5 Maternal mortality | Te mate o ngā whaea

Definitions

Maternal death is the death of a woman while pregnant or within 42 days of termination of pregnancy (miscarriage, termination or birth), irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management, but not from accidental or incidental causes.[59]

The cause of maternal death is sub-classified into the following categories based on *The WHO Application of ICD-10 to Deaths during Pregnancy, Childbirth and Puerperium: ICD-MM*.[60]

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

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

Findings

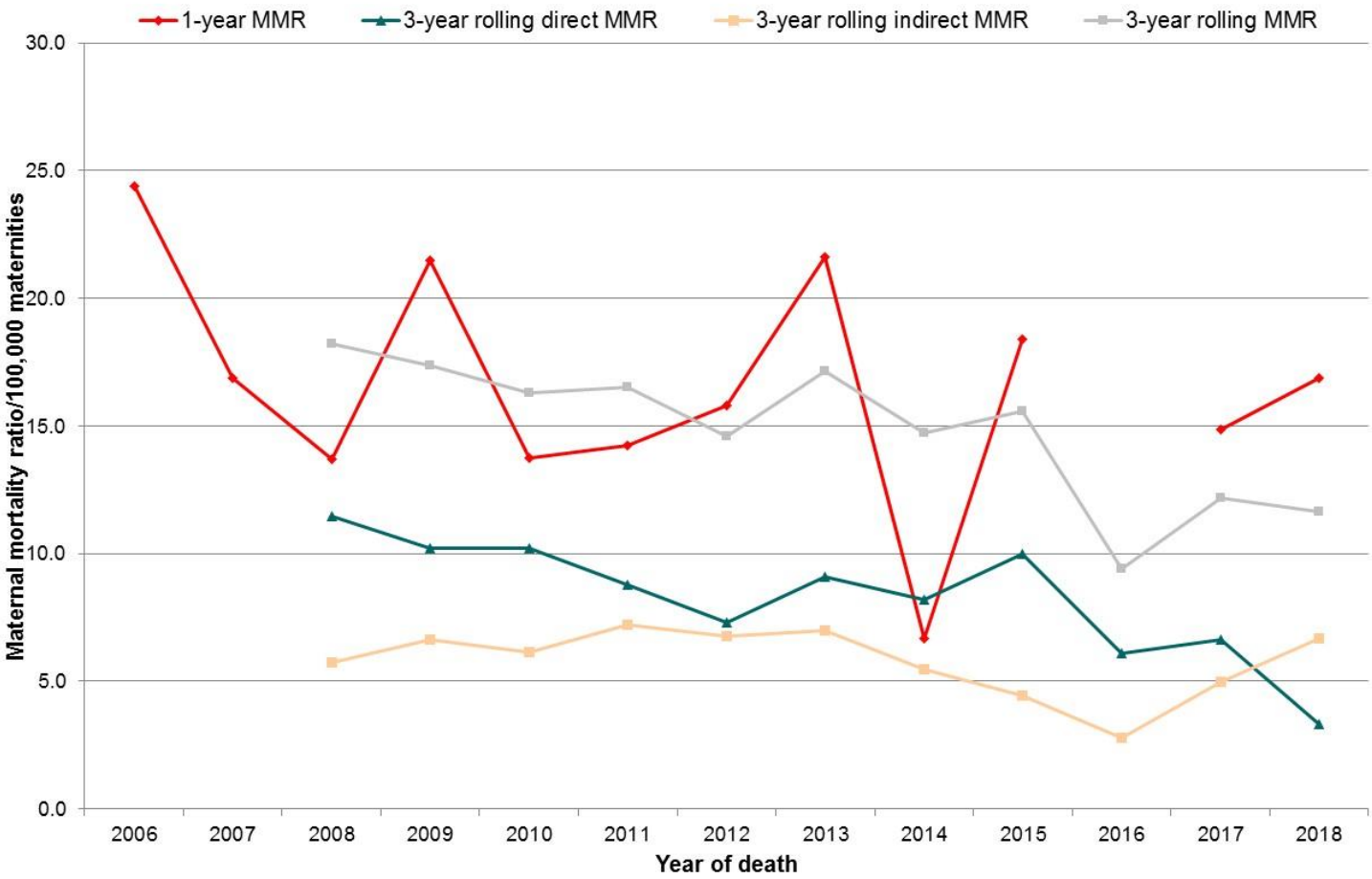
The number of maternal deaths has varied substantially over the period 2006–2018. The annual maternal mortality ratio has fluctuated from being too small to meaningfully calculate[61] up to 24.4 deaths per 100,000 maternities. Although the trend is not statistically significant, the total number of maternal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

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

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

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

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



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

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

MMR = maternal mortality ratio.

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

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

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

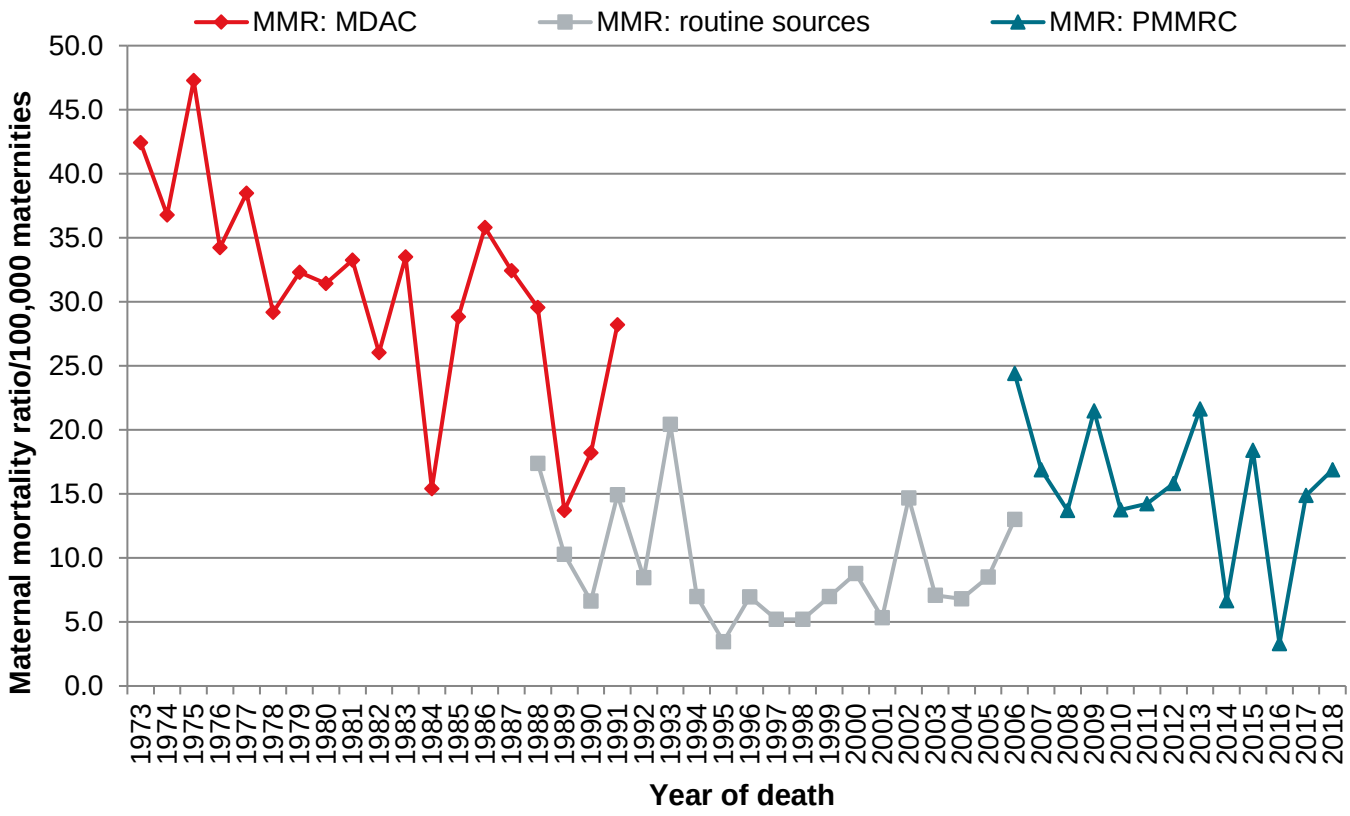
MMR = maternal mortality ratio.

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

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

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

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



MMR = maternal mortality ratio.

MDAC = Maternal Deaths Assessment Committee.

Sources:

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

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

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

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

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

Table 5.2: Demographic characteristics among maternal deaths 2006–2018

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

MELAA = Middle Eastern, Latin American, or African.

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

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

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

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

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

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

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

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

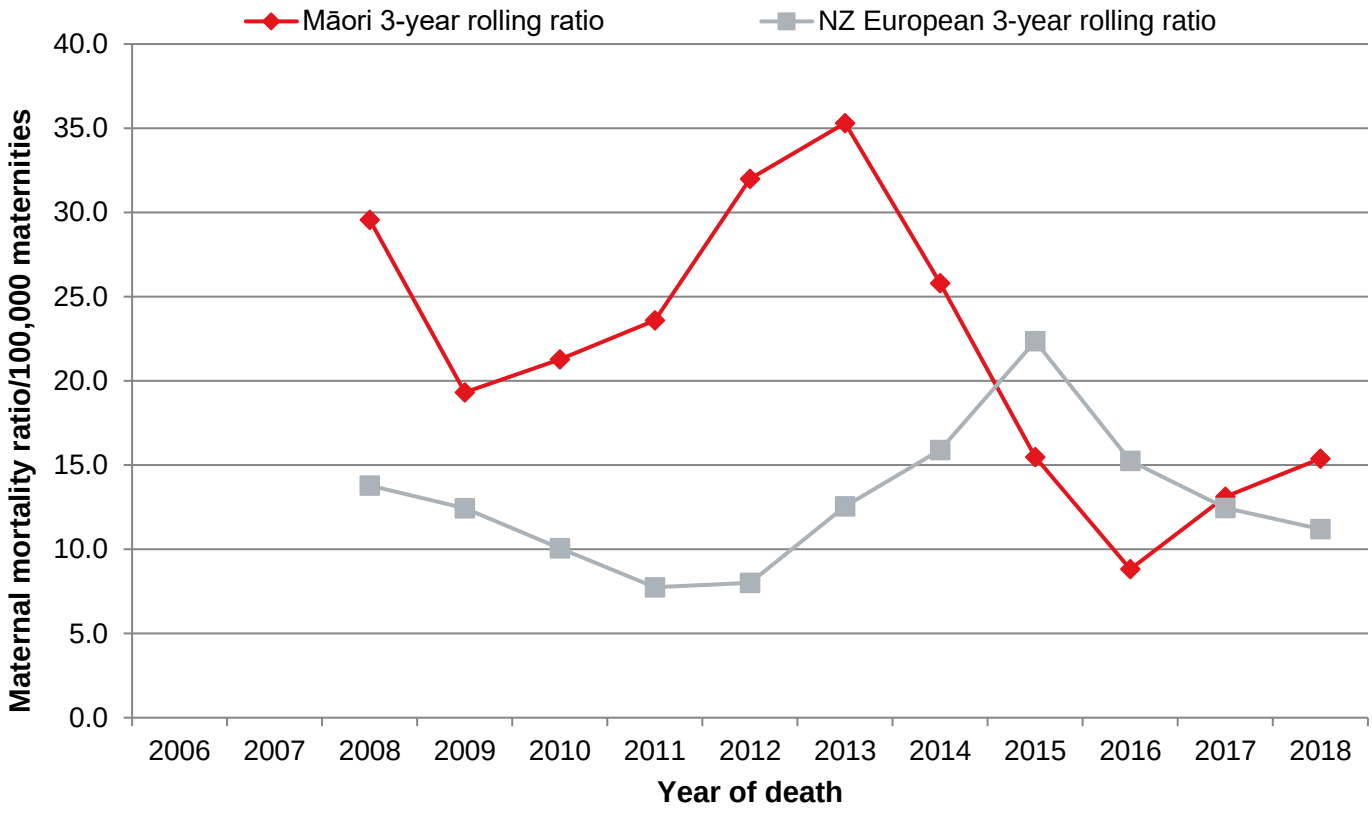
Mortality rates by BMI not calculated as denominator data unreliable.

BMI = body mass index.

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

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

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



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

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

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

* Other causes with small numbers have been suppressed.

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

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

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

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

Maternal suicide

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

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

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

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

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

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

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

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

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

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

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

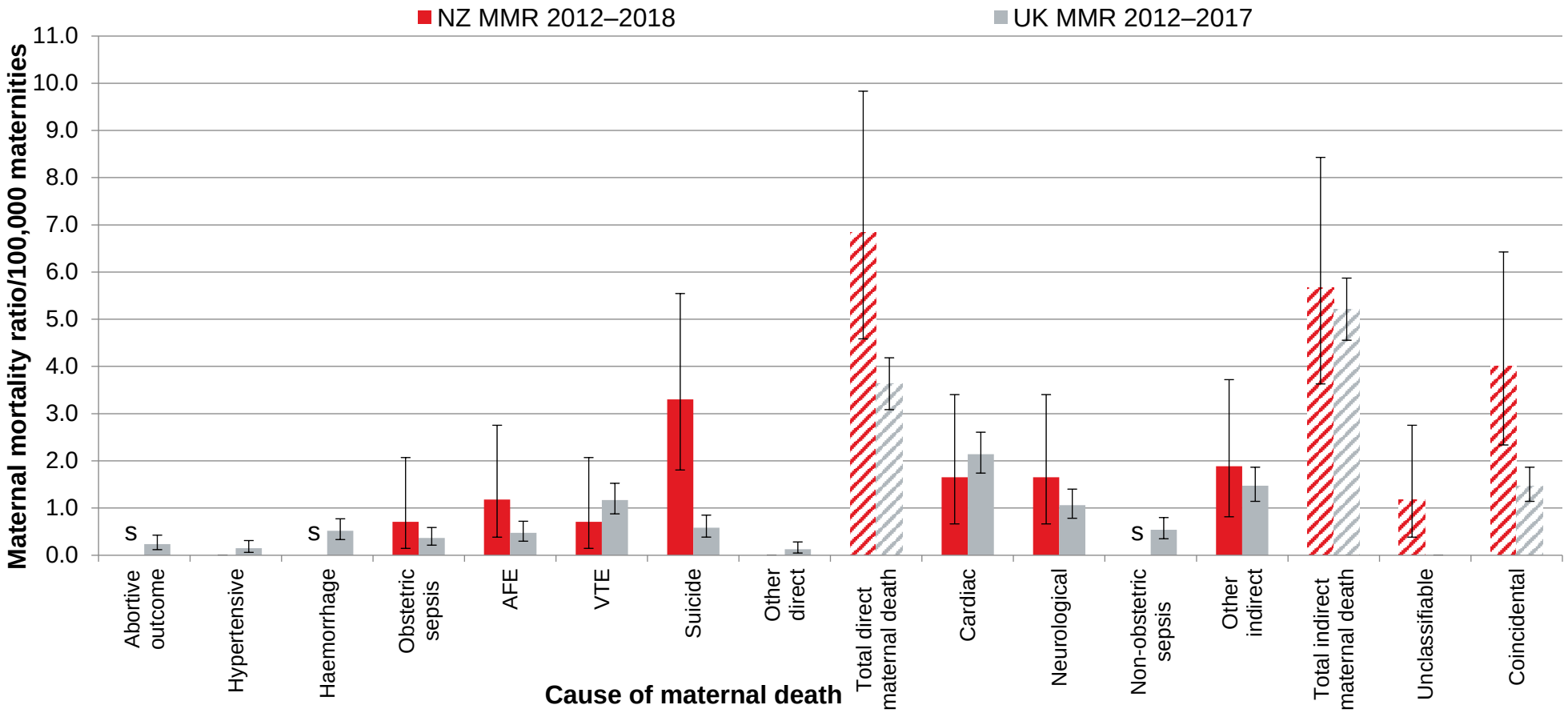
While both suicide prevention and mental wellbeing are topical, no governmental budget has been provided specifically to reduce maternal suicide deaths, and investment in maternal wellbeing is limited. In contrast, the UK has a proportionately lower maternal mortality from suicide and in July 2019 the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

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

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

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

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



* Includes coincidental deaths.

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

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

'Other direct' includes cardiomyopathy.

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

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

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

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