Severe maternal morbidity and maternal near miss in a tertiary hospital of Delhi

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ABSTRACT

Background. In addition to maternal mortality, information on maternal near miss and severe maternal morbidity are important in maternal healthcare. We aimed to determine the incidence, causes and outcome of severe maternal morbidity and near miss, and the sociodemographic and obstetric factors associated with these at a tertiary care teaching hospital in Delhi.

Methods. Women admitted with severe maternal morbidity and near miss, as defined by the WHO study group, were included in the study. The incidence ratio of near miss and severe morbidity in the hospital was determined, and a case–control study was conducted to study the factors associated with the occurrence of near miss. Information was obtained from hospital records and interviews, using a semi-structured open-ended questionnaire.

Results. The incidence ratio of near miss was 6.85/1000, and severe morbidity was 11.38/1000 live births. Hypertensive disorders and haemorrhage were the common causes of cases of near miss and severe morbidity. Coagulation dysfunction (62%) was the most common organ dysfunction, followed by uterine dysfunction (22%). Older age (odds ratio [OR] 2.01, confidence interval [CI] 1.02–3.93), the absence of formal education (OR 2.05, CI 1.11–3.75), <18 years of age at marriage (OR 2.01, CI 1.21–3.32), lower income (OR 3.8, CI 1.88–7.64), gravida of four or more (OR 2.25, CI 1.21–4.17) and residence outside Delhi (OR 9.31, CI 4.36–19.90) were significant predictors of near miss. Sepsis, hypertensive disorders and haemorrhage were the most common underlying conditions in women who died. The foetal outcome was a live birth in 64% of near-miss cases and 62% among severe morbidity.

Conclusions. The burden of severe maternal morbidity and near miss is high. These need to be identified and managed at the earliest.

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INTRODUCTION

Maternal mortality is an important indicator for the measurement of maternal health. Globally, the maternal mortality ratio (MMR) fell by nearly 44% over the past 25 years; however, the reduction has been uneven geographically and the Millennium Development Goal 5 was not achieved.[1] India still accounts for 15% of maternal deaths occurring globally, though there was a 68.7% change in the MMR from 556 in 1990 to 174 in 2015.[2] The notion of severe maternal morbidity and near-miss event was introduced in maternal healthcare to complement information obtained by the review of maternal deaths. Maternal near miss is defined as an ill pregnant woman or woman who has recently delivered who nearly died but survived a complication during pregnancy, childbirth or within 42 days of the termination of pregnancy. Women who develop severe maternal morbidity during pregnancy share many pathological and circumstantial factors related to their condition with those who die. Severe maternal morbidity data are vital for policy planners to know the requirements of essential and emergency obstetric care.[3,4]

Systematic reviews of the prevalence of severe maternal morbidity and maternal near miss noted the absence of standard definitions both for severe maternal morbidities and near-miss cases and cited this as a major constraint in obtaining an overall prevalence of these conditions.[5,6] Consequently, a WHO expert group listed a uniform set of identification criteria for maternal near-miss cases with the aim of facilitating reviews of these cases. A process of identifying cases with potentially life-threatening conditions was suggested. Among these, those with organ system failure or dysfunction as per the definition were classified as near-miss cases.[7,8] Recent studies in developing countries have reported the near miss ratio ranges from 2 to 12 per 1000 live births.[6,9–11] Not many studies have been carried out in India on severe morbidity and near miss using the WHO criteria.[12–14] The recent WHO multi-country survey on maternal and newborn health, which covered women attending health facilities in Africa, Asia, Latin America and the Middle East, found that life-threatening complications occurred in 7% of women and near miss or mortality in 1%.[15] Assessing the magnitude of severe maternal morbidity and near miss using the WHO criteria would aid in making comparisons across countries and regions, and studying the associated factors would help in their prevention. We aimed to study the incidence of severe

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maternal morbidity and near miss in a tertiary care teaching hospital in Delhi, using the WHO criteria, and to assess the feasibility of the application of the criteria to identify the cases in the facility. We also attempted to determine the causes of and sociodemographic and obstetric factors associated with the occurrence of near miss and severe morbidity.

METHODS

We did this study at the Department of Obstetrics and Gynaecology of a tertiary-level, 1000-bed teaching hospital in Delhi. It caters to the population of East Delhi and the adjoining areas of the state of Uttar Pradesh. To determine the incidence ratio, all cases of severe morbidity and near miss were included and to study the factors associated with near miss, a case–control study design was used. The sample size for the case–control study was calculated using the Epi Info 2000 software. A study on the predictors of maternal mortality and of morbidity caused by near miss had shown an OR of 2.3 for women above 35 years of age.[16] According to the National Family Health Survey-3, about 10% of women delivering in a public health facility are 35–49 years of age. With a type I error of 5%, power of study 80%, ratio of controls to cases as 2:1 and estimated OR of 2 for women older than 35 years, an estimated sample size of 223 was computed for cases and 446 for controls.[17] Assuming a non-response rate of 10%, a total of 250 cases and 500 controls were proposed to be recruited for the study.

Women admitted to the hospital from 1 January 2013 to 30 June 2015 with a potentially life-threatening condition during pregnancy, labour and the postpartum period were identified as per the operational definitions suggested by WHO, using the near-miss approach. It The potentially life-threatening conditions included those under haemorrhagic disorders and hypertensive disorders, other systemic disorders and severe management indicators. The WHO criteria of clinical, laboratory and management-based markers to identify organ dysfunction were used for the identification of near miss (Table I).[7,8] The antenatal and postnatal wards, labour and emergency rooms and the intensive care unit (ICU) were visited daily and case records were scrutinized by the investigator. Information obtained by interviewing the patient and/or attendant and from the case records was recorded on a semi-structured open-ended questionnaire designed for the study. It included socio-economic details, obstetric history, antenatal care, clinical presentation, management details, maternal outcome and foetal outcome. Those who fulfilled the WHO criteria for severe maternal morbidity and maternal near miss were classified accordingly.[7,8] For the case–control study, cases included all the women who met the criteria of near miss; and for every case, two women with no complications admitted on the same day were randomly selected, using the lottery method, as controls. No matching was done. Thus, three groups, namely severe maternal morbidity, near miss and controls were identified. Written informed consent was obtained from the patient or from her attendant, in case she was not fit to give consent.

Women residing within the National Capital Territory of Delhi were classified as from Delhi, while those from other areas were classified as from outside Delhi. Antenatal registration was defined as being registered with a medical practitioner for antenatal care, irrespective of the number of visits.

SPSS version 20 for Windows was used for analysis. The near-miss ratio incidence, which is the number of near-miss cases per 1000 live births, and the prevalence of each specific severe maternal morbidity was calculated. Bivariate analysis using the chi-square test was done to study the association between near miss and various factors and the OR was calculated with a 95% confidence interval.

To find the predictors of maternal near miss in women admitted to the hospital, a binary logistic regression analysis was performed, taking maternal near miss as the dependent variable.

The study was approved by the institutional ethics committee.

TABLE I. Criteria for identifying severe morbidity and near-miss cases

Severe morbidity criteria
Haemorrhagic disorders: Abruptio placenta, accreta/increta/percreta placenta, ectopic pregnancy, postpartum haemorrhage, ruptured uterus
Hypertensive disorders: Severe pre-eclampsia, eclampsia, severe hypertension, hypertensive encephalopathy, HELLP syndrome
Other systemic disorders: Endometritis, pulmonary oedema, respiratory failure, seizures, sepsis, thrombocytopenia <100 000/cmm, thyroid crisis
Severe management indicators: Blood transfusion, central venous access, hysterectomy, admission to an intensive care unit, prolonged hospital stay (>7 postpartum days), shock, non-anaesthetic intubation, return to operating room, surgical intervention
Near miss criteria
Cardiovascular dysfunction: Shock, cardiac arrest (absence of pulse/heart beat and loss of consciousness), use of continuous vasoactive drugs, cardiopulmonary resuscitation, severe hypoperfusion (lactate >5 mmol/L or >45 mg/dl), severe acidosis (pH<7.1)
Respiratory dysfunction: Acute cyanosis, gasping, severe tachypnoea (respiratory rate >40 breaths per minute), severe bradypnoea (respiratory rate <6 breaths per minute), intubation and ventilation not related to anaesthesia, severe hypoxaemia (O_2 saturation <90% for ≥60 minutes or PaO_2/FiO_2<200)
Renal dysfunction: Oliguria non-responsive to fluids or diuretics, dialysis for acute renal failure, severe acute azotaemia (creatinine >300 μmol/ml or >3.5 mg/dl)
Coagulation/haematological dysfunction: Failure to form clots, massive transfusion of blood or red cells (≥5 units), severe acute thrombocytopenia (<50 000 platelets/ml)
Hepatic dysfunction: Jaundice in the presence of pre-eclampsia, severe acute hyperbilirubinaemia (bilirubin >100 μmol/l or >6 mg/dl)
Neurological dysfunction: Prolonged unconsciousness (lasting >12 hours)/coma (including metabolic coma), stroke, uncontrollable fits/status epilepticus, total paralysis
Uterine dysfunction: Uterine haemorrhage or infection leading to hysterectomy

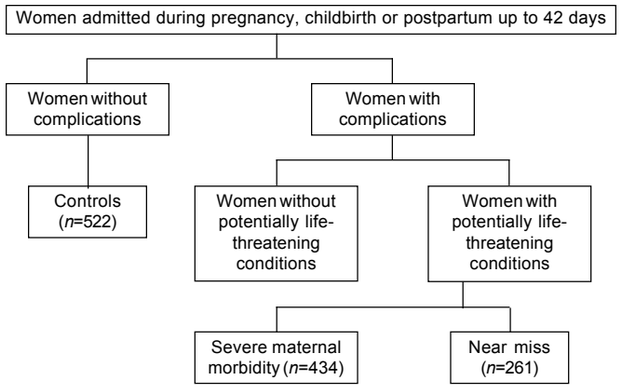

FIG 1. Identification of cases and controls

RESULTS

During the study period, 38 111 live births were recorded, 261 women met the WHO criteria of maternal near miss and 434 were classified as cases with severe morbidity. To maintain the case–control ratio of 1:2, 522 controls were recruited (Fig. 1). A total of 166 deaths occurred during the study period. The incidence ratio of near miss was 6.85/1000 live births, and that of severe morbidity was 11.38/1000 live births. The near miss to mortality ratio was 1.57 and the mortality index was 23%.

Haemorrhage and hypertensive disorders were the most common disease conditions in both severe maternal morbidity and near-miss cases (Table II). Hypertensive disorders were the most common disease conditions in near miss (39%), while haemorrhage was the most common complication in those with severe morbidity (36%). Among the hypertensive disorders, eclampsia accounted for 32% of near miss and 8% of severe morbidity, respectively, while pre-eclampsia was the most frequent cause in severe morbidity (88%). Antepartum haemorrhage (APH) accounted for 70% and 86% of near-miss and severe morbidity cases, respectively, among haemorrhagic disorders. The most common cause of APH was rupture uterus (35%) and placenta previa (27%) in near-miss cases, while in severe morbidity cases, placenta previa (56%) was the most common. Postpartum haemorrhage (PPH) accounted for 40% of near-miss cases as compared to 18% of severe morbidity cases. Anaemia was present in the majority of both near-miss and severe morbidity cases. The prevalence of severe anaemia was higher in near-miss cases (36%) as compared to severe morbidity cases (19%). Sepsis was observed in 5% of near-miss and 3.9% of severe morbidity cases. The conditions classified as 'others' were hepatic failure, thrombocytopenia and systemic causes, such as renal and heart diseases.

Based on the WHO classification, coagulation dysfunction (62%) was the most common cause of maternal near miss followed by uterine (22%), respiratory (22%) and neurological dysfunction (14%).

Age of more than 35 years, absence of formal education, age at marriage of <18 years, pregnancy order 4 or more, not being registered for antenatal care (ANC), residence outside Delhi, low family income and previous caesarean section were identified as significant factors associated with maternal near miss and severe morbidity on bivariate analysis (Tables III and IV).

Age, education, gravida, age at marriage, residence, family income, religion and antenatal care were the factors assessed to determine their relationship with near miss (Table V). The forward stepwise likelihood ratio was used to find significant predictors. Age of more than 30 years (OR 2.0), the absence of formal education (4.2), age at marriage of <18 years (2), relatively low income (3.8), gravida four or more (2.3) and residence outside Delhi (9.3) were significant predictors for near miss.

TABLE II. Diseases in maternal near miss and severe maternal morbidity

Disease	Maternal near miss (*n*=261), *n* (%)	Severe maternal morbidity (*n*=434), *n* (%)
Haemorrhage	94 (36.0)	144 (33.2)
Antepartum haemorrhage	66 (70.2)	124 (86.1)
Placenta previa	18 (27.3)	69 (55.6)
Accreta, increta, percreta placenta	10 (15.2)	3 (2.4)
Abruptio placenta	18 (27.3)	29 (23.3)
Ruptured uterus	23 (34.8)	18 (14.5)
Postpartum haemorrhage	38 (40.4)	22 (17.7)
Infection	13 (5.0)	17 (3.9)
Sepsis	13 (5.0)	16 (94.1)
Hypertensive disorders	101 (38.7)	113 (26.0)
Pre-eclampsia	71 (70.2)	99 (87.6)
Eclampsia	32 (31.7)	9 (8.0)
HELLP syndrome	14 (13.7)	10 (8.8)
Abortion	8 (3.1)	14 (3.2)
Ectopic pregnancy	8 (3.1)	76 (17.5)
Severe anaemia	95 (36.4)	82 (18.9)
Other complications and diseases	79 (30.3)	59 (13.5)
Hepatic failure	8 (10.1)	12 (20.3)
Thrombocytopenia	55 (69.6)	8 (13.5)
Other systemic diseases	33 (41.8)	38 (64.4)

*65 near-miss cases and 69 severe morbidity cases had more than one disease condition HELLP haemolysis, elevated liver enzymes, low platelet count

The three-delay model was used to identify the points at which delays can occur in the management of obstetric complications. Some form of delay was reported in 78% of near-miss and 57% of severe morbidity cases. The second delay, i.e. the delay in reaching an adequate health facility, was identified as a major contributor to both. The most important reason cited was the incompetence of health personnel at the first point of contact in managing the patients and in making referrals due to poor infrastructure (52% and 47% in near-miss cases and 60% and 89% in severe morbidity cases, respectively). More than half (54%) of near-miss and 43% of severe morbidity cases were referred from another facility.

More than half (55%) of near-miss and 50% of severe morbidity cases had a caesarean section delivery, whereas 39% of near-miss and 29% of severe morbidity cases had a normal vaginal delivery (Table VI). The foetal outcome was a live birth in 64% of near-miss cases and 62% of severe morbidity cases, as compared to 99% among the controls ($p<0.0001$). Among the live births, the prevalence of low birth weight was higher in the near-miss (60%) and severe morbidity (49.4%) cases than among the controls (33%). The risk of having a baby weighing <2.5 kg was three times higher among women with near miss than among controls.

Operative procedures, excluding caesarean section, were performed in about 35% of near-miss and 30% of severe morbidity cases. Hysterectomy (54%) was the most common procedure performed in near-miss cases and exploratory laparotomy (64%) was the most common among those with severe morbidity.

TABLE III. Sociodemographic characteristics of maternal near-miss and severe maternal morbidity cases and controls

Characteristic	Near miss	OR (95% CI)	Controls	Severe morbidity	OR (95% CI)
Age (years)					
<20	25 (9.6)	1.10 (0.66–1.83)	65 (12.5)	27 (6.2)	0.19 (0.43–1.13)
21–25	106 (40.6)	1.00	302 (57.9)	180 (41.5)	1
26–30	95 (36.4)	2.18 (1.54–3.10)*	124 (23.8)	144 (33.2)	1.95 (1.44–2.63)*
31–35	29 (11.1)	3.18 (1.80–5.64)*	26 (5.0)	68 (15.7)	4.39 (2.69–7.15)*
>35	6 (2.3)	3.42 (1.02–11.43)*	5 (1.0)	15 (3.5)	5.03 (1.80–14.08)*
Education (years)					
Nil	128 (49.0)	2.05 (1.11–3.75)	139 (26.6)	185 (42.6)	1.44 (0.87–2.37)
1–5	22 (8.4)	0.41 (0.19–0.83)*	120 (23.0)	34 (7.8)	0.31 (0.17–0.55)*
6–12	93 (35.6)	0.93 (0.50–1.70)	223 (42.7)	178 (41.0)	0.86 (0.53–1.41)
>12	18 (6.9)	1.00	40 (7.7)	37 (8.5)	1
Age at marriage (years)					
<18	53 (20.3)	2.26 (1.39–3.68)*	53 (10.1)	93 (21.4)	2.50 (1.63–3.82)*
18–21	135 (51.7)	0.97 (0.68–1.40)	323 (72.0)	224 (51.6)	0.99 (0.73–1.35)
22–25	65 (24.9)	1.00	138 (26.4)	98 (22.6)	1
>25	8 (3.1)	2.12 (0.69–6.57)	8 (1.5)	19 (4.4)	3.38 (1.42–8.03)*
Family income (₹)					
<5000	54 (20.7)	4.19 (2.28–7.69)*	54 (10.3)	77 (17.7)	2.20 (1.36–3.56)*
5000–10 000	186 (71.3)	2.05 (1.23–3.40)*	380 (72.8)	300 (69.1)	1.22 (0.85–1.76)
>10 000	21 (8.0)	1.00	88 (16.9)	57 (13.1)	1.00
Religion					
Hindu	181 (69.3)	1.00	401 (76.8)	299 (68.9)	1.00
Others (Muslim, Christian etc.)	80 (30.7)	1.46 (1.05–2.04)*	121 (23.2)	135 (31.1)	1.50 (1.12–2.00)*
Residence					
Delhi	131 (50.2)	1.00	387 (74.1)	248 (57.1)	1.00
NCT	92 (35.2)	2.19 (1.56–3.06)*	124 (23.8)	150 (34.6)	1.89 (1.42–2.51)*
Outside NCT	38 (14.6)	10.21 (5.06–20.54)*	11 (2.1)	36 (8.3)	5.11 (2.55–10.22)*

*p<0.05 OR odds ratio CI confidence interval NCT National Capital Territory

TABLE IV. Obstetric factors in maternal near-miss and severe morbidity cases and controls

Factor	Near miss	OR (95% CI)	Controls	Severe morbidity	OR (95% CI)
Gravida					
1	79 (30.3)	1.00	215 (41.2)	120 (27.6)	1.00
2–3	113 (43.3)	1.15 (0.81–1.61)	268 (51.3)	228 (52.5)	1.52 (1.15–2.30)*
≥4	69 (26.4)	4.81 (3.01–7.70)*	39 (7.5)	86 (19.8)	3.95 (2.55–6.13)*
Antenatal registration					
Done	207 (79.3)	1.00	474 (90.8)	311 (71.7)	1.00
Not done	54 (20.7)	2.57 (1.69–3.92)*	48 (9.2)	123 (28.3)	3.91 (2.72–5.61)*
Mode of delivery					
Normal vaginal	104 (57.1)	1.00	226 (73.6)	194 (61.8)	1.00
Caesarean section	42 (23.1)	6.08 (3.22–11.66)*	15 (4.9)	54 (17.2)	4.23 (0.35–7.08)
History of abortion					
Yes	60	1.60 (1.10–2.33)*	108	82	1.79 (1.29–2.45)*
No	201	1.00	326	440	1.00

*p<0.05 OR odds ratio CI confidence interval

The hospital MMR was computed as 436/100 000 live births during the study period. Sepsis, hypertensive disorders and haemorrhage were the most common underlying conditions in the women who died. Other complications and systemic diseases, such as anaemia, hepatic causes, fever, renal failure and congestive heart failure, were identified as major indirect causes of maternal death.

DISCUSSION

Our study is one of the few studies in India to use the WHOs near-miss criteria based on dysfunction of organ systems.[12–14] The incidence of near miss was observed to be 6.9/1000 live births and that of severe maternal morbidity, 11.2/1000 live births. This is comparable to that reported in systematic reviews published in 2004 and 2012, using criteria based on organ system dysfunction.[5,6] The observed incidence of near miss

TABLE V. Binary logistic regression analysis for significant predictors of near-miss cases

Variable	OR (95% CI)	p value
Age (years)		
≤20	1.06 (0.59–1.88)	0.851
21–25	Reference	
26–30	2.10 (1.34–3.28)	0.001*
>30	2.01 (1.02–3.93)	0.043*
Education		
Nil	Reference	
1–5 years	0.23 (0.13–0.40)	<0.001*
>5 years	0.71 (0.48–1.06)	0.090
Age at marriage (years)		
<18	2.01 (1.21–3.32)	0.007*
18–21	Reference	
≥22	0.91 (0.59–1.41)	0.672
Family income (₹)		
>10 000	Reference	
5000–10 000	1.96 (1.12–3.44)	0.019*
<5000	3.79 (1.88–7.64)	<0.001*
Religion		
Hindu	Reference	
Other than Hindu	1.16 (0.78–1.74)	0.470
Gravida		
1	Reference	
2–3	0.76 (0.49–1.17)	0.213
≥4	2.25 (1.21–4.17)	0.010*
Residence		
Delhi	Reference	
NCT	2.27 (1.57–3.30)	<0.001*
Outside NCT	9.31 (4.36–19.90)	<0.001*
Antenatal care		
Yes	Reference	
No	1.55 (0.94–2.54)	0.084

*p<0.05. Reference was the category with least risk for all factors except for education NCT National Capital Territory OR odds ratio CI confidence interval

TABLE VI. Maternal and foetal outcome in near-miss and severe morbidity cases and controls

Outcome	Near miss, *n* (%)	Controls, *n* (%)	Severe morbidity, *n* (%)
Mode of delivery			
Normal vaginal	102 (39.0)	508 (97.3)	126 (29.0)
Caesarean section	143 (54.8)	14 (2.7)	218 (50.2)
Foetal outcome			
Live birth	166 (63.6)	519 (99.4)	269 (62.0)
Stillbirth	66 (25.3)	1 (0.2)	64 (14.7)
Abortion	16 (6.1)	0	90 (20.7)
Neonatal death	13 (5.0)	2 (0.4)	11 (2.5)
Baby weight (kg)			
≤2.5	66 (39.8)	349 (67.2)	136 (50.6)
<2.5	100 (60.2)	170 (32.8)	133 (49.4)

was higher than that reported in studies from other developing countries, such as Iraq and Malaysia; but that of severe morbidity was lower than those reported from Malaysia and Brazil.[14–16] A much higher figure of 76.97/1000 live births was reported from Pakistan.[17] Many studies that have used the criteria based on organ system dysfunction have reported a higher prevalence of near miss than our study. This could be because the WHO near-miss criteria have been modified in these studies, especially with regard to the criteria based on the number of units of blood transfused. A study that used a threshold of 2 units of blood instead of 5, as suggested by WHO, reported an incidence of 120/1000 live births. The study from Pakistan used a threshold of 4 units. We used a cut-off of 5 or more units, as suggested by the WHO study group. In our study, 49% (214) of patients with severe morbidity received 2–4 units of blood. Counting these cases as 'near miss' would double the near-miss ratio.[13,19] In studies comparing the various criteria for identifying or validating severe morbidity and near miss, it was suggested that the use of broader criteria by Waterson and the inclusion of clinical criteria and disease conditions showed good validity and might be more useful in identifying near miss in resource-poor settings such as ours.[1,20,21]

In our study, the leading causes of near miss were hypertensive disorders and haemorrhage. This is similar to what was reported previously in the WHO multicountry survey.[14] However, the proportion of near miss due to hypertensive disorders was more than that observed in other studies. Eclampsia was the most common condition in near-miss cases. In the sample of women from Pakistan in the multicountry survey, PPH was the cause of severe maternal morbidity in 48.5% of women.[22] In Malaysia, haemorrhagic disorders were the most common cause of near miss. PPH contributed to 55% of these cases—more than the corresponding figure of 40% observed by us.[10] Rupture uterus was included in haemorrhage as per the WHO criteria. Forty-one cases of rupture uterus were reported, contributing to 11% of near miss. Rupture uterus occurred in 1.01% of women with a history of caesarean section (38/375), which is similar to what was reported previously. It continues to be a cause of severe maternal morbidity and perinatal mortality.[23]

Severe anaemia was present in more than one-third of near-miss and one-fifth of severe morbidity cases. The WHO multicountry survey also named anaemia as the most prevalent indirect cause of severe maternal outcome.[24] In a study from Indonesia, severe anaemia was present in one-fourth of near-miss cases.[25] Thrombocytopenia and systemic and hepatic diseases were the other common causes of near miss. Ectopic pregnancy was a cause in 3% of near miss and 17.5% of severe morbidity cases. In the WHO multicountry survey, ectopic pregnancy was a cause in 4% of women with severe maternal morbidity.[14]

There were 166 deaths, amounting to a hospital MMR of 436/100 000 live births. This is higher than that reported for Delhi and much lower than that reported from a tertiary hospital in Lucknow. Ours is a referral facility catering to a large number of referrals from the private and district hospitals of Delhi and the neighbouring states. About 50% of the deaths occurred within 24 hours of admission, and 60% of the women who died were from outside Delhi, as compared to 40% of the controls. Most were referred from other health facilities due to poor infrastructure and/or inability of health personnel in managing the conditions, leading to delay.

The Global Burden of Disease data for 1990 and 2013 show haemorrhage and hypertensive disorders as the most common causes of maternal mortality, though a decline in the proportion of deaths due to haemorrhage has been observed.[25] A study by the Federation of Obstetric and Gynaecological Societies of

India reported hypertension (29.4%), haemorrhage (21.56%), sepsis (15.05%) and medical disorders (12%) as the leading causes of death.[26] Sepsis was observed to be the third leading cause of death globally and in the multicountry survey. The latter showed that the prevalence of sepsis increases with the severity of disease. A similar trend was seen in our study; sepsis was present in 3.9%, 5% and 34% of severe morbidity, near miss and deaths, respectively.[26,24] The studies from Iraq and Pakistan also reported that the near miss to mortality ratio was the highest for pregnancy-related infection.[9,18] This highlights the importance of prevention, early detection and control of sepsis in obstetric care.

We observed coagulation/haematological dysfunction to be the most common organ dysfunction, followed by uterine and respiratory. The study from Malaysia also reported the former two as the most common events.[10] These were the result of the large number of massive blood transfusions and hysterectomies done. However, a study in Iraq reported cardiovascular dysfunction to be the most common.[9] Classification based on organ system dysfunction is feasible in facilities where procedures for monitoring are routinely performed, and which do not have resource constraints. Although organ system dysfunction criteria may be more reproducible, good laboratory facilities and records may not be available everywhere. The criteria based on the measurement of pH and PaO_2 could not be used as parameters even though the study was conducted in a tertiary hospital of Delhi, since these investigations were not available round the clock. This suggests that it may not be feasible to use these criteria in resource-poor, high-burden settings such as ours.

Advanced maternal age is generally defined as pregnancy in women of the age of 35 years or above. There are a considerable number of pregnancies among these women, especially in the higher income countries, and the risk of maternal morbidity among them is higher. In our study, the proportion of women in this age group in the near-miss cases was 2.3% and in the controls, 1%. This is much lower than the figure of 12.3% reported in a multicountry study conducted by WHO, in which the proportion ranged from 2.8% in Nepal to 31.1% in Japan. The majority of women were in the age group of 21–25 years. The probability of near miss was the least in this age group, thereafter increasing with age.[28]

Women with no formal education had twice the risk of near miss than those with 12 or more years of education. It was interesting that 1–5 years of education had a protective effect on the occurrence of near miss, while >5 years of education did not have a significant effect. This may be explained by the fact that compared to the controls, few women with near miss and severe morbidity had 1–5 years of education. A majority of the literate women, both controls and cases, had 6–12 years of education and thus no statistical significance was observed. In the WHO multicountry survey, lower levels of maternal education were associated with severe maternal near miss after adjustment for key confounding factors.[28] Lower levels of education are associated with lower economic status, especially in developing countries; the women in these countries are more likely to experience delays. Studies on maternal mortality have also shown that women with no education are at an increased risk of dying than those who are educated.[30]

It was found on regression analysis that women who had married before the age of 18 years were at twice the risk of near miss than those who had married later. No studies were found on the relation between severe maternal outcome and age at marriage; however, adolescent mothers have a higher risk of adverse pregnancy outcomes.[31]

The odds of near miss and severe morbidity were 10 and 5 times higher, respectively, in women from outside the National Capital Territory as compared to those residing within. Some of these women had travelled a distance of >50 km to reach the hospital, causing a delay; this highlights the lack of availability of emergency obstetric care services in the areas from which they travelled. It has been shown that women are more likely to seek care from far-off facilities if the target facility is perceived to offer better care.[32] It is important to highlight that the factors that were significantly associated with severe morbidity and maternal near miss, such as low income, lack of education and residence outside Delhi, are correlated and may be markers of the least advantaged women who lack access to emergency obstetric care. However, it was observed in the WHO multicountry survey that the adverse effects of low levels of education on maternal outcomes were mitigated in countries with strong health systems.[29]

The cases of near miss and severe morbidity were less likely to have received ANC than the controls, although this was not significant on regression analysis. Similar observations have been made by other authors.[9,11,13] The odds of a previous caesarean section were six times higher in near-miss cases than in controls. This is consistent with the results of other studies, which show that there is an increased likelihood of hysterectomy during the next pregnancy if the woman has had a caesarean section.[15] This calls for serious efforts to reduce primary caesarean section rates so as to prevent morbidity and mortality during a subsequent pregnancy.

The caesarean section rate was significantly higher in near-miss (55%) and severe morbidity cases (50%) than in controls. This is higher than the overall rate reported in the hospital, but lower than that in other studies on near miss and severe morbidity.[11,18]

As for the foetal outcome, there was a live birth in less than two-thirds of near-miss and severe morbidity cases. This is lower than the rate reported in other studies.[10,11] Stillbirths were reported in 25% of near-miss and 15% of severe morbidity cases. This is similar to the findings of a study in Nigeria, where stillbirths were 210/1000 deliveries among women with severe acute maternal morbidity.[33] The WHO multicountry survey also reported the risk of late foetal deaths and early neonatal mortality to be significantly higher in the case of mothers with complications.[34]

A majority of the women received blood products. In near-miss cases with a diagnosis of haemorrhage, ectopic pregnancy and severe anaemia, the use of blood products was near-universal (90%), while 72% of severe morbidity cases received these products. This is much higher than the figures reported in the WHO multicountry survey, which showed the provision of blood products for PPH near miss to be 64%.[35] The proportion of the transfusion of 5 or more units of whole blood or packed red blood cells was 43%, which is similar to some studies, while a study from Malaysia reported an even higher rate of 62%.[9]

The proportion of women admitted to the ICU with near miss was 27%, which is lower than the figure observed in other studies.[10,18] The low rate of ICU admission indicates a shortage of ICU beds as the hospital has a common ICU with a few beds for obstetric patients. Though the coverage of essential maternal interventions, such as uterotonics for the prevention and

management of PPH, magnesium sulphate for eclampsia and intravenous antibiotics for maternal infections, was high, the rates of adverse maternal and foetal outcomes were also high. This could be due to aspects of obstetric care other than the coverage of essential interventions, such as delays or obstacles in implementation.

We used the WHO near miss criteria to identify cases of near miss and severe morbidity and its feasibility in an institution with a high patient load and limited resources. However, some bias may have crept in while classifying the cases, and the women could not be followed up till 42 days after pregnancy, which may have led us to miss some cases. The selection of a set of controls from an intermediate group of women with complications that are not life-threatening would have provided an important comparison group. However, it is difficult to identify cases with low and moderate morbidity as no standard definitions exist.

The burden of near miss and severe morbidity in our hospital is high. This translates to a significant adverse effect on maternal and foetal outcomes and a burden on health services, in the form of drugs, blood transfusions and operative procedures, among other things. We need to identify the bottlenecks in the management of such cases so that they can be corrected. Delays, mainly at the second level, were significant. Strategies need to be developed to identify life-threatening conditions early, so that such cases reach the appropriate facility in time to prevent maternal and perinatal mortality and morbidity. Delays in seeking care could be prevented if quality antenatal, essential and emergency obstetric care were made available and accessible to all. Further, the availability of obstetric high-dependency and intensive care units at tertiary care hospitals such as ours would be of help to patients of severe morbidity.

Conflicts of interest. None declared

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