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Received: 6 October 2021 | Revised: 30 November 2021 | Accepted: 20 December 2021

DOI: 10.1111/aogs.14312

AOGS Acta Obstetricia et Gynecologica Scandinavica

ORIGINAL RESEARCH ARTICLE

Confidential enquiry into maternal deaths in the Netherlands, 2006–2018

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Funding information
Open access publication of this article was made possible through a grant offered by Stichting Merel Foundation.

Abstract

Introduction: To calculate the maternal mortality ratio (MMR) for 2006–2018 in the Netherlands and compare this with 1993–2005, and to describe women's characteristics, causes of death and improvable factors.

Material and Methods: We performed a nationwide, cohort study of all maternal deaths between January 1, 2006 and December 31, 2018 reported to the Audit Committee Maternal Mortality and Morbidity. Main outcome measures were the national MMR and causes of death.

Results: Overall MMR was 6.2 per 100 000 live births, a decrease from 12.1 in 1993–2005 (risk ratio [RR] 0.5). Women with a non-western ethnic background had an increased MMR compared with Dutch women (MMR 6.5 vs. 5.0, RR 1.3). The MMR was increased among women with a background from Surinam/Dutch Antilles (MMR 14.7,

Abbreviations: AMSM, Auditcommissie Maternale Sterfte en Morbiditeit (audit committee maternal mortality and morbidity); ICD-MM, International Classification of Diseases to deaths during pregnancy, childbirth, and the puerperium; MBRRACE-UK, mothers and babies: reducing risk through audits and confidential enquiries in the UK; MMR, maternal mortality ratio; RR, risk ratio.

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RR 2.9). Half of all women had an uncomplicated medical history (79/161, 49.1%). Of 171 pregnancy-related deaths within 1 year postpartum, 102 (60%) had a direct and 69 (40%) an indirect cause of death. Leading causes within 42 days postpartum were cardiac disease (*n* = 21, 14.9%), hypertensive disorders (*n* = 20, 14.2%) and thrombosis (*n* = 19, 13.5%). Up to 1 year postpartum, the most common cause of death was cardiac disease (*n* = 32, 18.7%). Improvable care factors were identified in 76 (47.5%) of all deaths.

Conclusions: Maternal mortality halved in 2006–2018 compared with 1993–2005. Cardiac disease became the main cause. In almost half of all deaths, improvable factors were identified and women with a background from Surinam/Dutch Antilles had a threefold increased risk of death compared with Dutch women without a background of migration.

KEYWORDS
confidential enquiry, maternal health, maternal mortality, the Netherlands

1 | INTRODUCTION

In 2017, 295 000 women worldwide died during pregnancy or postpartum, over 90% in low- and middle-income countries.[1] However, in high-income countries as well, reporting and reviewing maternal deaths remains important: lessons can be drawn from every death to improve obstetric care and prevent future deaths. The national maternal mortality ratio (MMR) is an important healthcare indicator. To unravel further the reasons why women die, several countries have established systems of confidential enquiry into maternal deaths.[2,3]

Whereas the global rate of maternal mortality dropped by 43% between 1990 and 2015, in some high-income countries, such as the USA, the MMR rose.[4,5] In the Netherlands, the MMR increased from 9.7 per 100 000 live births in 1982–1992 to 12.1 in 1993–2005.[6–8] This was attributed to demographic changes, a rise in risk factors such as obesity and chronic hypertension, and reduced underreporting.[6] In light of these trends, an updated national maternal mortality report was deemed necessary.

In 1993–2005, the most common cause of death was (pre)eclampsia, which was accountable for almost one in three deaths. In 2013, the Netherlands Obstetric Surveillance System (NethOSS) was introduced for nationwide registration of severe maternal morbidity (and later also mortality). Results showed a 70% reduction in eclampsia rates comparing timeframes 2004–2006 and 2013–2016.[9] This was attributed to increased awareness of the hypertension-related risk, combined with improved management (earlier treatment with magnesium sulfate and antihypertensives, early term induction) and obstetric emergency training.[10,11] It is not yet known whether this decline in the incidence of eclampsia is also reflected in the number of hypertension-related deaths.

Our primary aim was to calculate the MMR for 2006–2018, and compare it with 1993–2005. Secondary aims were to describe women's and obstetric characteristics, causes of deaths and improvable factors.

Key message

Maternal mortality halved in the Netherlands, with cardiac disease being the most common cause of maternal death. Improvable factors in care were present in almost half of all deaths. Women from Surinam/Dutch Antilles had a threefold increased risk of death.

2 | MATERIAL AND METHODS

This was a nationwide cohort study of maternal deaths between January 1, 2006 and December 31, 2018.[12]

Maternal mortality is defined as the death of a woman during pregnancy, childbirth or within 42 days postpartum or after termination of pregnancy. Death after 42 days up to 1 year postpartum is defined as late maternal mortality.[13] In the Netherlands, maternal deaths until 1 year postpartum are reported to the Audit Committee Maternal Mortality and Morbidity (*Auditcommissie Maternale Sterfte en Morbiditeit*, *AMSM*), as stated in a national guideline by the Netherlands Society of Obstetrics and Gynecology.[14] The AMSM consists of eight consultant obstetrician-gynecologists, one obstetric anesthesiologist and two registrars in obstetrics and gynecology, employed at academic and non-academic teaching hospitals.

Deaths are reported to the AMSM by medical specialists, midwives or general practitioners using a case report form, requesting basic pregnancy and birth data.[14] Starting from 2016, electronic reporting of deaths was also available through the Netherlands Obstetric Surveillance System. A monthly email is sent out to assigned clinicians in every hospital with a maternity ward asking them to report cases meeting inclusion criteria or declare "nothing to report."[9] Thereafter, the AMSM requests all medical records necessary for external audit.

To ensure completeness of reporting, a cross-check with Statistics Netherlands, the national authority collecting vital statistics, was performed annually until December 31, 2011. After 2011, Statistics Netherlands did not allow further cross-checking, since anonymity of data was considered to be potentially compromised due to small numbers. Statistics Netherlands relies on information from death certificates, including only cause of death and the woman's age.[15] Postpartum deaths identified from cross-checking were included as non-late deaths to avoid underestimation.

The main outcome was the MMR for 2006–2018 compared with that of 1993–2005. A sensitivity analysis was conducted for the absence of cross-checking after 2011, comparing the MMR with and without additional deaths from Statistics Netherlands. Maternal and obstetric characteristics are presented alongside those of the general pregnant population that were extracted from the Netherlands Perinatal Registry.[16] For parity, age groups and ethnic background groups, an MMR was calculated, with the number of live births obtained from Statistics Netherlands.[17]

We analyzed underlying causes of death, as described by the confidential enquiry. A cause-specific MMR was calculated and compared with 1993–2005. Underlying cause is defined as the disease or condition that initiated the morbid chain of events.[1] Causes are classified as "direct," "indirect" or "non-pregnancy-related" according to the World Health Organization classification.[1] Non-pregnancy-related deaths, eg traffic accidents, non-pregnancy-related malignancies and violence, were excluded from further analyses. Late maternal deaths were excluded from calculations of the MMR but were included in other analyses. According to the 10th revision of the International Classification of Diseases to deaths during pregnancy, childbirth and the puerperium (ICD-MM), with regard to the classification of suicide as a direct cause of death, all suicide deaths were re-classified into that category.[18] Deaths due to malignancy were categorized as non-pregnancy-related unless disease course, treatment or diagnosis were affected or delayed by the pregnancy.

Causes of death were categorized according to the classification applied by "Mothers and Babies: Reducing Risk through Audits and Confidential Enquiries in the UK" (MBRRACE-UK), which is based on the ICD-MM but has more extensive subclassifications. In the previous national maternal mortality report, a classification that differed from international standards had been applied.[6] To compare our results with those from 1993 to 2005, while still seeking international uniformity, the previous time period was reclassified according to the MBRRACE-UK categories (Table S1).

In all deaths available for enquiry, quality of care was assessed with regard to possible improvable factors. These refer to events that might have contributed to the death, but do not necessarily imply that it could have been avoided. Care received was compared with the standard of care, laid out in national guidelines or -in case these were absent- determined by best available evidence. To overcome possible information bias, considerable effort was put into collecting all information necessary for enquiry, from all levels of care, both information documented in the medical records and additional information collected over the phone through contacting involved care givers. Improvable factors could be patient-, primary obstetric care- (general practitioner or midwife) or hospital care-related (obstetricians and other medical specialists).[6] Additionally, lessons learned were proposed by the AMSM, translating improvable factors into generalized clinical recommendations, aiming to promote care improvements at all levels. Lessons were categorized in a manner similar to that of the national perinatal mortality audit, with regard to guidelines, communication and training of health professionals.[19]

We compared improvable factors for women with different ethnic backgrounds. Ethnic background was based on medical records, without further information available as to whether women were native or foreign-born. Categorization into western and non-western was based on definitions of Statistics Netherlands. Western women were those originating from Europe (excluding Turkey), North-America, Oceania, Indonesia and Japan, and non-western women those from Africa, Latin-America, Turkey and the remainder of Asia.[20] Dutch women were natives without a background of migration. Dutch women and western women were grouped together for comparison with non-western women, due to the very small proportion of non-Dutch women with a western ethnic background. This is in line with studies from the USA, where the risk of maternal death was comparable for US-native white and foreign-born white women, but much lower than that of black women, born in the USA or elsewhere.[21]

The MMR is defined as the number of maternal deaths during pregnancy or within 42 days postpartum per 100 000 live births.[1] Live births were collected from Statistics Netherlands.[17] Obesity was defined as a body mass index of ≥30 kg/m^2 at booking, or when obesity was explicitly mentioned in medical records. Cesarean sections are classified into "planned" if vaginal birth was never intended, even if the woman presented in labor, and "unplanned" when the decision for cesarean section was made during labor. In the Netherlands, "low risk" women receive maternity care and give birth in midwife-led primary care, or are referred to hospital obstetrician-led care if assessed as being "high-risk" at booking or if complications arise according to national guidelines.[22]

Risk ratios (RR) were calculated to compare the MMR between groups. Statistical analyses were performed using IBM SPSS for Mac (SPSS Inc., Chicago, IL, USA).

2.1 | Ethical approval

In the Netherlands, ethical approval is not required for confidential enquiry, which is considered an essential element to improve birth care. Data collected in the database are strictly de-identified and none of our published outcomes can be traced back to individual patients or health workers. Therefore, approval of the Ethics Committee was waived.

3 | RESULTS

A total of 206 maternal deaths were reported to the AMSM during the 13-year period. After cross-checking with Statistics Netherlands

for 2006–2011, 11 additional mortalities were identified. In 46 women, death was classified as non-pregnancy-related. These were excluded from further analysis (Table S2). In 30/171 (17.5%), death occurred after 42 days postpartum. In 94.5% of all deaths (205/217), medical records were available for enquiry. Statistics Netherlands documented 83 deaths in 2006–2018, compared with 206 reported to the AMSM, amounting to 60% underreporting in routine vital statistics.

The MMR for 2006–2018 was 6.2 per 100 000 live births (141/2 304 271), lower than 12.1 for 1993–2005 (RR 0.5). Excluding deaths identified after cross-checking with Statistics Netherlands did not substantially alter the reduction (MMR 5.7 vs. 10.4 per 100 000 live births, RR 0.5). Considerable decreases were seen in both direct and indirect deaths (Table 1). After excluding numbers from Statistics Netherlands, these decreases remained similar: 3.6 vs. 7.2 per 100 000 live births for direct deaths (RR 0.5) and 2.1 vs. 3.2 per 100 000 live births for indirect deaths (RR 0.7).

Of the 130 maternal deaths within 42 days postpartum (excluding numbers from Statistics Netherlands), 62 (47.7%) were in nulliparous women. Nulliparous women and women of higher parity had a higher risk of death compared with women with a second ongoing pregnancy, who had the lowest MMR: RR 1.5 and 2.2, respectively (Table 2). Mean age was 31.9 years (range 17–53). Compared with Dutch women, women with a non-western ethnic background had an increased MMR (6.5 vs. 5.0 per 100 000; RR 1.3). Compared with Dutch and western women, women with a non-western ethnic background more often had preexisting medical conditions (23/41 vs. 33/119, RR 2.0), obesity (13/41 vs. 19/119, RR 2.0) and teenage pregnancies (4/41 vs. 0/119, RR 25.7) (Table S3). Women with a background from Surinam and the Dutch Antilles (n = 13) had a considerably increased MMR (14.7 per 100 000).

Of 160 women who died up to 1 year postpartum, 60 (37.5%) were booked as "high-risk" and received antenatal care in secondary or tertiary obstetrician-led care. Eighty-seven (54.4%) were initially booked at primary care and nine (5.6%) received no antenatal care at all. Sixty-five women (40.6%) were referred from primary care to secondary or tertiary care during pregnancy (n = 52, 80%), childbirth (n = 5, 7.7%) or postpartum (n = 5, 7.7%). A total of 119 women (74.4%) died postpartum, of whom 13 had given birth at home (10.9%). Cesarean section was performed in 60 (50.4%) women: 40 were unplanned (66.7%) and 14 (2.3%) were perimortem cesarean sections during resuscitation. Autopsy was performed in 68 women (42.5%) (Table 3).

Medical history was uncomplicated in 79/160 (49.4%) women before conception. Thirteen (8.1%) women had a previous thromboembolic event, 20 (12.5%) were known to have a cardiovascular condition and 12 (7.5%) had a mental health condition (Table S4).

Following confidential enquiry of all 171 deaths within 1 year postpartum, 102 (59.6%) were categorized as direct and 69 (40.4%) as indirect. For 141 maternal deaths within 42 days postpartum, leading causes were cardiac disease (n = 21, 14.9%), hypertensive disorders of pregnancy (n = 20, 14.2%) and thrombosis (n = 19, 13.5%). Up to 1 year postpartum, cardiac disease (n = 32, 18.7%) and hypertensive disorders (n = 21, 12.3%) remained the most common causes (Table 1). For late deaths, cardiac disease and suicide were the most common (n = 11, 13.3%) (Table S5).

Assessment of quality of care for cases available for enquiry up to 1 year postpartum (n = 160) identified improvable factors in 76 women (47.5%) (Table 4). The majority of these pertained to secondary or tertiary care (n = 46, 28.8%), mostly due to inadequate management (n = 27, 16.9%) and delay in diagnosis (n = 18, 11.3%), followed by delay in diagnosis in primary care (n = 14, 8.8%). Lessons learned during audit are presented in Box 1.

4 | DISCUSSION

Maternal mortality decreased by 50% in the Netherlands in 2006–2018 compared with 1993–2005. This trend was contrary to the previous increase in maternal deaths, though changes in case ascertainment method might have contributed to the observed differences. Improvable factors in care were identified in nearly half of all deaths. Women with a background from Surinam and the Dutch Antilles had an almost threefold higher MMR, remarkably higher than other women with a non-western background. The most common causes of death were cardiac disease, hypertensive disorders and thromboembolism.

Compared with other high-income countries, the Netherlands has one of the lowest MMRs, although differences in case ascertainment must be considered. In the UK, the MMR was 9.8 in 2015–2017, and has remained stable in the last decade. In contrast with the Netherlands, indirect causes of death have been more prevalent than direct causes since 2003.[23] In France, the MMR was 10.3 in 2010–2012, the most common cause being obstetric hemorrhage, with double the hemorrhage-related MMR compared with the Netherlands (1.6 vs. 0.6 per 100 000 live births).[24] In Italy, the MMR was 9.2 per 100 000 live births in 2006–2012, with obstetric hemorrhage being the leading cause (1.9 per 100 000 live births).[25,26] Differences in rates of deaths caused by obstetric hemorrhage and hypertensive disorders might partly be explained by classification differences, which were previously demonstrated between the UK and the Netherlands.[27] However, such differences are unlikely to have a substantial impact on these comparisons.

The leading cause of death has become cardiac disease, in line with the UK and the USA.[4,23] However, in the UK, rates of mortality due to cardiac disease are more than twice as high as in the Netherlands (MMR 2.1 vs. 0.9 per 100 000 live births), accounting for 23.0% of deaths. In the USA, cardiovascular diseases account for 15.5% of maternal deaths. Possible explanations for the growing contribution of cardiac disease are changes in risk profiles, with more pregnant women being older, obese and having preexisting cardiac conditions. Some women with congenital heart defects now reach fertile age due to improved care and have an increased risk of adverse outcome.[28,29]

We recommend that women with preexisting conditions including cardiac disease access pre-conception counseling and

TABLE 1 Maternal mortality ratio and underlying causes of death in the Netherlands, 2006–2018 vs. 1993–2005

	1993–2005 Live births: 2 557 208			2006–2018 Live births: 2 304 271			
	≤1 year (*n*)	≤42 days (*n*)	MMR	≤1 year (*n*)	≤42 days (*n*)	MMR	RR
All maternal deaths	333	309	12.1	171	141	6.2	0.5
Direct deaths	236	224	8.8	102	90	3.9	0.4
Indirect deaths	97	85	3.3	69	51	2.2	0.7
Underlying cause of death	***n* (%)[a]**	***n* (%)**	**MMR**	***n* (%)[a]**	***n* (%)**	**MMR**	**RR**
Cardiac disease	45 (13.5)	40 (12.9)	1.6	32 (18.7)	21 (14.9)	0.9	0.6
Hypertensive disorders of pregnancy	99 (29.7)	95 (30.7)	3.5	21 (12.3)	20 (14.2)	0.9	0.2
Thrombosis	44 (13.2)	42 (13.6)	1.6	19 (11.1)	19 (13.5)	0.8	0.5
Neurological—indirect	17 (5.1)	17 (5.5)	0.7	19 (11.1)	15 (10.6)	0.7	1.0
Unascertained—direct	22 (6.6)	21 (6.8)	0.9	14 (8.2)	14 (9.9)	0.6	0.7
Hemorrhage	25 (7.5)	25 (8.1)	1.0	13 (7.6)	13 (9.2)	0.6	0.6
Suicide	7 (2.1)	4 (1.3)	0.3	19 (11.1)	8 (5.7)	0.3	2.2
Amniotic fluid embolism	11 (3.3)	11 (3.6)	0.4	8 (4.7)	8 (5.7)	0.3	0.8
Sepsis—non obstetric	10 (3.0)	10 (3.2)	0.4	9 (5.3)	8 (5.7)	0.3	1.0
Pregnancy-related infection	20 (6.0)	19 (6.1)	0.7	6 (3.5)	6 (4.3)	0.3	0.4
Other indirect	15 (4.5)	13 (4.2)	0.5	6[b] (3.5)	5[b] (3.5)	0.2	0.4
Early pregnancy death	7 (2.1)	7 (2.3)	0.3	2 (1.2)	2 (1.4)	0.1	0.3
Indirect malignancy	3 (0.9)	1 (0.3)	0.0	3[c] (1.8)	2[c] (1.4)	0.1	2.2
Anesthesia	2 (0.6)	2 (0.6)	0.1	0	0	0	
Other direct	6 (1.8)	2 (0.6)	0.3	0	0	0	

Note: Classified according to MBRRACE-UK classification. Numbers after cross-matching with Statistics Netherlands included. Risk ratio comparing MMR for 2006–2018 and 1993–2005.

Abbreviations: RR, risk ratio; MMR, maternal mortality ratio (≤42 days postpartum).

[a]Late deaths, up to 1 year postpartum, included.

[b]Other indirect causes of deaths within 42 days: systemic lupus erythematosus (1), antiphospholipid syndrome (1), upper gastrointestinal bleeding (1), relapsing polychondritis (1), pheochromocytoma (1). After 42 days: aplastic anemia (1).

[c]Indirect malignancy within 42 days: brain tumor (1), cervical carcinoma (1). After 42 days: melanoma (1).

multidisciplinary care by a dedicated team of obstetricians and other specialists. In-depth analysis of cardiac deaths may help identify additional lessons. Our findings stress the importance of efforts to stop smoking and reduce obesity.

In 1993–2005, hypertensive disorders accounted for one-third of maternal deaths, compared with 14% in 2006–2018, with a dramatic decrease in MMR from 3.5 to 0.9.[6,7] This is in line with the demonstrated decline in incidence of eclampsia, related to more timely management of hypertensive disorders following an updated national guideline.[9,11] Nevertheless, the proportion of hypertensive disorder-related deaths remains considerable, with improvable factors still present with regard to frequency of antenatal monitoring and timely treatment of severe hypertensive disorders.

Suicide was one of the most common causes of death up to 1 year postpartum, more than twice as many as reported in 1993–2005. This rise is in line with other high-income countries. In Austria and Italy, suicides represented 11% and 12% of maternal deaths up to 1 year postpartum, respectively.[30,31] The increased suicide rate in the Netherlands may also be partly explained by better reporting of suicides and late maternal mortality. According to Statistics Netherlands, a similar trend was observed in the general Dutch population, with suicide rates dropping from 1991 to 2007 but then showing a steady increase until 2017.[32] We endorse recommendations to implement methods to identify women at risk of depression during pregnancy or postpartum, to promote joint efforts between obstetric care and mental health professionals for pregnancy-related mental health matters and to increase awareness among women and their families to timely recognize symptoms and seek care. The number of suicide-related maternal deaths, most of which occur after 42 days postpartum, underlines the importance of addressing late deaths.

The number of autopsies performed hardly changed compared with 1993–2005 (40%) and in 8% of all deaths, the cause of death remained unascertained. We believe that in a large proportion of these deaths, a cause could have been identified had autopsy been performed. Therefore, we underline the importance of autopsy, especially in women without apparent preexisting or obstetric disease, also in the case of death at home. In these cases, we recommend consultation with a forensic pathologist.

TABLE 2 Maternal mortality ratio for parity, age and ethnic background

	N	Live births	MMR	RR
Parity				
0	62	1 052 002	5.9	1.5
1	34	844 224	4.0	Ref
2	23	293 585	7.8	1.9
3+	10	114 460	8.7	2.2
Missing	1			
Age[a] (years)				
15–19	3	19 562	15.3	3.9
20–24	13	190 412	6.8	1.8
25–29	25	642 711	3.9	Ref
30–34	50	886 680	5.6	1.4
35–39	36	469 620	7.7	2.0
40–44	9	90 656	9.9	2.6
≥45	1	4630	21.6	5.6
Missing	4			
Ethnic background				
Dutch native	83	1 644 594	5.0	Ref
Western[b]	9	231 180	3.9	0.8
Non-western[c]	38	588 888	6.5	1.3
Surinam/Dutch Antilles	13	88 581	14.7	2.9
African	11	156 741	7.0	1.4
Turkey	5	79 453	6.3	1.3
Morocco	4	99 750	4.0	0.8
Asian	3	133 116	2.3	0.6

Note: Numbers from statistics Netherlands excluded for age and ethnic background.

Abbreviations: MMR, maternal mortality ratio; RR, risk ratio.

[a]Numbers from Statistics Netherlands included.

[b]Western: European (5), Indonesian (3), Japanese (1).

[c]Non-western: additionally Syrian (1), South American (1).

Although outcomes of women with a non-western ethnic background appear to have improved, women from Surinam and the Dutch Antilles continue to lag behind. In this group of second or third generation migrants, risk factors for adverse outcomes appear to be more common, with almost double the rate of obesity during pregnancy, around 40%.[33] Previously this group was also found to have higher rates of severe acute maternal morbidity.[34] They require particular vigilance from health professionals.[35]

The major strength of this study is its nationwide character, with collection of data over 13 years. Based on the systematic confidential enquiry performed in all reported deaths, we were able to distill lessons for care based on access to actual medical records. We adjusted categorization of deaths to that used by the MMBRACE-UK, which is based on the ICD-MM, to conform with the international literature, enabling future comparisons.[23]

TABLE 3 Pregnancy, birth and obstetric care characteristics of all deaths up to 1 year postpartum

	Maternal deaths, *n* (%)	General population[a] (%)
Initial antenatal care	*N* = 160	
Primary maternity care	87 (54.4)	84.6
Obstetrician	60 (37.5)	15.4
Not (yet) under obstetric care	9 (5.6)	
Unknown	4 (2.5)	
Referral by primary care giver	*N* = 65	
During pregnancy	52 (80.0)	61.8
During birth	5 (7.7)	35.9
Postpartum	5 (7.7)	2.2
Unknown	3 (4.6)	
Time of death	*N* = 160	
During pregnancy	38 (23.8)	
Postpartum	119 (74.4)	
Within 1 day	27 (22.7[b])	
Between 1–7 days	28 (23.5[b])	
Between 8–42 days	33 (27.7[b])	
Late death (>42 days)	30 (25.2[b])	
Unknown	1 (0.8[b])	
1st trimester pathology[c]	3 (1.9)	
Place of death	*N* = 160	
At home	37 (23.1)	
In hospital	119 (74.4)	
Start lethal event out of hospital	43 (36.1[b])	
Unknown	4 (2.5)	
Twin pregnancy	3 (1.9)	1.6
Birth	*N* = 119	
At home	13 (10.9)	15.9
In hospital	97 (81.5)	82.7
During transport	1 (0.8)	
Unknown	8 (6.7)	
Mode of birth	*N* = 119	
Vaginal	51 (42.9)	80.6
Instrumental	8 (6.7)	6.9
Cesarean section	60 (50.4)	14.9
Planned	6 (10.0[b])	
Unplanned	40 (66.7[b])	
Perimortem	14 (2.3[b])	
Autopsy performed	*N* = 160	
Yes	68 (42.5)	
Unknown	3 (1.9)	
Intrauterine fetal death	*N* = 160	
<24 weeks	27 (16.9)	
≥24 weeks	6 (3.8)	

TABLE 3 (Continued)

	Maternal deaths, *n* (%)	General population[a] (%)
Perinatal death[d]	24 (14.9)	0.4[e]
Smoking	*N* = 160	
Yes	38 (23.8)	24.9
Unknown	36 (22.5)	
Obesity	37 (23.1)	12

[a]National reference values from Perinatal Registry the Netherlands (Perined), 2006–2018.

[b]Percentages of their subheading.

[c]Women who died shortly after miscarriage (2) or abortion (1).

[d]Perinatal death defined as stillbirth with birthweight ≥1000 g or ≥28 weeks of gestation, or neonatal death in the first 7 days postpartum.

[e]Only numbers until 2016 available.

Although it appears that deaths during pregnancy and up to 42 days postpartum are reported to the AMSM with great compliance, the relatively low number of late maternal deaths compared with other enhanced maternal mortality systems suggests possible underreporting. Compared with the previous Dutch maternal mortality report where 23/333 (12%) of pregnancy-related deaths were late, the reporting of late deaths seems to have increased to 30/171 (17.5%), which is still low compared for instance with Italy (>40%).[25] Besides cross-checking with Statistics Netherlands, there is no way to identify unreported maternal deaths. Therefore, re-establishing such cross-checking, or including a pregnancy-checkbox in the death certificates has been prioritized by the AMSM.[6]

5 | CONCLUSION

The MMR in the Netherlands is among the lowest in the world and the decline of maternal mortality implies improvements in quality of obstetric care, particularly with regard to management of hypertensive disorders. The decrease, however, should not be taken for granted, as risk factors for developing pregnancy-related complications are increasing nationally and globally. Effort should be made to optimize care for women at higher risk of mortality, such as women from Surinam and the Dutch Antilles and women with preexisting conditions. Maternal mortality should not be seen as a mere obstetric problem given the latest trends in causes of mortality with increases in cardiac- and mental health-related deaths.

ACKNOWLEDGEMENTS

We would like to thank all previous members of the AMSM during the years 2006–2018 who contributed to the inquiries into all maternal deaths: Nicole Engel, Christianne de Groot, Mieke Kerkhof, Jos van Roosmalen and Nico Schuitemaker. We also thank general practitioners, midwifes, obstetricians and other clinicians reporting maternal deaths to the AMSM.

CONFLICT OF INTEREST

None.

AUTHOR CONTRIBUTION

AK, a member of the AMSM, and JMS, a former member of the AMSM, are shared lead authors, contributed equally to collecting data, conducting data analysis and drafting the manuscript together with LS and

TABLE 4 Improvable factors in care, compared between women with different ethnic background

	Dutch and western women (*N* = 119)	Non-western women (*N* = 41)	Total (*N* = 160)
Improvable factors in care	55 (46.2)	21 (51.2)	76 (47.5)
Patient			
Delay consulting doctor	7 (5.9)	2 (4.9)	9 (5.6)
Refusing medical advice	9 (7.6)	2 (4.9)	11 (6.9)
Communication difficulties	1 (0.8)	5 (12.2)	6 (3.8)
Primary obstetric care[a]			
Delay in diagnosis	12 (10.1)	2 (4.9)	14 (8.8)
Delay in referral to hospital	2 (1.7)	2 (4.9)	4 (2.5)
Inadequate referral to perinatal center	0	1 (2.4)	1 (0.6)
Secondary or tertiary care[b]			
Inadequate antenatal visits	0	1 (2.4)	1 (0.6)
Delay in diagnosis	15 (12.6)	3 (7.3)	18 (11.3)
Inadequate management	19 (16.0)	8 (19.5)	27 (16.9)

Note: Late deaths included. Values denoted as *n* (%).

[a]Primary midwifery care and/or general practitioner.

[b]Obstetricians and/or other medical specialists.

BOX 1 Lessons learned as deducted from the improvable factors formulated by the Audit Committee Maternal Mortality and Morbidity (AMSM) during audit of maternal deaths in the Netherlands, 2006–2018

Guidelines and obstetric care

- Generate awareness among pregnant women for alarm symptoms in pregnancy especially for hypertensive disorders and cardiac symptoms. Every woman should be encouraged to seek medical advice in case of new symptoms without experiencing any barriers in terms of communication or other. Maternity care givers should invest time and effort in overcoming language barriers with women of non-native ethnic background.
- Manage hypertensive diseases timely and appropriately with administration of magnesium sulfate and antihypertensive medication. Plan adequate or more frequent antenatal visits for woman at risk of hypertensive disorders or monitor more intensively at home or in hospital.
- Implement screening methods at booking, to identify women at risk of developing perinatal depression, such as the Edinburgh Postnatal Depression Scale. For women with estimated high risk of mental problems, organize a multidisciplinary care pathway in pregnancy and postpartum.
- Implement obstetric early warning scores for monitoring and early detection of critically ill or deteriorating women, especially postoperatively.
- Stabilize critically ill women, before proceeding to birth or transportation to another facility/department. Maximize the use of multidisciplinary expertise when caring for critically ill pregnant women.
- Consider timely postpartum hysterectomy in the management of major hemorrhage, especially in women refusing blood transfusion. Delay due to applying serial conservative options might lead to adverse outcomes.

Communication

- Women with severe preexisting medical conditions require a timely multidisciplinary approach and preferably even preconception counseling.
- Improve communication, collaboration and comprehension between obstetricians and anesthesiologists by joint team training sessions in obstetric emergencies.

Training

- Be aware of non-specific complaints in the postpartum period. Shortness of breath should not be attributed to hyperventilation without further analysis but prompt medical evaluation including vital parameters, especially oxygen saturation.

TA. LS contributed to collecting data and analysis. IB, KB, BB, JC, SK, SL, AR, TS, JS, JZ and TA, all members of the AMSM, all contributed substantially to confidential inquiry of maternal mortalities, revised the manuscript and contributed to conceptualization of the study.

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SUPPORTING INFORMATION

Additional supporting information may be found in the online version of the article at the publisher's website.

How to cite this article: Kallianidis AF, Schutte JM, Schuringa LEM, et al. Confidential enquiry into maternal deaths in the Netherlands, 2006–2018. *Acta Obstet Gynecol Scand*. 2022;101:441–449. doi:10.1111/aogs.14312