With intrapartum complications: Uterine rupture	-	-	-	-	1	0.6	1	0.1
7.12	With intrapartum complications: Cord prolapse	-	-	2	0.6	-	-	2	0.3
7.18	With intrapartum complications: Other	-	-	1	0.3	2	1.1	3	0.4
7.2	Evidence of non-reassuring fetal status in a normally grown infant (eg, abnormal fetal heart rate, fetal scalp ph/lactate, fetal pulse oximetry without intrapartum complications)	-	-	4	1.3	6	3.4	10	1.5
7.3	No intrapartum complications and no evidence of non-reassuring fetal status	-	-	2	0.6	-	-	2	0.3
7.9	Unspecified hypoxic peripartum death	-	-	1	0.3	-	-	1	0.1
	Fetal growth restriction (FGR)								
8.1	With evidence of reduced vascular perfusion on Doppler studies and/or placental histopathology (eg, significant infarction, acute atherosis, maternal and/or fetal vascular thrombosis or maternal floor infarction)	-	-	27	8.4	3	1.7	30	4.5
8.3	No placental pathology	1	0.6	-	-	1	0.6	2	0.3
8.4	No examination of placenta	-	-	3	0.9	1	0.6	4	0.6
8.8	Other specified placental pathology	-	-	12	3.8	1	0.6	13	1.9
	Spontaneous preterm								
9.1	Spontaneous preterm with intact membranes, or membrane rupture <24 hours before delivery	-	-	-	-	-	-	-	-
9.11	Spontaneous preterm with intact membranes, or membrane rupture <24 hours before delivery: With chorioamnionitis	-	-	10	3.1	12	6.7	22	3.3
9.12	Spontaneous preterm with intact membranes, or membrane rupture <24 hours before delivery: Without chorioamnionitis	-	-	3	0.9	3	1.7	6	0.9
9.17	No clinical signs of chorioamnionitis, no examination of placenta	1	0.6	2	0.6	10	5.6	13	1.9
9.19	Spontaneous preterm with intact membranes, or membrane rupture <24 hours before delivery: Unspecified or not known whether placenta examined	-	-	2	0.6	4	2.2	6	0.9

Perinatal death classification (PSANZ-PDC)		Fetal deaths							
		Termination of pregnancy		Stillbirths		Neonatal deaths		Perinatal related deaths	
		n=171		n=320		n=178		n=669	
		n	%	n	%	n	%	n	%
	Spontaneous preterm								
9.2	Spontaneous preterm with membrane rupture ≥24 hours before delivery	-	-	-	-	-	-	-	-
9.21	Spontaneous preterm with membrane rupture ≥24 hours before delivery: With chorioamnionitis	3	1.8	9	2.8	11	6.2	23	3.4
9.22	Spontaneous preterm with membrane rupture ≥24 hours before delivery: Without chorioamnionitis	2	1.2	1	0.3	5	2.8	8	1.2
9.23	Spontaneous preterm with membrane rupture ≥24 hours before delivery: With clinical evidence of chorioamnionitis, no examination of placenta	-	-	1	0.3	2	1.1	3	0.4
9.27	No clinical signs of chorioamnionitis, no examination of placenta	1	0.6	3	0.9	5	2.8	9	1.3
9.29	Spontaneous preterm with membrane rupture ≥24 hours before delivery: Unspecified or not known whether placenta examined	-	-	1	0.3	1	0.6	2	0.3
9.3	Spontaneous preterm with membrane rupture of unknown duration before delivery	-	-	-	-	-	-	-	-
9.31	Spontaneous preterm with membrane rupture of unknown duration before delivery: With chorioamnionitis	-	-	2	0.6	1	0.6	3	0.4
9.33	Spontaneous preterm with membrane rupture of unknown duration before delivery: With clinical evidence of chorioamnionitis, no examination of placenta	-	-	-	-	1	0.6	1	0.1
9.37	No clinical signs of chorioamnionitis, no examination of placenta	-	-	2	0.6	-	-	2	0.3
9.39	Spontaneous preterm with membrane rupture of unknown duration before delivery: Unspecified or not known whether placenta examined	-	-	1	0.3	2	1.1	3	0.4
	Unexplained antepartum death								
10.1	With evidence of reduced vascular perfusion on Doppler studies and/or placental histopathology (eg, significant infarction, acute atherosis, maternal and/or fetal vascular thrombosis or maternal floor infarction)	-	-	17	5.3	-	-	17	2.5
10.2	With chronic villitis	-	-	3	0.9	-	-	3	0.4
10.3	No placental pathology	-	-	13	4.1	-	-	13	1.9
10.4	No examination of placenta	-	-	20	6.3	-	-	20	3.0
10.8	Other specified placental pathology	-	-	33	10.3	-	-	33	4.9
10.9	Unspecified or not known whether placenta examined	-	-	1	0.3	-	-	1	0.1

Perinatal death classification (PSANZ-PDC)		Fetal deaths							
		Termination of pregnancy		Stillbirths		Neonatal deaths		Perinatal related deaths	
		n=171		n=320		n=178		n=669	
		n	%	n	%	n	%	n	%
	No obstetric antecedent								
11.2	Postnatally acquired infection	-	-	-	-	3	1.7	3	0.4
11.3	Accidental asphyxiation	-	-	-	-	1	0.6	1	0.1
11.4	Other accident, poisoning or violence (postnatal)	-	-	-	-	1	0.6	1	0.1
11.8	Other specified	-	-	-	-	1	0.6	1	0.1
11.9	Unknown/Undetermined	-	-	-	-	2	1.1	2	0.3
11.91	Unclassified Sudden Infant Death	-	-	-	-	1	0.6	1	0.1

Table A28: Complete primary neonatal death classification (PSANZ-NDC) for neonatal deaths 2012

Neonatal death classification (PSANZ-NDC)		Neonatal deaths n=178	
		n	%
	Congenital abnormality		
1.1	Central nervous system	4	2.2
1.2	Cardiovascular system	3	1.7
1.3	Urinary system	4	2.2
1.4	Gastrointestinal system	2	1.1
1.5	Chromosomal	11	6.2
1.6	Metabolic	3	1.7
1.7	Multiple/Non-chromosomal syndromes	4	2.2
1.8	Other congenital abnormality	-	-
1.81	Musculoskeletal	1	0.6
1.82	Respiratory	1	0.6
1.83	Diaphragmatic hernia	3	1.7
1.88	Other specified congenital abnormality	2	1.1
	Extreme prematurity		
2.1	Not resuscitated	60	33.7
2.2	Unsuccessful resuscitation	9	5.1
	Cardio-respiratory disorders		
3.1	Hyaline membrane disease/Respiratory distress syndrome (RDS)	5	2.8
3.3	Primary persistent pulmonary hypertension	2	1.1
3.4	Pulmonary hypoplasia	1	0.6
3.5	Chronic neonatal lung disease (typically, bronchopulmonary dysplasia)	1	0.6
3.6	Pulmonary haemorrhage	2	1.1
3.8	Other	3	1.7
	Infection		
4.1	Bacterial	-	-
4.11	Congenital bacterial	-	-
4.112	Congenital bacterial: E. coli	3	1.7
4.118	Congenital bacterial: Other bacterial	2	1.1
4.119	Congenital bacterial: Unspecified bacterial	2	1.1
4.12	Acquired bacterial	-	-
4.121	Acquired bacterial: Group B Streptococcus	1	0.6
4.125	Acquired bacterial: Other gram negative bacilli (other than E. coli)	1	0.6
4.126	Acquired bacterial: Staphylococcus aureus	1	0.6
4.128	Acquired bacterial: Other specified bacterial	1	0.6

Neonatal death classification (PSANZ-NDC)		Neonatal deaths	
		n=178	
		n	%
	Infection		
4.2	Viral	-	-
4.21	Congenital viral	-	-
4.218	Congenital viral: Other specified viral	1	0.6
4.22	Acquired viral	-	-
4.223	Acquired viral: Herpes simplex virus	1	0.6
4.228	Acquired viral: Other specified viral	1	0.6
4.9	Unspecified organism	1	0.6
	Neurological		
5.1	Hypoxic ischaemic encephalopathy/Perinatal asphyxia (typically infants of >24 weeks gestation or >600g birthweight)	18	10.1
5.2	Intracranial haemorrhage	-	-
5.21	Intraventrical haemorrhage	6	3.4
5.8	Other	1	0.6
	Gastrointenstinal		
6.1	Necrotising enterocolitis	2	1.1
6.8	Other	1	0.6
	Other		
7.2	Multisystem failure	-	-
7.28	Multisystem failure: Other specified	1	0.6
7.29	Multisystem failure: Unspecified/Undetermined primary cause or trigger event	1	0.6
7.3	Trauma	-	-
7.31	Trauma: Accidental	3	1.7
7.8	Other specified	2	1.1
7.9	Unknown/Undetermined	2	1.1
7.91	Unclassified Sudden Infant Death	-	-
7.911	Unclassified Sudden Infant Death: Bed sharing	5	2.8

Appendix B: Summary of Key PMMRC Recommendations and Progress 2006–2012 Reports

Recommendation	Progress
Perinatal mortality	
1. Early booking	
All women should commence maternity care before 10 weeks. This enables: • opportunity to offer screening for congenital abnormalities, sexually transmitted infections, family violence and maternal mental health, with referral as appropriate • education around nutrition, smoking, alcohol and drug use and other at-risk behaviour • recognition of underlying medical conditions, with referral to secondary care as appropriate • identification of at-risk women (maternal age, obesity, maternal mental health problems, multiple pregnancy, socioeconomic deprivation, maternal medical conditions).	The Ministry is supporting all DHBs, through local Maternity Quality and Safety Programmes, to identify and implement actions to increase the number of women accessing primary maternity services in their first trimester. All DHBs are required in their 2013/14 Annual Plans to identify actions they will take to increase the number of women accessing primary maternity services in their first trimester. The National Maternity Monitoring Group, established as an advisory group to the Director General of Health, has identified timely registration with maternity services as one of their five priority areas, and has undertaken a number of actions to raise the profile of the importance of early booking and identify and share good practice examples and initiatives being undertaken by DHBs. Many DHBs have initiated media and social media campaigns, and recently the New Zealand College of Midwives, supported by the Ministry of Health, launched the 'Find Your Midwife' website which further supports women to find and book with an LMC. The TAHA Well Pacific Mothers & Infant Service has launched a smartphone app with information on pregnancy and parenting. This can be accessed at: *www.tapuaki.org.nz* The Ministry of Health is in the process of revising the DHB funded Pregnancy and Parenting Education service specifications to focus on providing information for pregnancy and parenting as well as education for targeted groups.
2. Teenage mothers (<20 years old)	
LMCs should be aware that teenage mothers are at increased risk of stillbirth and neonatal death due to preterm birth, fetal growth restriction and perinatal infection. Maternity services need to address this risk, paying attention to: • maternity care before 10 weeks • smoking cessation, prevention of preterm birth, screening for fetal growth restriction • antenatal education • undertaking research on the best model of care • engagement with the Ministry of Education regarding education in the school setting.	The review of the service specification for DHB funded Pregnancy and Parenting Education proposes to focus education and support more intensively on high needs and vulnerable pregnant women and families including teenage mothers. The Ministry is progressing work to support the Maternal Tobacco Health Target that seeks to ensure that 90 percent of pregnant women are provided brief advice and cessation support to help them quit smoking at first contact with primary maternity services. Most DHBs have comprehensive maternal tobacco cessation programmes and initiatives, some being specifically targeted to teen mothers. The Ministry is supporting all DHBs, through local Maternity Quality and Safety Programmes, to identify and implement actions to increase the number of women accessing primary maternity services in their first trimester. A particular focus for many DHBs is how to best engage specific populations including teen mothers.

Recommendation	Progress
Perinatal mortality	
3. Contributory factors and potentially avoidable perinatal deaths	
Key stakeholders providing health and social services to women at risk should work together and identify: • reasons for barriers to accessing maternity care • interventions to address barriers. Clinical services and clinicians have the following responsibilities: • continuing education • local review linked to quality improvement • up-to-date policies and guidelines that are implemented and audited • culture of teamwork • culture of practice reflection on patient outcomes linked to quality improvement • staff arrangements ensuring timely access to specialist services. Ministry of Health to develop a plan to translate these recommendations into clinical practice.	All DHBs have established local Maternity Quality and Safety Programmes. These bring together maternity stakeholders from DHBs, community-based clinicians and consumer representatives to identify local quality improvement priorities and undertake continuous quality improvement actions. These include development and dissemination of policies and guidelines, review of maternity data and outcomes, local clinical review and continuing education and workforce development. The Ministry of Health expects the PMMRC report recommendations to be disseminated through the professional networks created as part of the Maternity Quality and Safety Programme. The development of local quality improvement priorities and delivery of DHBs' Maternity Quality and Safety Programmes are being overseen and supported by the Ministry of Health and the National Maternity Monitoring Group.
4. Birth information	
Accurate, robust and timely clinical data on all pregnancies are important. A national perinatal database needs to be established so that perinatal mortality rates can be calculated and comparisons can be made between babies who die and those who survive the perinatal period.	The Ministry of Health supports national perinatal reporting and is supporting a number of informatics projects to enable better capture, reporting and use of perinatal outcomes data. The Ministry has worked with the PMMRC to provide data from the recently redeveloped maternity information system and is further developing this system to capture additional primary maternity data over the coming year.
The current birth registration dataset should be required to henceforth include maternity data critical to research (eg, parity, major complications, mode of birth, history of smoking and previous obstetric history).	The Ministry of Health's position is that the Births, Deaths and Marriages (BDM) birth registration process is not an appropriate system for collecting additional obstetric/maternal information, especially as it relies on the parents completing the birth registration form. The Ministry of Health already collects this information from hospitals and LMCs. The Ministry has worked with the PMMRC to provide data from the recently redeveloped maternity information system and is further developing this system to capture additional primary maternity data over the coming year.
All babies, whether stillborn or live born, should be assigned a National Health Index (NHI) at the time of birth.	Stillborn babies are given an NHI in 18 of 20 DHBs.
Continued support and funding is required for DHBs and LMCs for collection of complete perinatal mortality statistics.	The Ministry continues to support and fund DHBs and LMCs in their reporting of mortality data and collection of complete perinatal mortality statistics.
Possible causes for the increase in perinatal related death of babies born to Pacific women, Māori women, women under the age of 20 or 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.	The Ministry has commissioned research into barriers to accessing maternity services in South Auckland and Porirua. This information has been shared with the review of maternity services carried out by Counties Manukau DHB (see below) and is informing projects aimed at the integration of maternity, well child and primary health services.

Recommendation	Progress
Perinatal mortality	
5. DHB disparities	
Further research is warranted to understand the higher rate of perinatal related mortality in the Counties Manukau region.	An independent review was commissioned by Counties Manukau DHB of the excess perinatal related mortality in the region and published in late 2012. A copy of this report can be obtained at: *http://www.countiesmanukau.health.nz/About_CMDHB/Accountability/Reports/report-external-maternitycare-review.pdf* This is an ongoing process of quality improvement.
6. Ethnicity	
New legislation should enable BDM to accept NHI data and update the routine NHI dataset with regard to ethnicity.	Progressing Memorandums of Understanding between BDM and the Ministry of Health has been proposed as one solution. This will be progressed further in the coming year.
Clinicians and LMCs should be encouraged to collect accurate ethnicity details at the time of booking.	This is a focus of a number of DHBs' Maternity Quality and Safety Programmes with regard to improving data collection and addressing inequalities. The development of a nationwide Maternity Clinical Information System for DHBs should assist with standardising ethnicity data.
7. Access to care	
The Ministry of Health, DHBs and professional colleges should collaboratively explore barriers to early booking with a view to increase the number of women who book with an LMC before 10 weeks gestation. A national media campaign should be considered.	Research into barriers to access is being undertaken by a number of DHBs as part of local Maternity Quality and Safety Programmes and in response to the National Maternity Monitoring Group selecting timely registration with primary maternity services as a priority in 2012–13. Media and social media activities are underway in a number of DHBs as part of local Maternity Quality and Safety Programmes. Local innovations and resources with regard to early booking and access to care are being shared with all DHBs through national networks. The New Zealand College of Midwives, supported by the Ministry of Health, launched the 'Find Your Midwife' website which further supports women to find and book with an LMC.
Strategies to improve awareness of antenatal care services and increase access among women who are isolated for social, cultural or language reasons should be developed.	As per previous comments regarding activities being undertaken by DHBs as part of local Maternity Quality and Safety Programmes.
Clinicians and LMCs should be aware that Pacific women, Māori women, women under 20 or over 40 years of age and those women who live in areas of high socioeconomic deprivation are at higher risk of a perinatal death.	The Ministry of Health expects that this recommendation will be distributed and discussed within each DHB's Maternity Quality and Safety Programme.

Recommendation	Progress
Perinatal mortality	
8. Smoking cessation	
All health professionals who provide care to pregnant women should offer smoking cessation advice.	It is intended that information about advice to quit will be collected at the point of booking into a maternity facility and will feed into the National Maternity Clinical Information System. The Ministry is progressing work to support the Maternal Tobacco Health Target that seeks to ensure that 90 percent of pregnant women are provided brief advice and cessation support to help them quit smoking at first contact with primary maternity services. Most DHBs have comprehensive maternal tobacco cessation programmes and initiatives. Maternal tobacco use is a priority of the National Maternity Monitoring Group, who has worked with the Ministry of Health in 2012–13 to analyse maternal tobacco use and support the implementation of the Maternal Tobacco Health Target.
9. Screening for gestational diabetes, smoking and family violence	
LMCs should follow the Ministry of Health pregnancy guidelines for: • diabetes screening • smoking cessation • family violence screening. Screening for family violence should be a routine part of maternity care and documented.	Promotion of smoking cessation is a national health priority and a priority of the National Maternity Monitoring Group. The Ministry is developing evidence-based guidelines for the screening, diagnosis and management of gestational diabetes in New Zealand. Once completed, these will be implemented by all DHBs as part of their Maternity Quality and Safety Programmes. The PMMRC will be collaborating with the Family Violence Death Review Committee to further identify strategies to improve screening for family violence in the maternity setting. It is expected that LMCs screen for family violence and all DHBs have in place screening for family violence when people are admitted to hospital.
10. Multiple pregnancies	
All women with a multiple pregnancy should be offered an early specialist consultation, including ultrasound diagnosis of chorionicity prior to 14 weeks gestation. Women with high-risk monochorionic multiple pregnancies require fortnightly scans and specialist care.	Advice is available through the New Zealand Maternal Fetal Medicine Network. The care of multiple pregnancies was the subject of a further recommendation (2) in the seventh annual PMMRC report in 2013. This recommendation should be distributed and discussed within each DHB's Maternity Quality and Safety Programme.
11. Detection of fetal growth restriction	
Height and weight should be measured at the first antenatal visit, and a customised growth chart, GROW (*www.gestation.net*), should be used to record fundal height to improve the recognition of SGA infants. If SGA is confirmed by ultrasound at term, timely delivery is recommended.	Some obstetric databases have included the GROW program for use by clinicians. This recommendation should be distributed and discussed within each DHB's Maternity Quality and Safety Programme.

Recommendation	Progress
Perinatal mortality	
12. Antepartum haemorrhage	
All women with bleeding during pregnancy, regardless of the apparent cause, should be monitored more closely for fetal growth and preterm birth.	This recommendation should be distributed and discussed within each DHB's Maternity Quality and Safety Programme.
13. Maternal gestational weight gain	
Pregnant women should be given an indication of ideal weight gain in pregnancy according to their BMI.	The Ministry of Health is developing evidence-based guidelines for weight management in pregnancy. This is also being addressed by the Ministry of Health's review of DHB funded Pregnancy and Parenting Education and obesity policy development.
14. Sudden unexpected death in infancy (SUDI)	
National guidelines should be developed for safe sleeping arrangements in postnatal wards to improve ward safety and to model safe sleeping practices that parents can follow after discharge.	The Ministry of Health published guidance on observation of mother and baby in the immediate postpartum in 2012. This guidance supports safe sleeping in postnatal wards. Further guidance for safe sleeping policies has been developed and is available for all DHBs via Change for Our Children.
The Ministry of Health should prioritise the preparation and dissemination of a comprehensive statement for parents and caregivers on risk factors and methods of prevention of SUDI to be provided to pregnant women.	The Ministry has funded a national SUDI prevention toolkit for DHBs and health practitioners, with a particular focus on supporting vulnerable families at higher risk of SUDI. This has been contracted to Whakawhetu. Updated information on SUDI prevention has also been incorporated into the redevelopment of the *Well Child/ Tamariki Ora Practitioner Handbook*, nearing completion, and the parent-held *Well Child Health Book*, reviewed in 2012.
15. Access to perinatal investigation and supporting parents	
The Ministry of Health should require DHBs to ensure all providers of maternity services provide support to parents, families and whānau who have experienced perinatal and maternal loss, including providing access to information, counselling and clinical follow-up.	Funding is secured for the ongoing production of Stillbirth and Newborn Death Support (Sands) material. The secondary maternity services specification requires funding of 'social work' services, but these are not specified. These specifications are finalised and all DHBs are required to implement them.
The low uptake of post-mortems amongst families who experience perinatal loss should be investigated.	This issue was investigated during the Ministry of Health's Review of the Regulation of Human Tissue and Tissue-based Therapies in 2004. Public opinions of human tissue were explored as part of submissions received on this review. Reasons for low uptake of human tissue investigation among some populations included the need to involve both immediate and wider family in the consent process and the desire to have the body intact for burial.
The reasons for the difference in rates of optimally investigated perinatal deaths between DHBs needs investigation.	Part of the reason for differences in rates of optimally investigated perinatal deaths between DHBs is regional shortages of perinatal pathologists. Paediatric pathology is one of the services currently being considered by the National Health Board for national planning and funding. Rates of investigated deaths will be considered once planning and funding arrangements for paediatric pathology have been determined.

Recommendation	Progress
Perinatal mortality	
16. Neonatal encephalopathy	
Arterial and venous cord gases should be performed on all babies born with an Apgar <7 at one minute. 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. All babies with moderate or severe neonatal encephalopathy should undergo a formal neurological examination and have the findings clearly documented prior to discharge.	These recommendations should be distributed and discussed within each DHB's Maternity Quality and Safety Programme.
Maternal mortality	
17. Maternal information	
Support is required for national reporting of maternal deaths.	A tick box has been added to the death certificate indicating that the deceased was pregnant or had been pregnant within the last 42 days. All maternal deaths must be reported to Coronial Services.
Improved communication between primary and secondary services is required. A variety of means should be used such as women-held maternity notes, integrated notes systems and electronic transfer of information.	The National Health IT Board is progressing this recommendation through the development and roll out of a nationally standardised Maternity Clinical Information System, which will support more consistent and comprehensive data capture by DHBs and support better communication between primary and secondary care through the use of 'shared view' of the maternity information available to primary care, primary maternity and women receiving maternity care.
Pregnant women who are identified with pre-existing medical disease during pregnancy should be referred appropriately.	This is reflected in the referral guidelines for LMCs. A further recommendation (6) was added to the seventh annual PMMRC report.
18. Seatbelts during pregnancy	
There is a need for greater public awareness of the importance of wearing a seatbelt during pregnancy. All pregnant women should know that three-point seatbelts should be worn throughout pregnancy, with the lap strap placed as low as possible beneath the 'bump', lying across the thighs, and the diagonal shoulder strap placed above the 'bump', lying between the breasts.	A poster has been developed and distributed through DHBs.
19. Maternal mental health	
Maternal mental health services should be integrated into maternity services.	The Ministry supports the recommendation that maternal mental health services be integrated into maternity services. This is in line with best practice. The Ministry has developed perinatal and infant mental health guidance *(Healthy Beginnings)* that is consistent with this recommendation. It proposes collaboration across maternal health, child health and mental health.
Clinicians and LMCs should be encouraged to conduct antenatal screening and document any mental health history to identify women who are at increased risk of mental illness.	The Ministry of Health intends to forward this recommendation to the professional colleges and the National Screening Advisory Committee for additional advice.

Recommendation	Progress
Maternal mortality	
19. Maternal mental health	
Access should be provided to a mother and baby unit in the North Island. Women with a previous history of serious affective disorder or other psychoses should be referred for psychiatric assessment and management even if well. Clinicians are reminded that the most common cause of maternal death in New Zealand is suicide.	This recommendation is supported by the Ministry of Health publication *Healthy Beginnings: Developing Perinatal and Infant Mental Health Services in New Zealand.* Budget 2013 put an extra $18.2 million over four years into dedicated maternal mental health beds and new specialist community services around the North Island for around 650 mothers and their babies a year.
The committee notes the publication of the *Healthy Beginnings* report in January 2012 and supports the recommendations with particular regard to the establishment of mother and baby units in the North Island and the importance of screening for a history of mental health disorders. 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. Termination of pregnancy services should undertake holistic screening for maternal mental health and family violence and provide appropriate support and referral.	See above.
20. Team approach to care	
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. Pregnant women who are admitted to hospital for medical conditions not related to pregnancy need to have specific pathways for perinatal care.	This recommendation should be distributed and discussed within each DHB's Maternity Quality and Safety Programme.
21. Hypertension in pregnancy	
Healthcare practitioners should follow the evidence-based management of hypertension in pregnancy recommended by the Society of Obstetric Medicine of Australia and New Zealand.	This can be found at *http://www.somanz.org/pdfs/somanz_guidelines_2008.pdf* This item was raised again in section 2 in the seventh annual PMMRC report in 2013.
22. Postpartum haemorrhage	
Acute obstetric units should develop a massive transfusion protocol to respond to major obstetric haemorrhage.	A national guideline for the treatment of postpartum haemorrhage has been finalised and distributed to professional colleges and DHBs. This can be accessed at: *http://www.health.govt.nz/publication/national-consensus-guideline-treatment-postpartum-haemorrhage.* This recommendation should be distributed and discussed within each DHB's Maternity Quality and Safety Programme.

Recommendation	Progress
Maternal mortality	
23. Emergency obstetric training	
All staff involved in care of pregnant women should undertake regular training in management of obstetric emergencies.	The Midwifery Council of New Zealand requires that midwives attend training in resuscitation annually and training in management of obstetric emergencies every three years. At DHB level, 'skills and drills' sessions take place for all practitioners. A number of DHBs are supporting DHB and community-based clinicians to attend multidisciplinary emergency obstetric training programmes such as Practical Obstetric Multiprofessional Training.
24. Pandemic influenza (A) H1N1	
Pregnant women should be immunised against influenza. Pregnant women should consult their LMC as soon as symptoms of an influenza-like illness develop or if other family members are unwell, to allow referral and prescription of antiviral medication.	Immunisation against influenza for pregnant women is available free of charge. Influenza immunisation promotion has included specific promotion to pregnant women.

Appendix C: Classifications of the Perinatal Society of Australia and New Zealand (PSANZ 2009)

PSANZ Perinatal mortality classification

PSANZ perinatal death classification (PSANZ-PDC)

1. Congenital abnormality (including terminations for congenital abnormalities)

- 1.1 Central nervous system
- 1.2 Cardiovascular system
- 1.3 Urinary system
- 1.4 Gastrointestinal system
- 1.5 Chromosomal
- 1.6 Metabolic
- 1.7 Multiple/non-chromosomal syndromes
- 1.8 Other congenital abnormality
  - 1.81 Musculoskeletal
  - 1.82 Respiratory
  - 1.83 Diaphragmatic hernia
  - 1.84 Haematological
  - 1.85 Tumours
  - 1.88 Other specified congenital abnormality
- 1.9 Unspecified congenital abnormality

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
  - 2.28 Other viral
  - 2.29 Unspecified viral
- 2.3 Protozoal (eg, Toxoplasma)

2.5 Fungal

2.8 Other specified organism

2.9 Other unspecified organism

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

3.51 With laboratory evidence of thrombophilia

3.6 Pre-eclampsia superimposed on chronic hypertension

3.61 With laboratory evidence of thrombophilia

3.9 Unspecified hypertension

4. Antepartum haemorrhage (APH)

4.1 Placental abruption

4.11 With laboratory evidence of thrombophilia

4.2 Placenta praevia

4.3 Vasa praevia

4.8 Other APH

4.9 APH of undetermined origin

5. Maternal conditions

5.1 Termination of pregnancy for maternal psychosocial indications

5.2 Diabetes/Gestational diabetes

5.3 Maternal injury

5.31 Accidental

5.32 Non-accidental

5.4 Maternal sepsis

5.5 Antiphospholipid syndrome

5.51 Other maternal thrombophilia (if considered cause of death)

5.6 Obstetric cholestasis

5.8 Other specified maternal conditions

6. Specific perinatal conditions

6.1 Twin–twin transfusion

6.2 Fetomaternal haemorrhage

6.3 Antepartum cord complications

6.31 Cord haemorrhage

6.32 True knot with evidence of occlusion

6.38 Other

6.39 Unspecified

6.4 Uterine abnormalities (eg, bicornuate uterus, cervical incompetence)

6.5 Birth trauma (typically infants of >24 weeks gestation or >600g birthweight)

6.6 Alloimmune disease

6.61 Rhesus

6.62 ABO

6.63 Kell

6.64 Alloimmune thrombocytopenia

6.68 Other

6.69 Unspecified

6.7 Idiopathic hydrops

6.8 Other specific perinatal conditions

6.81 Rupture of membranes after amniocentesis

6.82 Termination of pregnancy for suspected but unconfirmed congenital abnormality

6.83 Fetal subdural haematoma

6.88 Other

6.89 Unspecified

7. Hypoxic peripartum death (typically infants of >24 weeks gestation or >600g birthweight)

7.1 With intrapartum complications

7.11 Uterine rupture

7.12 Cord prolapse

7.13 Shoulder dystocia

7.18 Other

7.2 Evidence of non-reassuring fetal status in a normally grown infant (eg, abnormal fetal heart rate, fetal scalp pH/lactate, fetal pulse oximetry without intrapartum complications)

7.3 No intrapartum complications and no evidence of non-reassuring fetal status.

7.9 Unspecified hypoxic peripartum death

8. Fetal growth restriction (FGR)

8.1 With evidence of reduced vascular perfusion on Doppler studies and/or placental histopathology (eg, significant infarction, acute atherosis, maternal and/or fetal vascular thrombosis or maternal floor infarction)

8.2 With chronic villitis

8.3 No placental pathology

8.4 No examination of placenta

8.8 Other specified placental pathology

8.9 Unspecified or not known whether placenta examined

9. Spontaneous preterm (<37 weeks gestation)

- 9.1 Spontaneous preterm with intact membranes or membrane rupture <24 hours before delivery
  - 9.11 With chorioamnionitis confirmed on placental histopathology
  - 9.12 Without chorioamnionitis on placental histopathology
  - 9.13 With clinical evidence of chorioamnionitis, no examination of placenta
  - 9.17 No clinical signs of chorioamnionitis, no examination of placenta
  - 9.19 Unspecified or not known whether placenta examined
- 9.2 Spontaneous preterm with membrane rupture 24 hours before delivery
  - 9.21 With chorioamnionitis confirmed on placental histopathology
  - 9.22 Without chorioamnionitis on placental histopathology
  - 9.23 With clinical evidence of chorioamnionitis, no examination of placenta
  - 9.27 No clinical signs of chorioamnionitis, no examination of placenta
  - 9.29 Unspecified or not known whether placenta examined
- 9.3 Spontaneous preterm with membrane rupture of unknown duration before delivery
  - 9.31 With chorioamnionitis confirmed on placental histopathology
  - 9.32 Without chorioamnionitis on placental histopathology
  - 9.33 With clinical evidence of chorioamnionitis, no examination of placenta
  - 9.37 No clinical signs of chorioamnionitis, no examination of placenta
  - 9.39 Unspecified or not known whether placenta examined

10. Unexplained antepartum death

- 10.1 With evidence of reduced vascular perfusion on Doppler studies and/or placental histopathology (eg, significant infarction, acute atherosis, maternal and/or fetal vascular thrombosis or maternal floor infarction)
- 10.2 With chronic villitis
- 10.3 No placental pathology
- 10.4 No examination of placenta
- 10.8 Other specified placental pathology
- 10.9 Unspecified or not known whether placenta examined

11. No obstetric antecedent

- 11.1 Sudden infant death syndrome (SIDS)
  - 11.11 SIDS Category IA: classic features of SIDS present and completely documented
  - 11.12 SIDS Category IB: classic features of SIDS present but incompletely documented
  - 11.13 SIDS Category II: infant deaths that meet Category I except for one or more features
- 11.2 Postnatally acquired infection
- 11.3 Accidental asphyxiation
- 11.4 Other accident, poisoning or violence (postnatal)
- 11.8 Other specified
- 11.9 Unknown/Undetermined
  - 11.91 Unclassified sudden infant death
  - 11.92 Other unknown/undetermined

PSANZ neonatal death classification (PSANZ-NDC)

1. Congenital abnormality (including terminations for congenital abnormalities)

- 1.1 Central nervous system
- 1.2 Cardiovascular system
- 1.3 Urinary system
- 1.4 Gastrointestinal system
- 1.5 Chromosomal
- 1.6 Metabolic
- 1.7 Multiple/Non-chromosomal syndromes
- 1.8 Other congenital abnormality
  - 1.81 Musculoskeletal
  - 1.82 Respiratory
  - 1.83 Diaphragmatic hernia
  - 1.84 Haematological
  - 1.85 Tumours
  - 1.88 Other specified congenital abnormality
- 1.9 Unspecified congenital abnormality

2. Extreme prematurity (typically infants of ≤24 weeks gestation or ≤600g birthweight)

- 2.1 Not resuscitated
- 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 Chronic neonatal lung disease (typically, bronchopulmonary dysplasia)
- 3.6 Pulmonary haemorrhage
- 3.7 Pneumothorax
- 3.8 Other

4. Infection

- 4.1 Bacterial
  - 4.11 Congenital bacterial
    - 4.111 Group B Streptococcus
    - 4.112 E. coli
    - 4.113 Listeria monocytogenes

4.114 Spirochaetal (eg, syphilis)

4.118 Other bacterial

4.119 Unspecified bacterial

4.12 Acquired bacterial

4.121 Group B Streptococcus

4.122 E. coli

4.125 Other Gram-negative bacilli (other than E. coli)

4.126 Staphylococcus aureus

4.127 Coagulase negative Staphylococcus

4.128 Other specified bacterial

4.129 Unspecified bacterial

4.2 Viral

4.21 Congenital viral

4.211 Cytomegalovirus

4.213 Herpes simplex virus

4.214 Rubella virus

4.218 Other specified viral

4.219 Unspecified viral

4.22 Acquired viral

4.221 Cytomegalovirus

4.223 Herpes simplex virus

4.224 Rubella virus

4.228 Other specified viral

4.229 Unspecified viral

4.3 Protozoal (eg, Toxoplasma)

4.5 Fungal

4.8 Other

4.9 Unspecified organism

5. Neurological

5.1 Hypoxic ischaemic encephalopathy/Perinatal asphyxia (typically infants of >24 weeks gestation or >600g birthweight)

5.2 Intracranial haemorrhage

5.21 Intraventricular haemorrhage

5.22 Subgaleal haemorrhage

5.23 Subarachnoid haemorrhage

5.24 Subdural haemorrhage

5.28 Other intracranial haemorrhage

5.8 Other

6. Gastrointestinal

- 6.1 Necrotising enterocolitis
- 6.8 Other

7. Other

- 7.1 Sudden infant death syndrome (SIDS)
  - 7.11 SIDS Category IA: classic features of SIDS present and completely documented
  - 7.12 SIDS Category IB: classic features of SIDS present but incompletely documented
  - 7.13 SIDS Category II: infant deaths that meet Category I except for one or more features
- 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
- 7.8 Other specified
- 7.9 Unknown/Undetermined
  - 7.91 Unclassified sudden infant death
    - 7.911 Bed sharing
    - 7.912 Not bed sharing
  - 7.92 Other unknown/undetermined

Appendix D: PMMRC Classification of Contributory Factors and Potential Avoidability (2012 version)

Systems review – contributory factors

Contributory factors may be highly specific to the death or generalised to the system(s). Identifying contributory factors that occur and are inherent in the system is an important part of the review. These factors are commonly sub-classified into organisational/management, personnel and those relating to barriers to access and/or engagement in care.

Please read options below and select if any of the following were present

Have any organisational and/or management factors been identified? **Yes** ☐ **No** ☐
(eg, inadequate supervision of staff, lack of appropriate clinical management protocols or guidelines, lack of communication between services)

If 'yes' please classify – select ALL relevant:

- poor organisational arrangements of staff ☐
- inadequate education and training ☐
- lack of policies, protocols or guidelines ☐
- inadequate numbers of staff ☐
- poor access to senior clinical staff ☐
- failure or delay in emergency response ☐
- delay in procedure (eg, caesarean section) ☐
- delayed access to test results or inaccurate results ☐
- equipment (eg, faulty equipment, inadequate maintenance, quality of or lack of equipment) ☐
- building and design functionality (eg, space, privacy, ease of access, lighting, noise, power failure, operating theatre in distant location) ☐
- other – if other please state or provide any comments: ☐

Have factors relating to personnel been identified? **Yes** ☐ **No** ☐
(eg, staff factors relating to professional care and service provision)

If 'yes' please classify – select ALL relevant:

- knowledge and skills of staff were lacking ☐
- delayed emergency response by staff ☐
- failure to maintain competence ☐
- communication between staff was inadequate ☐
- failure to seek help/supervision ☐
- failure to follow recommended best practice ☐
- lack of recognition of complexity or seriousness of condition by caregiver ☐
- other – if other please state or provide any comments: ☐

Have barriers to access and/or engagement with care been identified? **Yes** ☐ **No** ☐
(eg, no, infrequent or late booking for antenatal care, woman declined treatment/advice)

If 'yes' please classify – select ALL relevant:

- no antenatal care ☐
- infrequent care or late booking ☐
- declined treatment or advice ☐
- obesity impacted on delivery of optimal care (eg, ultrasound scan) ☐
- substance use ☐
- family violence ☐
- lack of recognition by the woman or family of the complexity or seriousness of condition ☐
- maternal mental illness ☐
- cultural barriers ☐
- language barriers ☐
- not eligible to access free care ☐
- environment (eg, isolated, long transfer, weather prevented transport) ☐
- other – if other, please state or provide any comments: ☐

Was this death potentially avoidable? **Yes** ☐ **No** ☐

Complete this after considering the selected contributory factors above.

If 'yes', the absence of which contributory factor(s) might have meant the death was avoidable?

- organisation and/or management ☐
- personnel ☐
- barriers to access and/or engagement with care ☐

Name of person completing this form:

Contact person for additional information:

Phone number:

Signed:

Date:

Appendix E: PMMRC DHB Local Coordinators (April 2014)

DHB	DHB Local Coordinator	Contact details
Northland	**Yvonne Morgan** *Clinical Charge Midwife* **Kristy Wolff** *Obstetrician*	Whangarei Hospital
Waitemata	**Dr Sue Belgrave** *Clinical Director of Obstetrics* **Claire Shears** *Midwife* **Sharon Williams** *Midwife* **Carol Chamley** *Midwife*	North Shore Hospital Waitakere Hospital
Auckland	**Professor Lesley McCowan** *Obstetrician* **Teresa Krishnan** *Midwife* **Claire McLintock** *Obstetric Physician (AMOSS)*	Auckland City Hospital
Counties Manukau	**Dr Sarah Wadsworth** *Obstetrician* **Dr Graeme Parry** *Obstetrician* **Debbie Davies** *Midwife*	Middlemore Hospital
Waikato	**Dr Alastair Haslam** *Obstetrician* **Sarah Waymouth** *Obstetrician* **Phil Weston** *Paediatrician* **Pauline Martyn** *Midwife* **Tracey Williams** *Midwife*	Waikato Hospital
Bay of Plenty	**Margret Norris** *Midwife Leader*	Tauranga Hospital
Lakes	**Amanda Griffiths** *Midwife*	Rotorua Hospital
Tairawhiti	**Sheila Noakes** *Midwife* **Tiziana Manea** *Midwife*	Gisborne Hospital
Taranaki	**Finola Mooney** *Midwife* **Belinda Chapman** *Midwife*	Taranaki Base Hospital
Hawke's Bay	**Dr Lynda Croft** *Obstetrician* **Sara Paley** *Midwifery Educator*	Hawke's Bay Hospital
Whanganui	**Lucy Pettit** *Midwife* **Robyn McDougal** *Midwife*	Whanganui Hospital
Midcentral	**Billie Bradford** *Midwife Educator* **Dr Steven Grant** *Consultant Obstetrician*	Palmerston North Hospital
Wairarapa	**Michelle Thomas** *Midwife*	Masterton Hospital
Capital & Coast	**Dr Rose Elder** *Consultant Obstetrician* **Hazel Irvine** *Midwife*	Wellington Hospital
Hutt Valley	**Joanne McMullan** *Midwife*	Hutt Hospital
Nelson Marlborough	**Lois McTaggart** *Clinical Midwife Leader*	Nelson Hospital
West Coast	**Erica Lobb** *Midwife*	Grey Base Hospital
Canterbury	**Dianne Leishman** *Midwife* **Sonya Matthews** *Midwife*	Christchurch Women's Hospital
South Canterbury	**Dr John Weir** *Obstetrician* **Julie Dockrill** *Midwife Manager*	Timaru Hospital
Southern	**Helen Flockton** *Charge Midwife* **Dr Helen Patterson** *Obstetrician* **Jenny Humphries** *Director of Nursing and Midwifery* **Mel Rackham** *Midwife*	Dunedin Hospital Southland Hospital

List of Abbreviations

ACC	Accident Compensation Corporation
AFI	Amniotic fluid index
AMOSS	Australasian Maternity Outcomes Surveillance System
APH	Antepartum haemorrhage
BDM	Births, Deaths and Marriages
BMI	Body mass index (kg/m^2)
CEMACH	Confidential Enquiry into Maternal and Child Health
CI	Confidence interval
CMACE	Centre for Maternal and Child Enquiries
CTG	Cardiotocography
DHB	District Health Board
ECV	External cephalic version
EEG	Electroencephalography
FGR	Fetal growth restriction
FSH	Follicle-stimulating hormone
GP	General practitioner
ICSI	Intracytoplasmic sperm injection
IVF	In vitro fertilisation
LMC	Lead maternity carer
MAT	New Zealand National Maternity Collection
MMR	Maternal mortality ratio
MMRWG	Maternal Mortality Review Working Group
MRI	Magnetic resonance imaging
NE	Neonatal encephalopathy
NEWG	Neonatal Encephalopathy Working Group
NHI	National Health Index
NICE	National Institute for Health and Care Excellence, UK
NMDS	National Minimum Dataset
NZDep	New Zealand Index of Deprivation score
NZHIS	New Zealand Health Information Services (now Analytical Services, Ministry of Health)
NZPSU	New Zealand Paediatric Surveillance Unit
OR	Odds ratio
PMMRC	Perinatal and Maternal Mortality Review Committee
PPH	Postpartum haemorrhage

PSANZ	Perinatal Society of Australia and New Zealand
PSANZ-NDC	PSANZ neonatal death classification
PSANZ-PDC	PSANZ perinatal death classification
RANZCOG	Royal Australasian and New Zealand College of Obstetricians and Gynaecologists
RDS	Respiratory distress syndrome
RHD	Rheumatic heart disease
Sands	Stillbirth and Newborn Death Support
SGA	Small for gestational age
SIDS	Sudden infant death syndrome
SUDI	Sudden unexpected death in infancy
UK	United Kingdom
USS	Ultrasound scan
VBAC	Vaginal birth after caesarean
WHO	World Health Organization

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He matenga ohorere, he wairua uiui, wairua mutungakore

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