

Determinants of maternal near-miss event's among pregnant women attending tertiary care hospital: A case-control study



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ABSTRACT

Background: Women who have survived complications during pregnancy and childbirth have been studied as surrogates of maternal deaths and have been termed as maternal near-miss. Study of such cases is considered a less threatening approach to improve maternal health care by the service providers. With this tool, we will be able to identify the delays. As near-miss occurs much more frequently than maternal deaths, a more reliable quantitative analysis can provide a comprehensive profile of the health system functioning. Near-misses are relatively simpler to analyze and easier to resolve. This knowledge will help in identifying the contributory factors of maternal deaths so that actions can be taken at community and health systems level. **Aims and Objectives:** The objectives of this study were to determinants of maternal near-miss event's among pregnant women attending tertiary care hospital. **Materials and Methods:** This was a case-control study, conducted in the Department of Obstetrics and Gynecology at Government Medical College, Akola from January 2019 to January 2021. One hundred and twenty-five cases and 375 controls were included in the present study using EPI INFO in 2 years. Cases of near-miss events from hospital during study was identified and included in the study. **Results:** In this study, a total of 500 persons were questioned (125 cases and 375 controls), with a 100% response rate. The average ages of the cases and controls were 26.5 (4.42) and 29 (59.9) years, respectively. Pre-existing medical disorders were substantially linked to maternal near miss (MNM). More over half of the patients (59.2%) and less than a third of the controls (23.21%) had a history of at least one pre-existing medical condition. After adjusting in the multivariate logistic regression model, multigravida, lack of antenatal care, induction of labor, and delays in reaching hospital were positively associated with a MNM. For instance, those mothers who were pregnant for the 2nd-4th times (AOR: 4.94 [95% CI: 1.46-16.8]) and more or equal to 5 times (AOR: 3.84 [95% CI: 1.23-11.91]) were nearly five-fold and four-fold more likely to experience MNM events respectively. **Conclusion:** The factors that were found to be significant in our study are non-modifiable risk factors for maternal near-miss occurrences. These events can be prevented and mitigated by early detection and proper prenatal care.

Key words: MNT in women; Smoking in MNM; Alcohol in MNM; Complication in pregnancy; Abortions

INTRODUCTION

Maternal and child health¹ is one of the eight components of primary health care. Although, pregnancy is regarded as a normal physiological process, it can be detrimental to

a woman's life, leading to a variety of problems including maternal death.² Because mothers play such a significant role in the social, economic, and cultural development of their communities, protecting their health is a key priority of the Millennium Development Goals.³⁻⁵

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India accounts for around a quarter of all maternal deaths related to pregnancy and delivery worldwide.⁶ Maternal death evaluations are one of the most important measures for preventing maternal deaths.⁷ Another key technique for preventing maternal fatalities is to capture and analyze data on near-miss incidents that occur during pregnancy.⁸ The WHO, now, defines a maternal near-miss incident, also known as severe acute maternal morbidity, as “a woman who nearly died but survived a condition that happened during pregnancy, childbirth, or within 42 days of termination of pregnancy.”⁹

It is utilized as a substitute for obstetric care evaluation.¹⁰ Because a maternal near-miss is a precursor to a maternal death, identifying the risk factors for near-miss will aid in the development of maternal death prevention methods.¹¹ Near-miss rates have been reported to range from 0.6% to 14.98% in a comprehensive analysis utilizing disease-specific criteria.¹² The chief causes of maternal near-miss have been recognized as hypertensive disorders of pregnancy, obstetric hemorrhage, sepsis, anemia, and obstructed labor/dystocia worldwide.¹³⁻¹⁷

In India, very few investigations on the determinants of near-miss maternal episodes have been undertaken. As a result, we designed a case–control research to determine the factors that influence near-miss maternal events among pregnant women who visit a tertiary care hospital. Such research will aid doctors, program administrators, and policymakers in developing effective strategies to reduce maternal mortality.

Aims and objectives

The study was performed to analyze determinants of maternal near-miss events among pregnant women attending tertiary care hospital.

MATERIALS AND METHODS

Study setting, period, and design

From February 2019 to January 2020, a facility-based case–control study was undertaken in Department of Obstetrics and Gynecology at Tertiary care Institute and Medical College.

Sampling method and sample size

Sample size calculated using the following assumptions: Considering the 95% confidence level, 5% type 1 error, 20% type 2 error, 80% power, ratio of case to control = 1:3, odds ratio = 2.5 expected frequency of exposure in control = 8%, and sample size using software EPI INFO, which was found to be 125 cases and 375 controls. Cases of near-miss events from the hospital

during study duration were identified and included in the study.

Selection of cases

The WHO recommended three different approaches of selection criteria, for identification of maternal near-miss cases. They are disease-specific criteria, management-based criteria, and organ dysfunction criteria.¹⁷ Same criteria will be used for case definition in the study.

According to the World Health Organization, if a woman presents any of the conditions stated below during pregnancy, childbirth or within 42 days of termination of pregnancy, and survives, she is considered as a maternal near-miss case.

Cardiovascular dysfunction: Shock, cardiac arrest, severe hypoperfusion (lactate >5 mmol/l or >45 mg/dl), severe acidosis (ph40 breaths per minute), use of continuous vasoactive drugs, and cardiopulmonary resuscitation.

Respiratory dysfunction

Acute cyanosis, gasping, severe tachypnea (respiratory rate >40 breaths/min), severe bradypnea (respiratory rate), severe hypoxemia (O_2 saturation (O_2 saturation <90% for ≥ 60 minor $PAO_2/FiO_2 < 200$), intubation, and ventilation not related to anesthesia.

Renal dysfunction

Oliguria non-responsive to fluids or diuretics, severe acute azotemia (creatinine >300 μ mol/ml or >3.5 mg/dL), and dialysis for acute renal failure.

Coagulation dysfunction: Failure to form clots, severe acute thrombocytopenia (<50,000 platelets/ml), and massive transfusion of blood or red cells (≥ 5 units).

Hepatic dysfunction: Jaundice in the presence of pre-eclampsia, severe acute, and hyperbilirubinemia (bilirubin >100 μ mol/L or >6.0 mg/dL).

Neurologic dysfunction: Prolonged unconsciousness or coma (lasting >12 h), stroke, uncontrollable fit/status epilepticus, and global paralysis.

Uterine dysfunction: Hysterectomy due to uterine infection or hemorrhage.

Selection of controls

Controls were women who had normal pregnancy outcome without any complications. We had selected three unmatched controls from the same day that each case was enrolled from the department of obstetrics and gynecology to ensure a case and control ratio of 1:3.

Matching

Matching of cases and control was done with respect to some factors like age to rule for potential confounders.

Data collection tool, procedure, and personnel

The data collection tool was in the form of predesigned and semi-structured pro forma which included information on following seven heads: (1) Sociodemographic factors such as, age of mother, religion, marital status, education, spouse's education, mother's occupation, spouse's occupation, and the source of funding for the delivery. (2) Mother's medical history – history of smoking, alcohol use, contraceptive use, previous abortion, previous twins, gravida, and pre-existing medical conditions, height, and weight to calculate BMI. (3) History of a chronic medical condition – hypertension, diabetes, asthma, cardiac disease, sickle cell disease, and cerebrovascular disease. (4) Obstetric or reproductive factors – Stage of pregnancy, stage of labor, number of antenatal care (ANC) visits, and place of ANC care. (5) Health system factors – mode of delivery, attended by trained birth attendant or not, qualification of birth attendant, and referral from another facility (yes/no), any delay in treatment seeking (6) Reasons for admission to hospital – reason for admission to hospital (Various morbidities/complications, for example, eclampsia, dystocia hemorrhage, or comorbid causes), diastolic blood pressure (millimeters of mercury/mm Hg), systolic blood pressure (mm HG), hemoglobin level (grams per deciliter g/dL), pulse rate (beats per minute/bpm), and temperature (degrees Celsius/°C). (7) Determination of prenatal care – Kessner index¹⁸ was used for assessing the prenatal care (adequate, intermediate, or inadequate)

Data entry and analysis

Data entry and analysis was done using commercial statistical package SPSS 21.0 for MS-windows and appropriate statistical test and odds ratio was calculated to see the association between maternal near cases and various risk factors. The descriptive statistics are presented as numbers and percentages in the given study. P value which was $P < 0.005$ shows statistical significant difference.

Ethical approval

Ethical approval from the Institutional Ethical Committee was obtained (EC/44/2021). Consent from the participants was taken and confidentiality of the data were maintained.

Implications

The study will help to identify the risk factors associated with maternal near-miss events, which are considered as a surrogate for assessment of obstetric care given during pregnancy. Evaluating the risk factors and timely measures will help to reduce the complications during pregnancy. The present study will help doctors, program administrator, and policy makers for planning effective interventions for reducing near-miss maternal events and maternal deaths.

The perinatal survival rate in women can be improved by minimizing the impact of risk factors.

RESULTS

In this study, a total of 500 persons were questioned (125 cases and 375 controls), with a 100% response rate. The average ages of the cases and controls were 26.5 (4.42) and 29 (59.9) years, respectively. The age range of 20–35 years old accounted for 77.9% of cases and 85.5% of controls. MNM was assessed for 48 (38.40%) cases and 82 (21.87%) controls based on previous abortion status. Controls had a higher percentage of literate participants than cases (Table 1).

In this study, the proportion of second to fourth gravida in near-miss groups was higher than that of first and above fourth gravida. Similarly, 38.40% of cases and 21.87% of controls had an abortion previously (Table 2).

In this study, the absence of ANC visits was connected to maternal near-miss. In a multivariate logistic regression analysis, the absence of ANC, prior history of cesarean section, delay in attending the final place of treatment for more than 60 min, poor BPCR practice, and lack of prenatal care were all revealed as major factors of MNM (Table 3).

More over half of the patients (59.2%) and less than a third of the controls (23.21%) had a history of at least one pre-existing medical condition. Pre-existing medical disorders were substantially linked to MNM (Table 4).

Determinants of maternal near-miss at Nekemte Referral Hospital: Variables related to basic socio demographics and obstetrics were considered as risk factors associated with a MNM in the analysis of this study. After adjusting in the multivariate logistic regression model, multigravida, lack of ANC, induction of labor, and delays in reaching hospital were positively associated with a MNM. For instance, those mothers who were pregnant for the 2nd–4th times (AOR: 4.94 [95% CI: 1.46–16.8]) and more or equal to 5 times (AOR: 3.84 [95% CI: 1.23–11.91]) were nearly five-fold and four-fold more likely to experience MNM events, respectively. Likewise, mothers with no ANC (AOR: 6.02 [95% CI: 1.55–23.28]) were 6 times more likely to have MNM events compared to mothers who received ANC. Mothers who were induced with oxytocin (AOR: 9.40 [95% CI: 2.97–29.71]) were 9 times more likely to have MNM events (Table 5).

DISCUSSION

Maternal mortality is one of the worst performing health indicators in resource-constrained settings. Every year,

Table 1: Sociodemographic and economic characteristics of mothers admitted to tertiary hospitals

Variables categories	Cases	Percent	Control	Percent	Total (n=500)	P-value
Age of mother in years						
< 20	2	1.60	2	0.53	4	0.21
20–34	112	89.60	323	86.13	435	
35+	11	8.80	50	13.33	61	
Religion						
Hindu	119	95.20	301	80.27	420	0.001
Muslim	0	0.00	28	7.47	28	
Buddhist	5	4.00	36	9.60	41	
Christian	1	0.80	6	1.60	7	
Other	0	0.00	4	1.07	4	
Mother's educational level						
Literate	108	86.40	340	90.67	448	0.17
Illiterate	17	13.60	35	9.33	52	
Husband's education						
Literate	120	96.00	350	93.33	470	0.27
Illiterate	5	4.00	25	6.67	30	
Mother's occupation						
Government job	18	14.40	32	8.53	50	<0.001
Private job	6	4.80	22	5.87	28	
Health care worker	13	10.40	2	0.53	15	
Homemaker	85	68.00	287	76.53	372	
Labor	3	2.40	32	8.53	35	
Husband occupation						
Government job	73	58.40	170	45.33	243	<0.001
Private job	21	16.80	43	11.47	64	
Health-care worker	11	8.80	1	0.27	12	
Homemaker	1	0.80	0	0.00	1	
Labor	19	15.20	161	42.93	180	
Source of funding for delivery						
Government	90	72.00	305	81.33	395	0.22
Private	4	3.20	8	2.13	12	
Self	31	24.80	62	16.53	93	
Other	0	0.00	0	0.00	0	
History of smoking						
Yes	24	19.20	12	3.20	36	0.0001
No	105	84.00	363	96.80	468	
Alcohol use						
Yes	19	15.20	10	2.67	29	0.0001
No	106	84.80	365	97.33	471	
Previous abortion						
Yes	48	38.40	82	21.87	130	0.002
No	77	61.60	293	78.13	370	

more than 500,000 women aged 15 to 49 die worldwide as a result of difficulties during pregnancy and childbirth.¹⁸ Near-miss has proven to be a useful tool in the investigation of maternal deaths.¹⁹

To address any detected deficiencies or failures and take corrective action, it is vital to understand the processes of obstetrics care. Maternal health services have played a critical role in lowering the country's maternal mortality rate. The health care that a woman receives during pregnancy, labor, and the immediate post-operative period is critical for both the mother and the child's life and well-being.

A total of 500 MNM patients were screened in the current case–control research, which was conducted from February 2019 to January 2020.

In the present study, cases were divided into nine sociodemographic and financial categories, including mother's age, religion, mother's educational level, husband's educational level, mother's occupation and husband's occupation, source of delivery funding, history of smoking, alcohol usage, and previous abortion. Only the mother's occupation and husband's occupation yielded significant findings, whereas the rest of the factors yielded non-significant results. Suhurban *et al.*,²⁰ found a significant difference among the above linked indicators examined, indicating a low socioeconomic status to be a major confounding factor for MNM in developing countries.

When we examined the obstetric features of mothers admitted to a tertiary care hospital, we discovered that women with lesser education had a four-fold higher

Table 2: Obstetric characteristics of mothers admitted to tertiary hospital

Gravidity	Case	Percent	Control	Percent	Total (n=500)
0-1	46	36.80	96	25.60	142
02-4	69	55.20	268	71.47	337
5+	10	8.00	11	2.93	21
Previous abortion					
Yes	48	38.40	82	21.87	130
No	77	61.60	293	78.13	370
Previous twins					
Yes	8	6.40	7	1.87	15
No	117	93.60	368	98.13	485
Stage of pregnancy					
<28 weeks	34	27.20	84	22.40	118
28-36 weeks	64	51.20	203	54.13	267
>36 weeks	27	21.60	88	23.47	115
Referral from another facility					
Yes	45	36.00	2	0.53	47
No	80	64.00	373	99.47	453
Previous child					
Yes	99	79.20	283	75.47	382
No	26	20.80	92	24.53	118

Table 3: Maternal health service-related characteristics of mothers admitted to tertiary hospital

ANC visit	Case	Percent	Control	Percent
>4	15	12.00	351	93.60
02-03	65	52.00	22	5.87
1	9	7.20	2	0.53
No	36	28.80	0	0.00
Mode of delivery				
Vaginal birth	79	63.20	210	56.00
Unplanned CES	45	36.00	9	2.40
Scheduled CES	1	0.80	131	34.93
Natural birth	0	0.00	25	6.67

Table 4: Indications for admission

Pre-existing disorders	Case	Percent	Control	Percent
Hypertension	27	21.60	19	5.07
Diabetes	20	16.00	27	7.20
Asthma	12	9.60	19	5.07
Sickle cell disease	5	4.00	13	3.47
Cardiac disease	10	8.00	9	2.40

Table 5: Analyze maternal near-miss determinants using multivariate binary logistic regression

Characteristics	P-value	Adjusted odds ratio (95% CI)
Lack of ANC	0.001*	5.42 (3.115, 9.463)
Education	0.17	0.654 (0.352, 1.213)
Contraceptive use	0.0005*	0.42 (0.264, 0.686)
Stage of labor	0.021*	8.32 (0.08, 0.36)
Previous abortion	0.0003*	2.227 (1.440, 3.443)

*Statistically significant difference

risk of developing this illness. Women who resided in rural areas were at a significantly higher risk. In addition,

near-misses on arrival were linked to maternal age and 1st-time pregnancy, a lack of referral facilities, and a previous abortion. We suggested, that by identifying such subpopulations, treatments tailored to facilitate timely care-seeking for maternal complications could be developed.

The present study showed that among all the cases of near-miss event, 79 (63.20%) were vaginal deliveries in cases in contrast 210 (56.00%) vaginal deliveries which took place in controls. Unplanned cesarean sections were performed 45 times (36.0%) in cases, 9 times (2.40%) in controls, and just once (6.67%) in natural births. However, during the entire duration of the study, there was no maternal death reported among the 500 near-misses.

In the present study, hypertension, diabetes, asthma, sickle cell disease, and heart disease were all reported at the time of admission. A total of 500 mothers were screened for them, 27 (21.60%) of the mothers reported hypertension, while 19 (5.07%) of them had it under control. In addition, 20 (16.00%) of the participants had diabetes, compared to 27 (7.20%) controls. 12 (9.60%) cases had asthma, compared to 19 (5.07%) controls, 5 (4.00%) cases had sickle cell disease, compared to 13 (3.47%) controls, and 10 (8.00%) cases had cardiac illness, compared to 9 (2.40%) controls. It means that hypertension and diabetes had a significant impact on MNM, whereas heart disease had a minor impact on the condition. Asthma and sickle cell illness, on the other hand, had no bearing on MNM.

A study done by Aklilu Habte's showed that severe postpartum hemorrhage (50.6%) and sepsis (23.4%) were the most common reasons for admission of cases. Lack of ANC (AOR = 3.25; 95%CI: 2.21, 7.69), prior history of cesarean section (AOR = 3.53; 95%CI: 1.79, 6.98), and

history of preexisting medical disorders (AOR = 2.79; 95%CI: 1.45, 5.37) were identified as significant determinants of maternal near-miss. Hence, the lack of ANC, prior history of cesarean section, delaying more than 60 min to reach the final place of care, poor BPCR practice, and history of pre-existing medical conditions were established as determinants of a maternal near-miss.

Similarly, Khadka et al., had also reported that hemorrhage and hypertensive disorders are the leading causes of near-miss event. Evaluation of associated risk factor can be a potential tool for reduction of maternal morbidity and mortality.

Hence, the study concludes that maternal near-miss could be an important tool to assess maternal morbidity burden. Hence, this study recommends that we can utilize our knowledge of maternal near-miss cases to reduce maternal mortality by identifying preventable factors and doing vigilant timely interventions.

Limitations of the study

None.

CONCLUSION

During pregnancy, with little or no warning, any pregnant woman might develop life-threatening complications. However, a maternal near-miss concept will be useful to measure maternal mortality and maternal care quality. Hence, maternal near-miss investigation in recent years became very popular. In this study, we conclude that all women should have access to high-quality maternal healthcare that can detect and treat life-threatening complications. Maternal near-miss strategy was genuinely helpful for mitigating the risk of serious pregnancy complications, near-miss cases, and maternal mortalities.

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RjP- Concept and design of the study; **RP**- Prepared first draft of manuscript; **SC**- Concept, coordination; **MP**- Reviewed the literature and manuscript preparation, preparation of manuscript and revision of the manuscript; **VB**- Statistical analysis and interpretation.

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