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

Introduction

Neonatal encephalopathy (NE) is a clinically defined syndrome of disturbed neurological function within the first week after birth in an infant born from 35 weeks' gestation, manifested by difficulty in initiating and maintaining respiration, depression of tone and reflexes, subnormal level of consciousness and often seizures. The severity of the encephalopathy is measured by the Sarnat stages 1, 2 or 3 or as mild, moderate or severe.[45]

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

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

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

[46] Includes two late notifications.

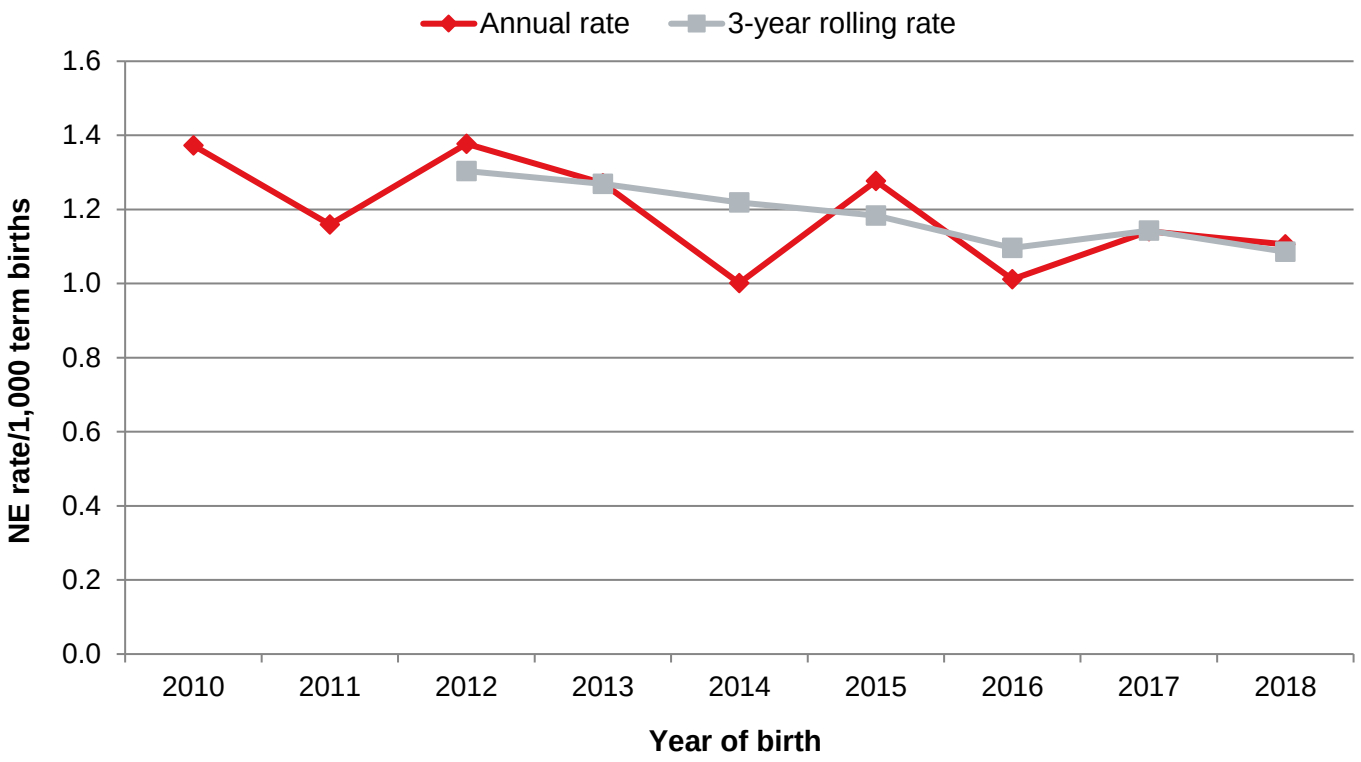
[47] Information on late notifications is not presented in the remainder of the chapter.

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

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

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

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



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

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

International comparisons

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

Findings

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

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

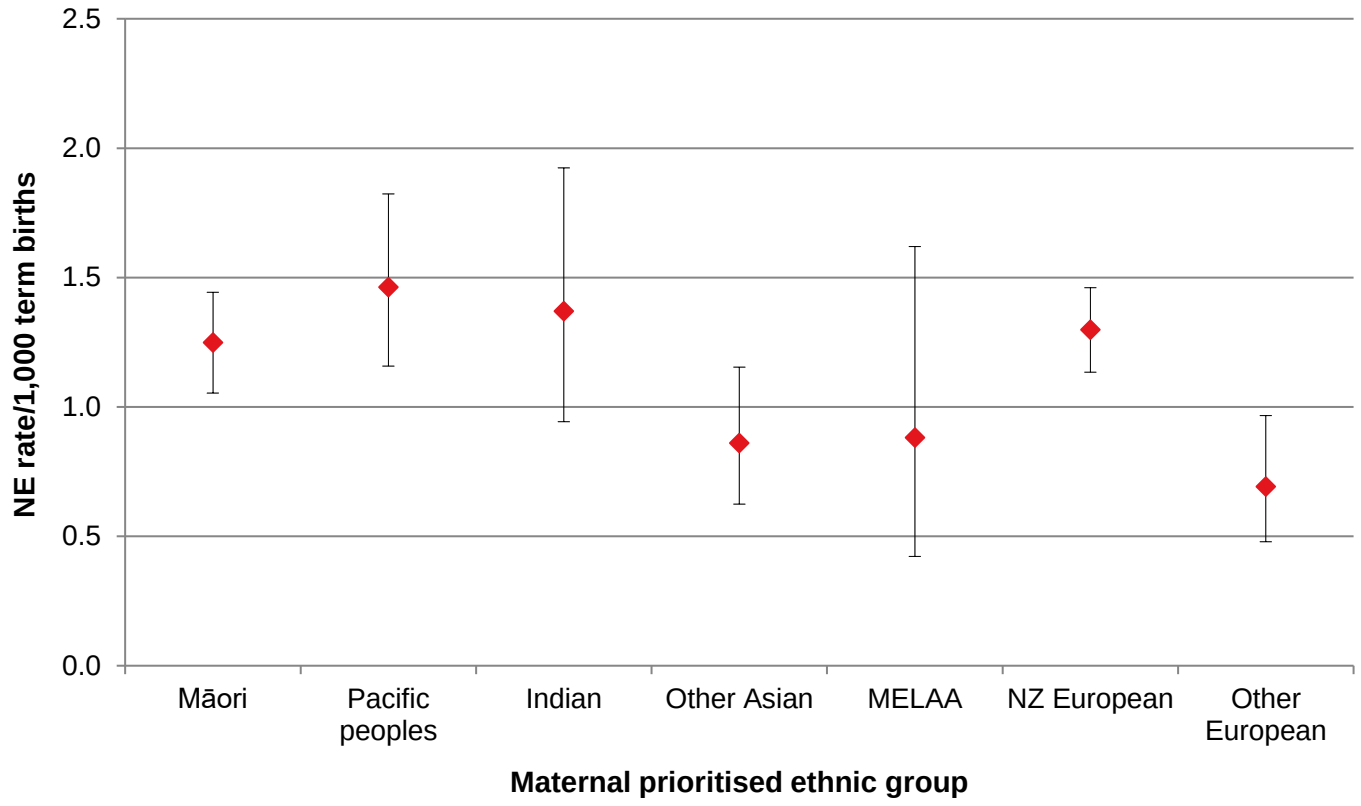
NE rates varied substantially by NZDep2013 quintile. Babies whose mothers lived in quintiles 2 to 5 were statistically significantly more likely to develop NE than those living in quintile 1[53] (Figure 4.3 and Table 4.11).

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

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

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

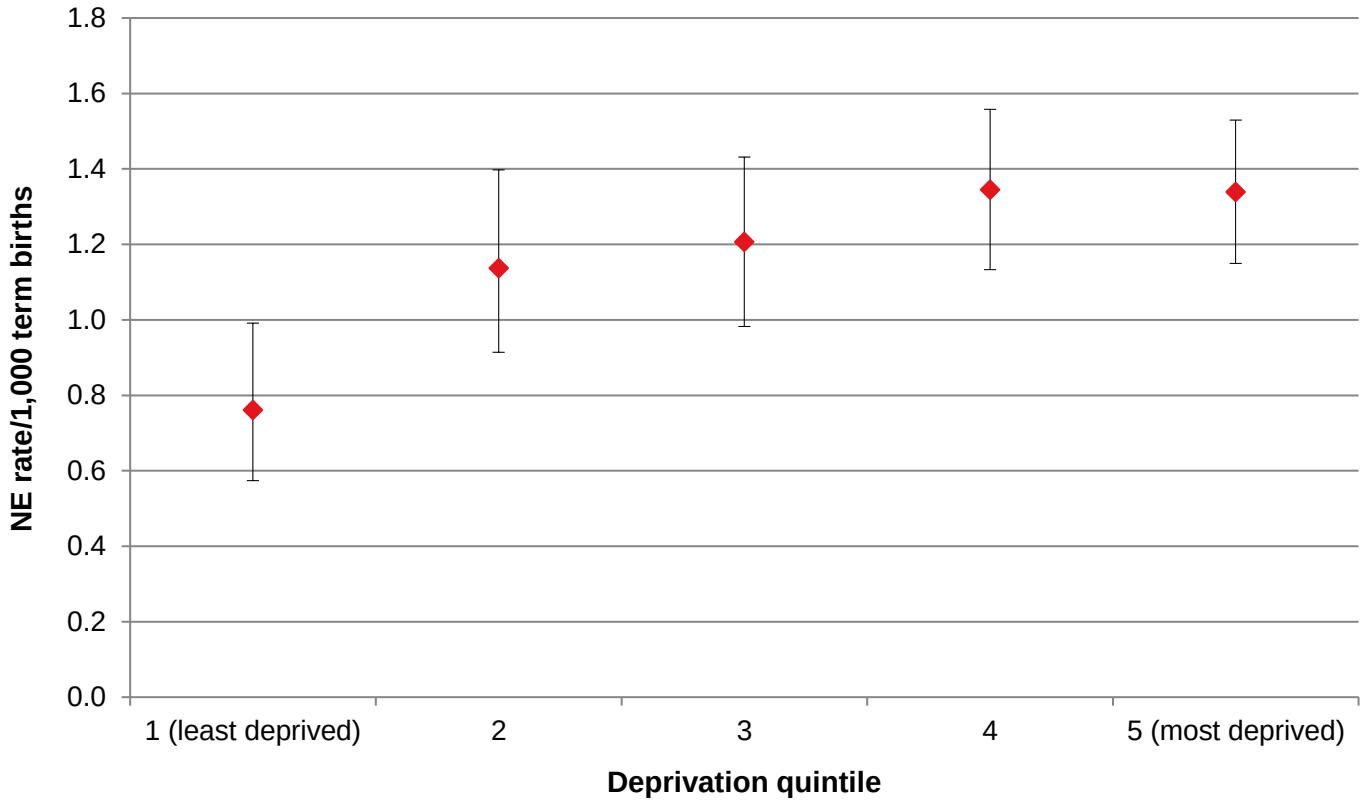
Figure 4.2: NE rates (per 1,000 term births, with 95% CIs) by maternal prioritised ethnic group 2010–2018



MELAA = Middle Eastern, Latin American, or African.

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

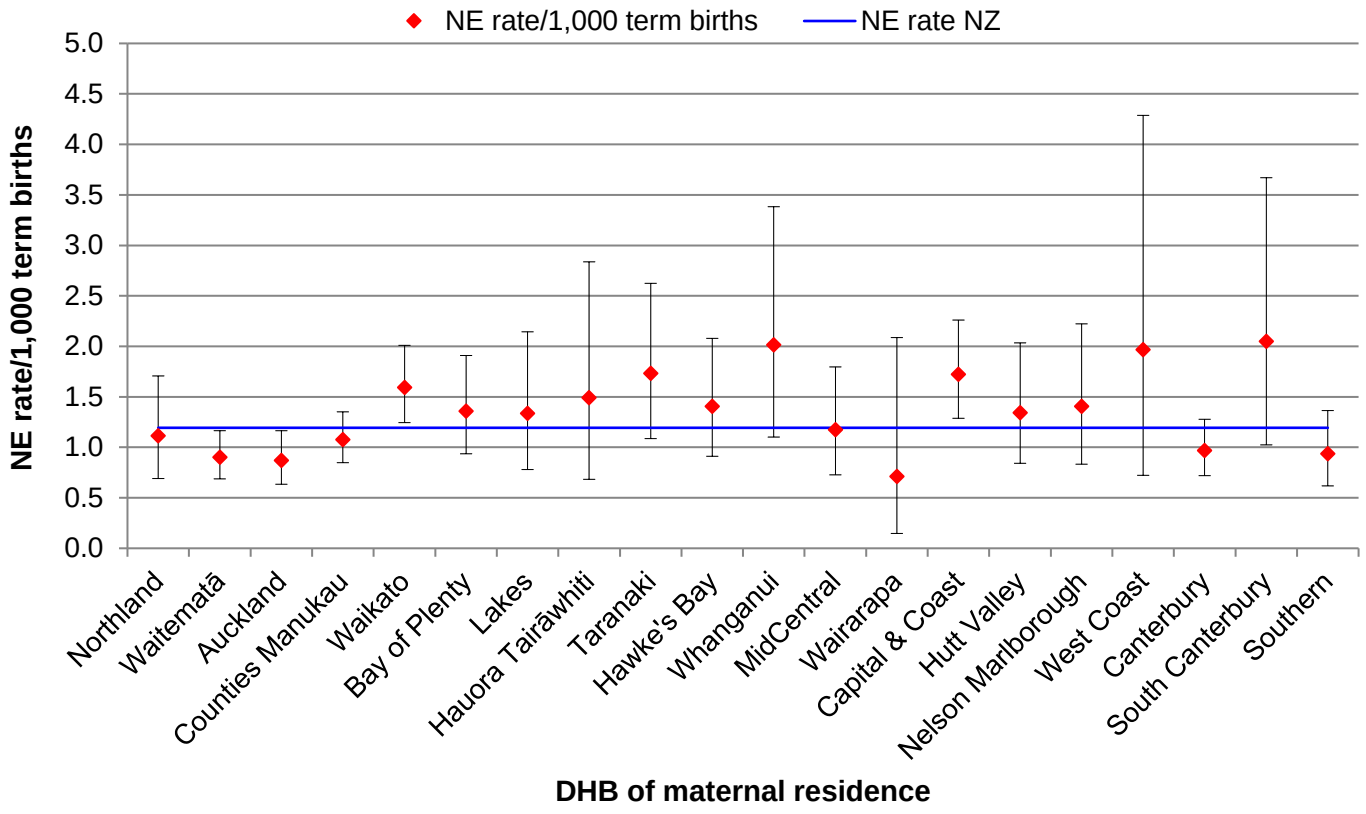
Figure 4.3: NE rates (per 1,000 term births, with 95% CIs) by NZDep quintile 2010–2018



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

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

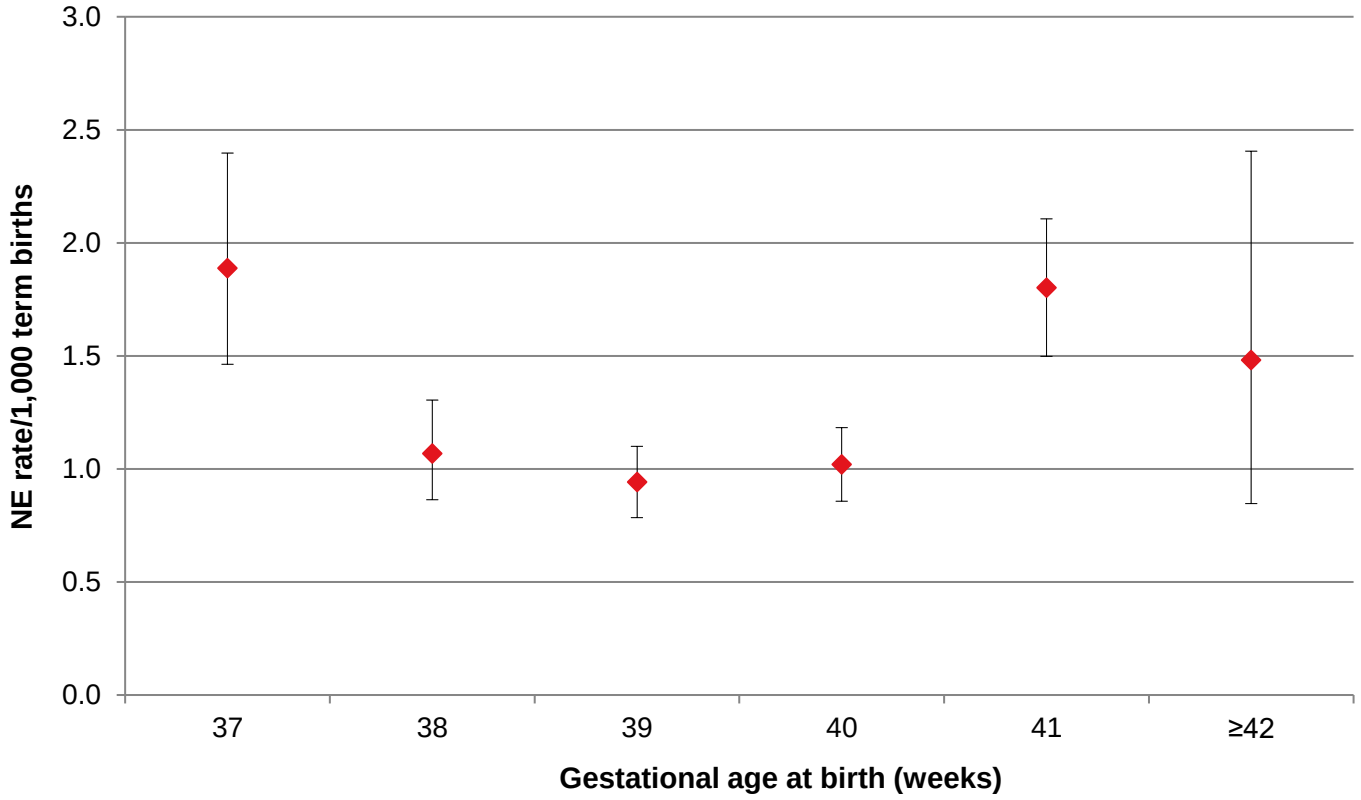
Figure 4.4: NE rates (per 1,000 term births, with 95% CIs) by DHB of maternal residence (compared with New Zealand NE rate) 2010–2018



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

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

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



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

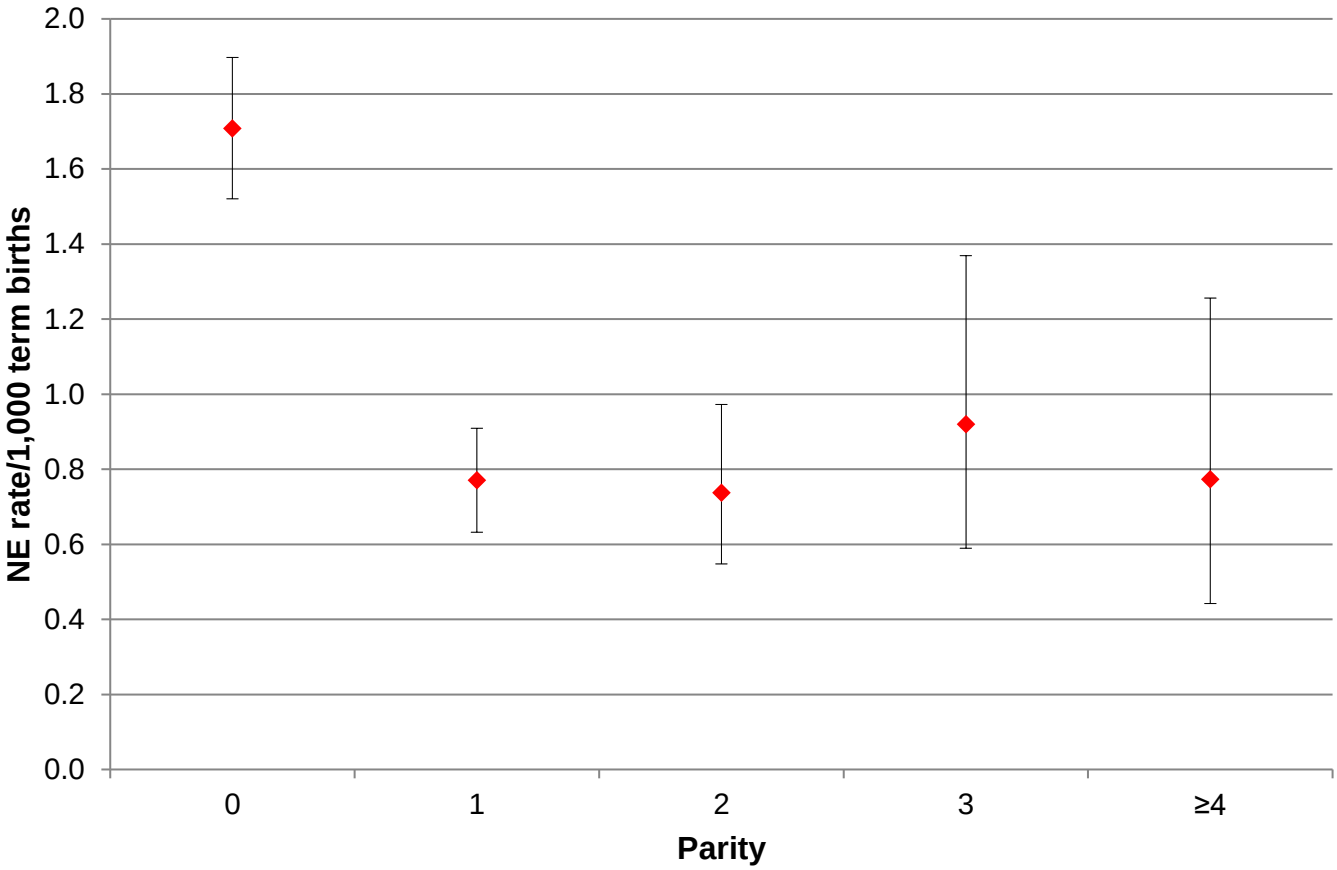
Table 4.1: NE rates (per 1,000 term births) by gestational age, sex, birthweight and plurality 2010–2018

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

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

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

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



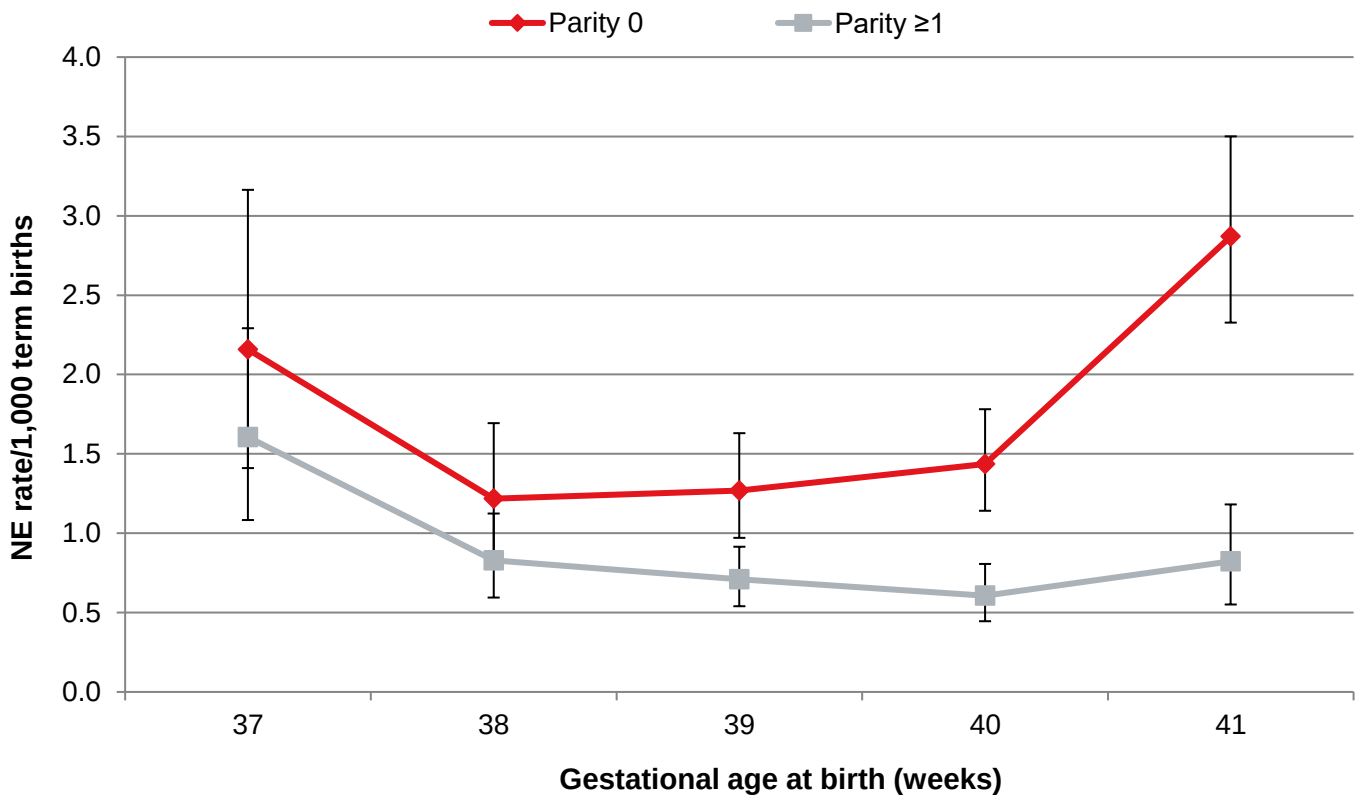
* All data limited to mothers who were registered for care with an LMC (a midwife, obstetrician or GP) claiming from the Section 88 Primary Maternity Services Notice.

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

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

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

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



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

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

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

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

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

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

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

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

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

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

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

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

'x' indicates percentage suppressed due to small numbers.

's' indicates rate suppressed due to small numbers.

BMI = body mass index.

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

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

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

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

* Vehicular, violent personal injury, other.

Primiparous: parity = 0 defined prior to current birth.

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

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

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

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

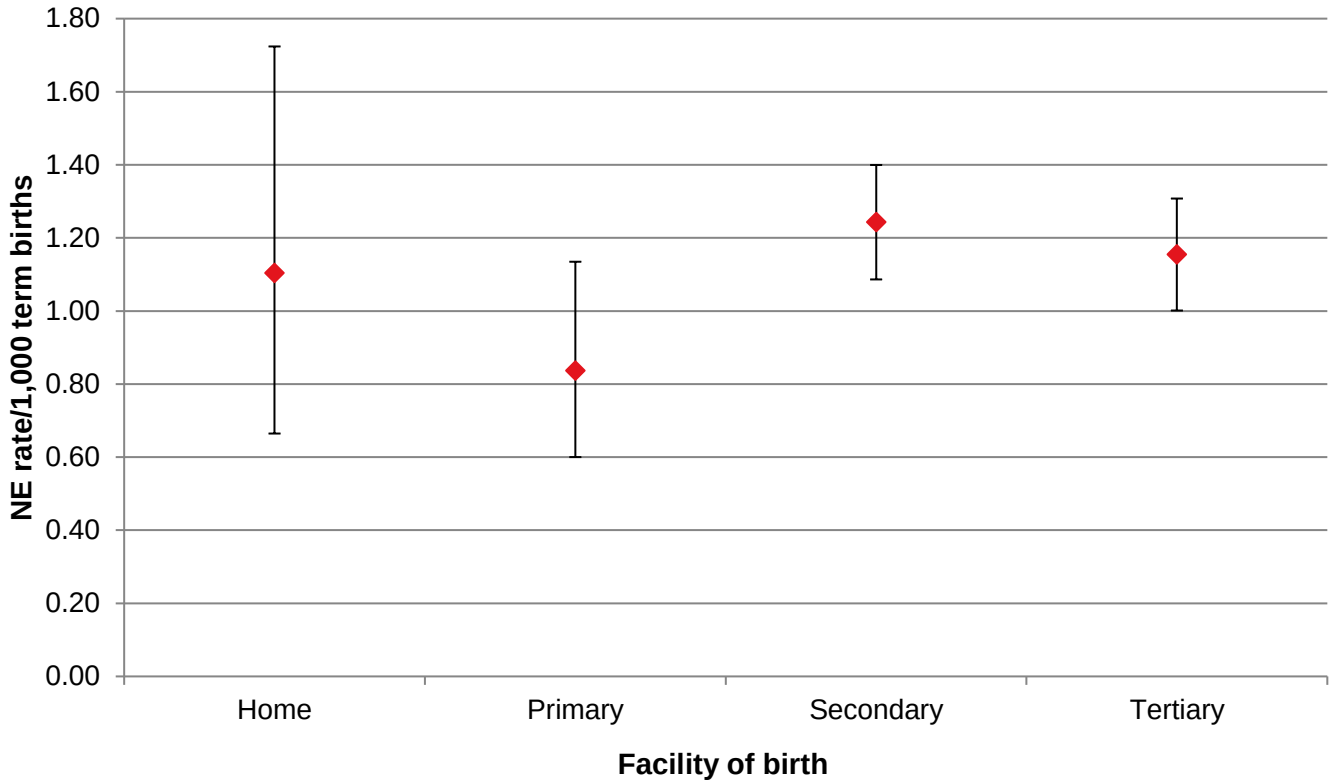
	Total NE cases n=601	
	n	%
Acute peripartum events	**154**	**25.6**
Cord prolapse	24	4.0
Abruption	47	7.8
Uterine rupture	12	2.0
Shoulder dystocia	42	7.0
Breech complication	15	2.5
Other complication	23	3.8
Liquor		
Blood stained	49	8.2
Thick meconium	136	22.6
Thin meconium	80	13.3
MODE OF BIRTH		
Normal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

'x' indicates percentage suppressed due to small numbers.

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

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

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



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

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

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

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

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

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

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

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

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

BE = base excess.

'x' indicates percentage suppressed due to small numbers.

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

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

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

'x' indicates percentage suppressed due to small numbers.

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

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

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

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

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

* Categories not mutually exclusive.

IPPV = intermittent positive pressure ventilation.

ETT = endotracheal tube.

'x' indicates percentage supressed due to small numbers.

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

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

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

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

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

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

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

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

MRI = magnetic resonance imaging (of the brain).

'x' indicates percentage suppressed due to small numbers.

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

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

Neonatal encephalopathy appended tables

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

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

* Includes 23 unknown maternal ethnicity among MAT births.

MELAA = Middle Eastern, Latin American, or African.

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

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

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

* Other includes Overseas, Unknown and Other.

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