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RESEARCH ARTICLE

General obstetrics

The contribution of suicide to maternal mortality: A nationwide population-based cohort study

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Abstract

Objective: To identify the incidence and characteristics of maternal suicide.

Design: Nationwide population-based cohort study.

Setting: The Netherlands, 2006–2020.

Population: Women who died during pregnancy or within 1 year postpartum, and a reference population of women aged 25–45 years.

Methods: The Cause of Death Register and Medical Birth Register were linked to identify women who died within 1 year postpartum. Data were combined with deaths reported to the Audit Committee for Maternal Mortality and Morbidity (ACMMM), which performs confidential enquiries. Maternal suicides were compared with a previous period (1996–2005). Risk factors were obtained by combining vital statistics databases.

Main outcome measures: Comparison of incidence and proportion of maternal suicides among all maternal deaths over time, sociodemographic and patient-related risk factors and underreporting of postpartum suicides.

Results: The maternal suicide rate remained stable with 68 deaths: 2.6 per 100 000 live births in 2006–2020 versus 2.5 per 100 000 in 1996–2005. The proportion of suicides among all maternal deaths increased from 18% to 28%. Most suicides occurred throughout the first year postpartum (64/68); 34 (53%) of the women who died by suicide postpartum were primiparous. Compared with mid-level, low educational level was a risk factor (odds ratio 4.2, 95% confidence interval 2.3–7.9). Of 20 women reported to the ACMMM, 11 (55%) had a psychiatric history and 13 (65%) were in psychiatric treatment at the time of death. Underreporting to ACMMM was 78%.

Conclusions: Although the overall maternal mortality ratio declined, maternal suicides did not and are now the leading cause of maternal mortality if late deaths up to 1 year postpartum are included. Data collection and analysis of suicides must improve.

KEYWORDS
maternal mortality, pregnancy-related mortality, suicide, underreporting

1 | INTRODUCTION

"Maternal suicide" is the death of a woman by suicide while pregnant or within 1 year postpartum. The World Health Organization (WHO) recommends classifying all maternal suicides up to 1 year postpartum as direct obstetric deaths.[1] This recommendation was made to address the extreme underreporting and misclassification of maternal suicides as a cause of death globally. Few countries have systems enabling enhanced case finding of maternal suicides, such as linkage

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between birth and death registers and/or confidential enquiries into maternal deaths including suicides.[2] This lack of systems for accurate case finding persists despite emerging evidence suggesting that maternal suicides comprise a considerable proportion of maternal mortality: between 13% and 36% in high-income countries.[2,3] In the UK and France, which have enhanced surveillance enabling the identification of late maternal deaths, suicides were found to have become a leading cause of deaths within 1 year postpartum.[2,4,5]

Previously, in the Netherlands, data on maternal suicide for 1996–2005 were obtained through linkage of birth and death registers from vital statistics. Maternal suicides accounted for 18% of maternal deaths: the maternal suicide rate (MSR) was 2.5 per 100 000 live births.[3,6] Importantly, there was substantial underreporting – estimated at 82% – of maternal suicides to the confidential enquiry run by the Netherlands Society of Obstetrics and Gynaecology (*Nederlandse Vereniging voor Obstetrie en Gynaecologie*, NVOG). Recently, confidential enquiry outcomes highlighted a decline in overall maternal mortality between 1993–2005 and 2006–2018 from 12.1 to 6.2 (up to 42 days postpartum).[7] However, because of anticipated underreporting of suicides, no conclusions were drawn about these findings. Moreover, as maternal death in the Netherlands becomes increasingly rare, concerns about data anonymity prohibited renewed linkage of registers. Therefore, it remains unclear whether the MSR or proportion of maternal suicides changed over time.

To inform and improve suicide prevention strategies, it is crucial that these gaps are addressed, and to acquire a better understanding of specific risk factors. From the literature, it is clear that a complex of factors is associated with maternal suicide: patient-related (e.g. sociodemographic and clinical characteristics), clinician-related (e.g. knowledge, experience, beliefs) and system-related factors (e.g. access to specialised care, policy, stigma).[5,8] Therefore, we aimed to compare incidence and proportion of maternal suicides in the Netherlands over time (between 2006–2020 and 1996–2005) and identify risk factors. We also explored underreporting of maternal suicides to the national confidential enquiry into maternal deaths.

2 | METHODS

Two databases were used to identify maternal suicides in the Netherlands for the period 2006–2020: the database of The Netherlands Audit Committee Maternal Mortality and Morbidity (ACMMM, *Auditcommissie Maternale Sterfte en Morbiditeit*, AMSM) and that of Statistics Netherlands (*Centraal Bureau voor de Statistiek*, CBS).[9]

In the Netherlands, all maternal deaths up to 1 year postpartum are collected by the ACMMM (part of the NVOG) by using a physical or online case report form (since 2016). Reminder emails are sent out to hospitals on a monthly basis. The ACMMM performs the confidential enquiry. The ACMMM database contains both antepartum and postpartum direct and indirect maternal deaths up to 1 year after birth. From this database, we obtained data pertaining to psychiatric history, history of substance misuse and involvement with mental health services.

The CBS is a Dutch public institution collecting nationwide vital statistics. Women who died within 1 year after giving birth were identified through the date of birth of their legal child and the Cause of Death database of CBS. This method of identification is used as an accurate proxy. A small number of women cannot be identified through legal parenthood, such as in the case of giving up a child for adoption. As the occurrence of a birth was a necessity to identify a woman who had been pregnant, antepartum deaths and deaths following miscarriage or ectopic pregnancy, could not be extracted from this database.

Characteristics of the women identified in the CBS data set collected were: cause of death, age, marital status, migration background, number of children, level of education, and timing of suicide related to date of childbirth. International Classification of Disease, 10th revision (ICD-10) codes were used to identify cause of death (ref CBS, REF ICD-10).[10] For migration background, we used the definition of CBS: 'at least one parent born outside the Netherlands'. The definition of educational level was in accordance with the definition used by CBS.[11]

Timing of suicides postpartum was assessed by: (1) the cutoff of the puerperium of 42 days after the end of pregnancy, which differentiates a maternal death (≤42 days) from a 'late maternal death' (43–365 days) according to ICD-10, and (2) by dividing the postpartum year into quarters.

To calculate the incidence of maternal suicide and the proportion of maternal suicides of all maternal deaths we combined both data sets. Postpartum maternal suicides identified in the data set of CBS were added to the ACMMM data set. Postpartum maternal suicides already in the ACMMM set were excluded from calculations of incidence to prevent possible double counting, but may have led to an occasional missed death in the situation that a maternal suicide was reported to the ACMMM, but not to CBS.

The proportion of maternal suicides of all maternal deaths was calculated as the percentage of maternal suicides among all maternal deaths in the same period (2006–2020). The maternal mortality ratio (MMR) up to 42 days and up to 1 year after the end of pregnancy was calculated as maternal deaths per 100 000 live births, all with the level of statistical significance set at 0.05 arriving at a 95% confidence interval (CI).

The MSR was calculated as the total number of suicides up to 42 days and 1 year postpartum per 100 000 live births. The number of live births was obtained from StatLine, an online open access database from CBS.[12]

The absolute number of maternal suicides, the MSR and the proportion of maternal suicides of all maternal deaths in 2006–2020 were compared with similarly obtained data from 1996 to 2005.[6]

To identify possible sociodemographic risk factors we assessed available variables in the data set of CBS as previously

reported in other studies such as age, parity, migration background and factors associated with low socio-economic status, such as level of education. We compared these characteristics between women who died by suicide and the general fertile female population (25–45 years), obtained from CBS. The ACMMM data set was used to identify clinical factors and patient characteristics, based on known risk factors from the literature (previous psychiatric diagnosis, substance use disorder, active or interrupted treatment, social problems).

We calculated the degree of underreporting of postpartum maternal suicides to the ACMMM as the proportion of unreported cases to the ACMMM of all maternal suicides identified in the data set of CBS, both for the first 42 days and up to 1 year postpartum.

3 | RESULTS

In total, 68 women who died by suicide while pregnant or within 1 year postpartum were identified: 64 postpartum suicides were identified through CBS, four antepartum suicides were identified in the ACMMM data set. This corresponds to a combined MSR of 2.6 per 100 000 live births (95% CI 2.0–3.2).

We found no substantial change in MSR comparing 1996–2005 with 2006–2020 (Table 1). Also, the average number of maternal suicides per year did not change considerably over time: an average of 5 (50 cases in 10 years) cases per year in the period 1996–2005 and 4.5 (68 cases in 15 years) cases per year in 2006–2020. In contrast, the proportion of maternal suicides of all maternal deaths increased substantially from 18% to 28%, due to a decline of maternal deaths from other causes.

The estimated MSR up to 42 days postpartum was 0.5 per 100 000 live births (95% CI 0.2–0.8), based on four antepartum and nine postpartum deaths by suicide within the first 42 days postpartum. This is comparable to the MSR within 42 days in the previous timeframe (Table 2). The proportion of maternal deaths up to 42 days postpartum attributable to suicide increased from 5.3% to 8.7%.

3.1 | Timing and characteristics

With regard to the timing of suicides up to 1 year after giving birth, we found that the majority (55/68; 81%) took place later than 42 days postpartum and, according to the WHO recommendation, could be classified as late maternal deaths.[1] The incidence of maternal suicide remained relatively stable if stratified by postpartum quarter (number of suicides per quarter: 18 [26%], 19 [28%], 17 [25%], 10 [15%]).

The mean age of women who died by suicide within the first year postpartum was 33.3 years: 48 women (75%) were 30 years or above, 34 (53%) had one child, 21 (33%) had a migration background and 27 (42%) had a low level of education (see Table 3).

Of the 20 women who died by maternal suicide as reported to the ACMMM and for whom medical records were reviewed, 11 (55%) had a psychiatric history documented in their obstetric or midwifery records (see Table 4). In 13 (65%), treatment for psychological problems or a psychiatric disorder was documented to have been active at the time of death. Two women had reported active substance use around birth (one used cigarettes, one illegal substances). In three women (15%) social problems shortly after giving birth were reported. No previous suicide attempts were documented in the medical records.

3.2 | Rates of underreporting and substandard care

We found a higher reporting rate for maternal suicide in the data set of CBS, compared with the ACMMM. In 2006–2020, 20 maternal suicides were reported to the ACMMM: four antenatal, four within the first 42 days postpartum and 12 between 42 days and 1 year postpartum. The corresponding degree of underreporting to the ACMMM was 55% (5/9) for maternal suicides up to 42 days postpartum and 78% (43/55) for suicides later than 42 days postpartum. Total underreporting for postpartum maternal suicides was 75% (48/64). Total underreporting for postpartum maternal suicides did not notably improve over time, because the underreporting rate for 1996–2005 was 87% (41/47).

In 4 out of 20 reported women (20%) the ACMMM committee identified improvable factors in the chain of medical care, mental health care or the organisation of health care at large.

4 | DISCUSSION

4.1 | Main findings

Our study shows that, proportionally, suicide has become an even more important cause of maternal mortality in the Netherlands compared with the previous timeframe. In light of the other causes of maternal mortality decreasing, the proportion of maternal suicides to all-cause maternal mortality within 1 year postpartum increased from 18% to 28%. This implies that in order to further reduce maternal mortality, increased attention to maternal mental health is needed, including suicide prevention strategies.

The estimated MSR up to 1 year postpartum of 2.6 appears to be higher than any other cause-specific MMR up to 1 year postpartum in the Netherlands, although cross-linking for other late causes has not been performed. Recent analysis from ACMMM data showed much lower MMR for cardiac disease and hypertensive disorders of pregnancy, of 1.4 and 0.9, respectively.[7] The amended MSR for the Netherlands lies within the range of what is reported in other high-income countries: 3.8 in Sweden, 2.5 in the UK, 2.3 in Italy and 1.4 in France.[2,4,13,14] In the UK and France, where enhanced surveillance systems allow for the study of maternal deaths up to 1 year postpartum, cardiovascular diseases and suicides

TABLE 1 Maternal deaths (direct+indirect) and suicides (antepartum [AP] + postpartum [PP]) maternal suicide ratio (MSR) and maternal mortality ratio (MMR) up to 1 year postpartum, by time period.

Period	Number of live births	Maternal deaths reported to ACMMM	Additional identified suicides from CBS data set	Total maternal deaths combined	Suicides AP + PP (% of total maternal deaths)	MSR (95% CI)	MMR (95% CI)
1996–2005	1 975 336	240	41	281	3 + 47 (18)	2.5 (1.8–3.2)	14.2 (12.6–15.9)
2006–2020	2 642 632	193	48	241	4 + 64 (28)	2.6 (2.0–3.2)	9.1 (8.0–10.3)

TABLE 2 Maternal deaths (direct+indirect) and suicides (antepartum [AP] + postpartum [PP]) maternal suicide ratio (MSR) and maternal mortality ratio (MMR) up to 42 days postpartum, by time period.

Period	Number of live births	Total maternal deaths reported to ACMMM	Additional identified suicides from CBS data set	Combined total maternal deaths	Suicides AP + PP (% of total maternal deaths)	MSR (95% CI)	MMR (95% CI)
1996–2005	1 975 336	218	7	225	3 + 9 (5.3)	0.6 (0.26–0.95)	11.4 (9.90–12.88)
2006–2020	2 642 632	144	5	149	4 + 9 (8.7)	0.5 (0.22–0.76)	5.6 (4.73–6.54)

TABLE 3 Demographic characteristics of maternal suicides postpartum with selected comparison to background population (women ages 25–45 years).

	Maternal suicides postpartum	General fertile female population	
Characteristic	***n*** **(%)**	***n*** **(%)**	**OR (95% CI)**
Age group, y			
20–29	16 (25)	15 424 506 (31)	Ref
30–39	41 (64)	16 058 790 (32)	2.5 (1.4–4.4)
40–49	7 (11)	18 429 596 (37)	0.4 (0.2–0.9)
Relationship status			
Marriage/civil partnerships	32 (50)	15 798 761 (48)	Ref
Separated/single/unmarried	32 (50)	16 993 847 (52)	0.9 (0.6–1.5)
Migration background			
No	43 (67)	23 770 973 (72)	Ref
Yes	21 (33)	9 021 635 (28)	1.3 (0.8–2.2)
Number of living children			
1	34 (53)	N/A	
2	20 (31)	N/A	
3	10 (16)	N/A	
Educational level			
Low	27 (42)	N/A (16)	4.2 (2.3–7.9)
Medium	16 (25)	N/A (41)	Ref
High	21 (33)	N/A (42)	1.2 (0.7–2.4)

TABLE 4 Main psychiatric diagnosis documented as previous psychiatric history among women who died from suicide reported to the ACMMM in the period 2006–2020.

Diagnosis	***n*** **(%)**
Depressive disorder	5 (25)
Psychotic disorder	1 (5)
Schizoaffective disorder	1 (5)
Anxiety disorder	1 (5)
Personality disorder	1 (5)
Other	2 (10)
No history	9 (45)

were previously identified as the most important contributors to maternal deaths up to 1 year, with proportions of maternal suicides to all-cause maternal mortality of 15% and 13%, respectively.[2]

The estimated MSR up to 42 days postpartum of 0.5 per 100 000 live births including CBS data seems higher than the recently estimated MSR of 0.3, which was based on ACMMM data alone, but lower than the MMR of cardiac disease (0.9), hypertensive disorders (0.9) and thrombosis (0.8).[7] The proportion of maternal deaths up to 42 days postpartum attributable to suicide increased from 5.3% to 8.7%, which implies that, even during pregnancy and the 42-day puerperium, suicide is a substantial cause of maternal death in the Netherlands. Compared with other European countries with permanent enhanced surveillance systems, the MSR up to 42 days postpartum lies within the reported range of 0.3–2.7.[2] The proportion of maternal suicides among all maternal deaths up to 42 days reported by those countries varies considerably, from below 5% in Slovakia, France and Italy to above 30% in Denmark and Finland.[2,3,5]

Our findings that most suicides took place between 6 weeks and 1 year postpartum, and that these are fairly evenly distributed across all quarters, are in line with those from previous studies from the UK, Italy and Canada.[4,14,15] Studies focusing on women with (newly diagnosed) severe postpartum psychiatric disorders also show a high remaining relative suicide risk throughout the first year postpartum,[16,17] which stresses the importance of prevention strategies for maternal mental health interventions targeting women throughout the entire first year postpartum, instead of focusing only on the 42-day puerperium within which maternity care is traditionally organised.

Few previous studies have examined socio-economic risk factors for maternal suicide.[4,5,18,19] Results are heterogeneous across settings and time, but seem to point towards a higher risk among women of younger age, those who are unmarried, women with a low socio-economic status and women facing several inter-individual and socio-economic challenges at once. We found that women had a lower educational level than the background population. To obtain data on the level of education in the reference population, data from the Labour Force Survey were used.[9] Surveys are by nature prone to some level of selection bias because of the groups being targeted and their voluntary nature. Therefore, the actual effect of education might be

less pronounced and this finding should be interpreted with caution. Having a migration background did not come out as a particular risk factor, although in the Netherlands and other high-income countries women with a migration background or recent newcomers seeking asylum have been found to have a higher risk of maternal mortality in general.[7,20] This counterintuitive finding for suicides might be a result of the general definition of 'migration background' used by CBS, which does not allow for differentiation between countries of origin, possibly resulting in having many relatively wealthy women from other high-income countries included in this group. Maternal suicides were not identified among teenagers, in contrast to other studies that have reported teenage pregnancy as a risk factor for maternal suicide.[4,5]

Consistent with the literature, many women who died by suicide had a history of mental disorder, most often depression, and/or active involvement from mental health services.[4,5,14,17–19] No previous suicide attempts were reported, but these may not have been identified or recorded in maternity care files. It is suggested that in maternity care, previous suicide attempts are not always discussed during consultations.

We found an alarming underreporting of maternal suicides to the ACMMM. Such underreporting is problematic, because it hampers multidisciplinary analysis of cases as part of the national confidential enquiry into maternal deaths. A recent International Network of Obstetric Survey Systems paper on maternal mortality in eight European countries underscores that confidential enquiries into late maternal deaths are only conducted in the UK and France, hampering broader understanding of risk factors for maternal suicides across Europe.[2] In the UK, it was found that in two out of three maternal suicide cases, improvements of care could have led to a different outcome.[4] It is crucial that countries expand confidential enquiries and vital statistics linkage procedures to the entire first year postpartum to enhance identification of late maternal deaths including suicides.[21] Identification of cases for confidential enquiry should be expanded from including only those cases happening within the realm of maternity care to include those happening in mental health care and general practice.

4.2 | Strengths and limitations

This study is one of the first to show the incidence of maternal suicides over a longer time and brings to light a relevant proportional increase of maternal suicides in light of other causes of maternal mortality decreasing. The main limitation is that our MSR is likely to be underestimated. The linkage method excludes maternal suicides after reproductive outcomes other than birth, such as miscarriage, abortion or ectopic pregnancy. Those deaths are also likely to be underreported to the ACMMM. Studies from Finland and Italy showed even higher rates of suicide following miscarriage or induced abortion than after giving birth.[14,22]

The quality of information regarding psychiatric management as supplied to the ACMMM was insufficient to perform robust audit. This has probably contributed to underestimation of identified improvable factors. Even though there are no legal barriers in the Netherlands for sharing clinical records for confidential enquiry between healthcare organisations, obtaining full information from organisations has been difficult. Cross-checking with or sharing data from CBS to ACMMM was until recently prohibited out of fear for a breach in confidentiality. Some European countries have applied other enhanced case identification methods. In Italy, a linkage between the national death register and the national hospital discharge database was applied to identify cases. In Sweden, an additional link with the National Patient Register enables the collection of detailed patient information.

4.3 | Interpretation of findings

Our study reveals an important barrier to an integrated multidisciplinary approach to studying maternal suicides because the identification and documentation of each case is insufficient. Not all countries have the aforementioned options, such a national patient register, available. However, identification may improve through a formal link between maternal mortality surveillance systems and mental health organisations for the sharing of maternal death reports and suicide reviews. Second, involving other care providers, such as general practitioners, mental healthcare providers, coroners and Child and Family Centres may contribute to improved case finding. A repeated cross-linkage with a vital statistics database to ensure completeness of case identification is indispensable.

Reviews of maternal deaths may benefit from involvement of healthcare workers with mental health expertise, not only for identification of improvable care factors in maternal suicide cases, but also for identification of 'missed' suicides in, for example, presumed car accidents or substance use deaths. Psychological autopsy, a method increasingly used in suicide prevention employing semi-structured interviews with relatives may contribute to better understanding of contributors to maternal suicide.[23]

Overall, our findings highlight that every year women die by suicide while pregnant or soon after giving birth. Maternal suicide is an important cause of maternal mortality in the Netherlands and deaths by suicide occur throughout the entire first year postpartum. If we want to further decrease maternal deaths, increased attention should be paid to improving data collection and analysis, which may contribute to policy development, clinical guidance and appropriate training of health professionals. In addition, surveillance and suicide prevention strategies with focus on the entire first year postpartum should be developed.

AUTHOR CONTRIBUTIONS

All authors were involved in the study design. KML, ALR and GB were involved in data collection and data analysis. All were involved in writing the article.

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CONFLICT OF INTEREST STATEMENT

None declared.

DATA AVAILABILITY STATEMENT

The aggregated data that support the findings of this study are available from the corresponding author upon reasonable request. Individual data are granted at the discretion of CBS and can only be accessed on the servers of CBS, for which researchers can request access.

ETHICS APPROVAL

For this study, direct approval of the Ethics Committee was waived. In the Netherlands, ethical approval is not required for confidential enquiry, which is considered an essential practice to improve birth care. Ethical aspects pertaining to the use of microdata from the CBS database are regulated under the CBS law. Data collected in both databases were strictly de-identified and none of our published outcomes can be traced back to individual patients or health workers.

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