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Original Article

Obstetrics and Gynaecology Section

Study of Maternal Near Miss and Maternal Mortality in a Tertiary Care Hospital

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ABSTRACT

Introduction: There are several advantages of using Severe Acute Maternal Morbidity (SAMM) as a tool compared to maternal mortality as an indicator of obstetric care. The health personnel are more forthcoming in giving detailed treatment information as there is no threat of punitive liability. Hence, over the last decade, there is a gaining momentum to use Maternal Near Miss as an indicator of obstetric care. However, unlike maternal deaths, it often becomes difficult to define maternal near miss cases. Ministry of Health and Family Welfare, India, have recently laid down Operational guidelines to define and report MNM cases in the country. Being a relatively new guideline, there is paucity of well designed, prospective studies using Near miss definition as per it.

Aim: To determine the incidence and cause of MNM cases and Maternal deaths in a tertiary care hospital and identify gaps in the existing Health system in India and determine an approach to resolve them.

Materials and Methods: An Audit of Maternal Death and MNM cases was undertaken in a Safdarjang hospital in Delhi, India from October 2015 to December 2016. During this study period, all the women who met the criteria according to MNM Operational Guidelines were identified and enrolled in the study; specially the potentially life-threatening conditions were selected. The MNM indices were calculated.

In data analysis, for qualitative data, proportions were calculated. Mean score was calculated for quantitative data. Test of significance of differences between proportions and mean were calculated. Qualitative data was analysed by Chi-square test and t-test was applied for quantitative data.

Results: There were 31,925 deliveries at the Institute. The MNM IR (Maternal Near Miss Incidence Ratio) in this study was 8/1000 live births and the MMR was 421/100,000 live births. The MNM: MM ratio was 1.9:1. Overall Mortality Index (MI) was 34%. Severe Maternal Outcome Ratio (SMOR) was 12.2/1000 live births. Most common causes of MNM were haemorrhage (53.8%), hypertensive disorders of pregnancy (21.7%), medical disorders (13.3%) and obstetric sepsis (8.8%).

Majority of Maternal deaths were due to direct obstetric causes (71.8%). The most common direct causes for maternal deaths were hypertensive disorders of pregnancy (31.2%). More number of women in the maternal death group (34.3% versus 27.7%) presented to the hospital with postpartum complications, however, the difference was not statistically significant. Illiteracy ($p<0.01$) and lower socio-economic status ($p<0.0001$) were associated with higher probability of maternal deaths.

Conclusion: The most common cause of MNM was haemorrhage, mostly, post-partum haemorrhage. Mothers will benefit by up-gradation of the infrastructure of the peripheral health centres (like ensuring availability of blood banks, round the clock operation theatre facility, magnesium sulphate for seizure prophylaxis etc.,) along with a network of referral linkage to ensure speedy and appropriate referrals.

Keywords: Developing nation, Maternal health, Quality of care, Severe acute maternal morbidity

INTRODUCTION

As per the latest report of the Registrar General of India, Maternal Mortality Ratio of India has declined from 212 per 100,000 live births in the period 2007-09 to 130 per 100,000 live births [1]. Reducing Maternal mortality and improving existing health care is a prime concern both for the country and worldwide.

Both, Maternal mortality and Maternal near miss are important indicators of maternal health. Maternal mortality, is often described as “the tip of the iceberg” [2], and maternal morbidity as the base. That is for each maternal death, there are several women who experienced a severe complication, nearly died but survived (near miss) [3].

Maternal Near Miss (MNM) is defined as “A Woman Who Survives Life Threatening Conditions during Pregnancy, Abortion, and Childbirth or within 42 Days of Pregnancy termination, irrespective of receiving Emergency Medical/Surgical Interventions” [4].

There are several advantages of using SAMM as a tool compared to maternal mortality, e.g., - the woman is alive to give a detailed account of the series of the event, there are more number of cases of SAMM compared to maternal deaths. The health personnel are more forthcoming in giving detailed treatment information as there is no threat of punitive liability [5]. Hence, over the last decade; there is a gaining momentum to use MNM as an indicator of obstetric care, even in developing countries [5,6].

However, unlike maternal deaths, it often becomes difficult to define MNM cases. With passage of time and geographical boundaries, the definition of near miss has evolved and literature demonstrates different criteria being used to define near miss (disease specific, management specific, organ system dysfunction specific, WHO criteria [7] etc.,). Ministry of Health and Family Welfare (MOHFW), India, have recently laid down Operational guidelines [4] to define and report MNM cases, adapted for and use in the country. Being a relatively new guideline, there is paucity of well-designed, prospective studies using it to Audit Near Miss.

Hence, this study was conducted, to identify gaps in the existing Health system in India and determine an approach to resolve them using the MNM review Operational guidelines, launched by MOHFW, India.

This study, also aimed to determine the incidence of MNM to Maternal Mortality Ratio (MNRM) and the Mortality Index (MI) in a tertiary care

hospital, over a period of one year according to the Maternal Near Miss operational Guidelines, laid by MOHFW, Government of India.

MATERIALS AND METHODS

A prospective cohort study was conducted in a Tertiary care hospital, in North India from October 2015 to December 2016, to determine the causes of MNM.

The cases which met the criteria of MNM as per the Maternal Near Miss Operational Guidelines, [4] were included for audit by the Maternal mortality review committee along with maternal death cases. The Institutional Ethical Committee approved the study (IEC/ VMMC/ SH/Thesis/October/2015). All the participants signed the consent form (Hindi or English).

Inclusion Criteria

During the study period, all the women who met the criteria for MNM were identified at the time of discharge and enrolled in the study. Maternal mortality cases were identified as per WHO definition of maternal death [8] from amongst all the female deaths in the hospital.

Facility based MNM Review form and Facility based maternal death form were filled for MNM cases and maternal deaths, respectively by the treating doctors. Patient characteristics including age, parity, gestational age at the time of admission, booked (at least 3 antenatal visits at the institute), mode of delivery, ICU admission, lifesaving intervention and foetal outcome were analysed for both the groups. Caregivers were interviewed and medical records reviewed to identify the gaps in both the groups by the members of the departmental committee members. In some near miss cases, women were also interviewed. Audit was conducted for both by the departmental committee, during the weekly and monthly meet.

Patients were categorised by final diagnosis with respect to haemorrhage, hypertension, sepsis, dystocia (direct causes). Anemia, thrombocytopenia, and other medical disorders were considered as indirect causes contributing to MNM and deaths.

The above data was analysed to calculate the following near miss indices [9]:

1. **Women with Life-Threatening Conditions (WLTC)** refers to all women who either qualified as maternal near-miss cases or those who died (i.e., women presenting a severe maternal outcome). It is the sum of maternal near-miss and maternal deaths (WLTC=MNM+MD).
2. **Severe Maternal Outcome Ratio (sMOR)** refers to the number of women with life-threatening conditions (MNM+MD) per 1000 live births (LB). {SMOR=(MNM+MD)/LB}.
3. **MNM Ratio (MNMR)** refers to the number of maternal near-miss cases per 1000 live births (MNMR=MNM/LB).
4. **Maternal Near-Miss Mortality Ratio (MNM: MD)** refers to the ratio between MNM cases and Maternal Deaths (MD).
5. **Mortality Index (MI)** refers to the number of maternal deaths divided by the number of women with life-threatening conditions expressed as a percentage [MI=MD/(MNM+MD)].

STATISTICAL ANALYSIS

Data entry was done on Microsoft Excel spreadsheet and it was analysed using Statistical Package for Social Sciences (SPSS) version 21.0. For qualitative data, proportions were calculated. Mean score was calculated for quantitative data. Test of significance of differences between proportions and mean were calculated. Qualitative data was analysed by Chi-square test and t-test was applied for quantitative data. p-value <0.05 was considered significant.

RESULTS

During the study period, there were 31,925 deliveries at the Institute. Total live births, maternal mortality and near miss cases are shown in [Table/Fig-1].

Indices	Numbers
Total no. of deliveries	31,925
Total no. of live births (LB)	31,111
Number of near miss cases (MNM)	249
Number of maternal mortality cases (MM)	131
Maternal near miss incidence ratio (MNM IR=MNM/LB)	8/1000 live births (0.8%)
Maternal mortality ratio (MMR=MM/LB)	421/1,00,000 live births (0.421%)
Maternal near miss: Maternal mortality ratio (MNM: MD)	1.9:1
Mortality index (MD/MNM+MD)	34.0%
Severe maternal outcome ratio (SMOR=MNM+MD/LB)	12.2/1000 live births (1.22%)

[Table/Fig-1]: Near miss indices.

[Table/Fig-2] shows the characteristics of women in both the groups. Mean age of the women in both the groups were

Patient characteristics	Near miss (249)	Maternal deaths (131)	p-value
Age (years)	26.55±4.16 years	26.02±5.05 years	0.29
≤20 yrs	14 (5.6%)	16 (12.2%)	
21-25 yrs	93 (37.3%)	52 (39.7%)	
26-30 yrs	111 (44.6%)	44 (33.6%)	
31-35 yrs	22 (8.8%)	14 (10.6%)	
≥35 yrs	9 (3.6%)	5 (3.8%)	
Parity			
Primipara	77 (30.9%)	43 (32.8%)	0.07
Multipara	172 (69%)	88 (67.1%)	
Antenatal/Postnatal status			
Antenatal	180 (72.3%)	86 (65.6%)	0.179
Postnatal	69 (27.7%)	45 (34.3%)	
LSCS done at another facility and referred	27.5%	37.8%	
Mean duration of hospital stay	8.94±3.06 days	3.27±6.9 days	**<0.01**
Antenatal care			
Booked	22 (8.8%)	8 (6.1%)	0.35
Unbooked	227 (91.2%)	123 (93.9%)	
Referral status			
Referred	178 (71.4%)	98 (74.8%)	0.49
Self admitted	71 (28.5%)	33 (25.2%)	
ICU admission	159 (63.9%)	90 (68.7%)	0.34
Not admitted in ICU	90 (36.1%)	41 (31.2%)	
Period of Gestation (POG) in weeks			
<12	23 (12.8%)	1 (1.2%)	**0.002**
12-28	15 (8.3%)	14 (16.3%)	
>28	142 (78.9%)	71 (82.6%)	
Socioeconomic status (Modified Kuppuswamy scale)			
Lower middle	58 (23.3%)	14 (10.7%)	**<0.0001**
Upper lower	16 (6.4%)	0	
Lower	175 (70.9%)	117 (89.3%)	
Level of delay			
First delay	169 (67.9%)	102 (77.9%)	**<0.01**
2nd delay	33 (13.3%)	5 (3.8%)	
3rd delay	175 (70.0%)	98 (74.8%)	
Educational status			
Illiterate	184 (73.9%)	120 (91.6%)	**<0.01**
Literate	65 (26.1%)	11 (8.4%)	

[Table/Fig-2]: Patient characteristics.

comparable, majority of the women were in their twenties. More number of women with teenage pregnancies died than survived (12.2% versus 5.6%). Most of the women were unbooked. Many women had more than one level of delay. Delay in women seeking care (level 1) was most common in both the groups. A high proportion of women also experienced a delay in referrals to the current Health facility (Level 3 delay), 70% and 74.8%, respectively. More number of women in the maternal death group (34.3% versus 27.7%) presented to the hospital with postpartum complications, however, the difference was not statistically significant. Many had undergone LSCS at another health facility and referred with multiple complications to the present facility (27.5% and 37.8%, in MNM and MM group, respectively).

A high proportion of women in MNM group had live births (61.8%) compared to MM group (38.9%, p-value <0.001). However, the incidence of Intra-uterine fetal deaths were comparable in both groups (23.4% vs 29.0%).

Most common causes of MNM in the study were haemorrhage (53.8%) [Table/Fig-3]. Majority of Maternal deaths were due to direct causes (71.8%). The most common causes were hypertensive disorders of pregnancy (31.2%). In the MNM group, admission to ICU was the most common intervention (63.9%), [Table/Fig-4-6].

Primary determinant	Maternal near miss (n=249)
Haemorrhage	134 (53.8%)
Early pregnancy	27 (10.8%)
Abortion	4 (1.6%)
Ectopic pregnancy	23 (9.2%)
Late pregnancy	107 (43%)
APH	19 (7.6%)
Placenta previa	12 (4.8%)
abruption	7 (2.8%)
PPH	53 (21.3%)
Atonic PPH	45 (18%)
Traumatic PPH	8 (3.2%)
Morbidly adherent placenta	13 (5.2%)
Rupture uterus	16 (6.4%)
Uterine inversion	6 (2.4%)
Hypertensive disorders in pregnancy	54 (21.7%)
Ecclampsia	33 (13.2%)
Pre-ecclampsia	21 (8.4%)
Obstetrical sepsis	22 (8.8%)
Postabortal	5 (2%)
Puerperal sepsis	17 (6.8%)
Medical disorder	32 (13.3%)
Cardiac dysfunction	9 (3.6%)
Haematological dysfunction	19 (7.6%)
Hepatic dysfunction	1 (0.4%)
Respiratory dysfunction	1 (0.4%)
Endocrine dysfunction	2 (0.8%)
Incidental/accidental causes	7 (2.8%)
Infections	6 (2.4%)
Anaphylaxis	1 (0.4%)

[Table/Fig-3]: Distribution of study participants according to primary cause in Maternal Near miss group.

DISCUSSION

Over the last decade; there is a gaining momentum to use MNM as an indicator of obstetric care. Several studies have been conducted to audit the MNM cases [10-27] both in India and across the globe.

Direct causes	Maternal mortality (n=131)
Pregnancy with abortive outcome	8 (6.1%)
Ectopic pregnancy	1 (0.8%)
Septic abortion	7 (5.3%)
II. Hypertensive disorders	41 (31.2%)
Eclampsia	20 (15.2%)
Severe PE/HELLP	21 (16%)
III. Obstetrical haemorrhage	25 (19%)
APH	8 (6.1%)
PPH	14 (10.7%)
Rupture uterus	3 (2.3%)
IV. Pregnancy related infections	19 (14.5%)
Chorioamnitis	1 (0.8%)
Wound infections	3 (2.3%)
Puerperal sepsis	15 (11.5%)
V. Other obstetric complications	1 (0.8%)
Amniotic fluid embolism	1 (0.8%)
VI. Unanticipated complications of management	0 (0.0%)
VII. Non obstetric complications	37 (28.2%)
Cardiovascular causes	8 (6.1%)
Haematological causes	8 (6.1%)
Hepatic disorders	10 (7.6%)
Neurological disorders	1 (0.8%)
Respiratory disorders	4 (3.0%)
Renal disorders	0 (0.0%)
Maternal infections and parasitic disease	6 (4.6%)
VIII Unknown	0 (0.0%)
IX Coincidental causes	0 (0.0%)

[Table/Fig-4]: Cause of maternal mortality according to International Classification of Disease 10th revision (ICD-10 & ICD-MM).

Cause	Total	MNM	MM	Mortality index MI (%)
Haemorrhage	160	134 (83.8%)	26 (16.3%)	16.3
Early pregnancy		27	1	
Late pregnancy		107	25	
APH		19	8	
PPH		53	14	
Rupture Uterus		16	3	
Uterine Inversion		9	-	
Morbidly adherent placenta		13	-	
Hypertension	95	54 (56.8%)	41 (43.2%)	43.2
Eclampsia		33	20	
Pre-eclampsia		21	21	
Medical disorders (indirect cause)	69	32 (46.4%)	37 (53.6%)	53.6
Obstetrical sepsis	48	22 (45.8%)	26 (54.2%)	54.2
Others	8	7 (87.5%)	1 (12.5%)	12.5

[Table/Fig-5]: Disease specific mortality index.

However, unlike maternal death, identifying MNM is complex. Different criteria have been used in the past to define MNM, like disease specific criteria, management specific criteria or organ system dysfunction criteria. WHO have defined near miss using organ system dysfunction criterion. While, many authors have used the WHO Criteria for near miss audit [Table/Fig-7], some had to make minor changes to this approach [14,16,23, 24] as the need was felt to modify according to the lack of some facilities at their centre or an underestimation of near miss cases was perceived using this approach.

Interventions	Maternal near miss (n=249)	Maternal mortality (n=131)
ICU admission	159 (63.9%)	90 (68.7%)
Resuscitative procedure/intubation	59 (23.7%)	98 (74.8%)
Mechanical ventilation	14 (5.6%)	25 (19.1%)
Use of cardiotonics/vasopressors	33 (13.3%)	64 (48.9%)
Laparotomy with B lynch suture	1 (0.4%)	1 (0.8%)
Hysterectomy	44 (17.3%)	12 (9.2%)
Internal iliac artery ligation	5 (2%)	5 (3.8%)
Repair of genital injuries	10 (4%)	0 (0%)
Manual removal of placenta	1 (0.4%)	0 (0%)
Reposition of inverted uterus	6 (2.4%)	0 (0%)
Balloon tamponade	14 (5.6%)	5 (3.8%)
Evacuation	6 (2%)	0 (0%)
Repair of bowel, bladder	5 (2%)	0 (0%)
Dialysis	14 (5.6%)	5 (3.8%)
Management of ketoacidosis	2 (0.8%)	2 (1.5%)
Drugs to reduce cerebral oedema (mannitol)	2 (0.8%)	5 (3.8%)
Blood transfusions	78 (31.3%)	42 (32.1%)

[Table/Fig-6]: Critical lifesaving interventions done in Maternal near miss and maternal mortality group.

Study and year	Study design	Setting/Total no. of deliveries	Criteria	MNM incidence ratio	MNM: mortality ratio	Mortality index	Most common cause (MNM)	Most common cause (MD)	Highest mortality index
Almerie Y et al., 2010 [11]	Retrospective	Damascus, Syria/ 28,025 deliveries	Disease specific (Flippi 2005)	32.9/1000 live births	60:1	0.02	Hypertensive disorders (52%)	Late pregnancy haemorrhage (60%)	Sepsis (7.4%)
Ali AA et al., 2011 [13]	Retrospective	Sudan/ 9,578 deliveries	Disease specific (Flippi 2005)	22.1/1000 live births	1.5:1	0.20	Haemorrhage (40.8%)	-	Infection (22.2%)
Roopa PS 2013 [10]	Audit	Manipal, India/ 7390 deliveries	WHO Near Miss Approach	17.8/1000 live births	5.6:1	0.15	Haemorrhage (44.2%)	Sepsis ((52.2%)	Cardiac disease (40%), Sepsis (36.3%)
Purandre CN et al., 2014 [2]	Prospective	Multicenter, India/27,433 deliveries	Guidelines from MOHF & W, Govt. of India, Dec 2014	9.623/1000 deliveries	-	-	Haemorrhage (46.9%)	-	-
Gupta S et al., 2015 [17]	Prospective	New Delhi, India/ 6,892 deliveries	WHO Near Miss Approach	3.98/1000 live births	3.37:1	0.228	Haemorrhage	Hypertensive disorders of pregnancy (37.5%)	-
Bansal M et al., 2016 [12]	Retrospective	Chhattisgarh, India/ 3,539 deliveries	WHO Near Miss Approach	11.9/1000 live births	2.05:1	0.33	Haemorrhage (43.5%)	Pre-ecclampsia/ ecclampsia (31.57%)	-
Kalisa R et al., 2016 [23]	Prospective cohort	Rwanda, 3979 deliveries	WHO Near Miss Approach (Pa o2/fi)2, pH, Lactate, Dialysis for Acute renal Failure not available)	21.5/1000 live births	6.62:1	0.131	Haemorrhage (57%)	Ecclampsia (30.7%)	Sepsis/ Peritonitis following cesarian (33.3%)
Rathod AD et al., 2016 [14]	Retrospective cohort	Yavatmal, India/ 21,992 deliveries	WHO Near Miss Approach (SOFA Score)	7.56/1000 live births	3.43:1	0.29	Haemorrhage (26.7%)	Hypertensive disorders (27.27%)	Cardiac dysfunction (68.42%)
Parmar TN et al., 2016 [24]	Cross-sectional study	Vadodra, Gujarat, India/ 2,104 deliveries	WHO Near Miss Approach and Mantel et al., criteria	23.85/1000 live births	2.6:1	0.281	-	-	-
Tallapureddy S et al., 2017 [15]	Retrospective	Tirupati, Andhra Pradesh, India	WHO Near Miss Approach	8.4/1000 live births	5.3:1	0.158	Haemorrhage (43.7%)	Hypertensive disorders (66.6%)	-
Herklots T et al., 2019 [16]	Prospective	Zanzibar, East Africa/ 22,054 deliveries	WHO Near Miss Approach (with local adaptation e.g., dialysis facility unavailable, blood transfusion >=5 included blood/ blood component therapy and women were included if they needed but could not get due to non availability etc.)	11.6/1000 live births	3.2:1	0.24	Hematological dysfunction	Cardiovascular or Respiratory dysfunction	-

Samant PY et al., 2019 [25]	Retrospective-prospective	Maharashtra, India	WHO Near Miss Approach	112.57/1000 live births	14.28:1	-	Severe pre-ecclampsia (51%)	-	-
Kamal s et al., 2019 [26]	Descriptive	Jharkand, India/ 20,000 deliveries	WHO Near Miss Approach	24/1000 live births	7.2:1	-	Haemorrhage (42.5%)	-	-
Kumari S et al., (Current study)	Prospective cohort	New Delhi, india/ 31,925 deliveries	Guidelines from MOHF & W, Govt. of India, Dec 2014	8/1000 live births (0.8%)	1.9:1	0.34	Haemorrhage (53.8%)	Hypertensive disorders of pregnancy (31.2%).	Obsterical sepsis (54.2 %) Medical disorders (53.6%)

[Table/Fig-7]: Review of literature.

Moreover, many previous studies are retrospective [11-15] or have a small sample size [10,12,17,23,24], making it difficult to arrive at a statistically powered conclusion. This study aimed to determine the incidence of MNM cases as defined in Maternal Near Miss Review Operational Guidelines, released by the MOHFW, Government of India in 2014 [4]. For identification of an MNM case according to this criterion (minimum three, one from each category) must be present:

Clinical findings (either symptoms or signs), Investigations, Interventions or any single criteria which signifies cardio respiratory collapse from different categories of various adverse events and disorders associated with them. Very few Indian studies have used the MOHFW criteria for MNM [10] to audit these cases.

The strength of the current study is that it has a large sample size, is prospective and is well-designed, also comparing the socio-demographic profile of MNM cases with maternal deaths. Roopa PS et al., [10], was a multi-centric, pilot study using the Operational guidelines by MOHFW [4], however, no comparison was made with maternal mortality cases.

The MNM Incidence Ratio in this study (0.8%) was lowest except for Gupta S et al., [Table/Fig-7] [17]. This difference can be explained due to different settings in which the studies were conducted. The latter caters to a selected population of medically insured patients who are often booked and the hospital is not open to general public. While the hospital in the current study is a tertiary care centre, receiving unbooked and complicated cases from across the state and the neighbouring states. Disease specific criterion as used by some studies [11,13], is known to report a higher no. of cases as near miss. Many studies have used the WHO criterion [9] or their modifications [Table/Fig-7] which may explain the difference in the incidence ratio. WHO criterion is organ system dysfunction based, while, the Indian guidelines incorporates all the 3 criterion; disease based, management based and organ system dysfunction based (1 from each category is required to label as near miss, unless there is evidence of cardiovascular collapse).

The low MNM/MD ratio in this study [Table/Fig-7], may be wrongly interpreted as a poor quality of care, but it actually is due to strict adherence to Indian guidelines and also, most of these patients were unbooked (91.2-93.9%) and referred (71.4-74.8%) to the centre after multiple complications.

In spite of the heterogeneity in the study design and the setting, most of the studies like the current study have reported haemorrhage followed by hypertensive disorders as the most common cause of MNM, while hypertensive disorders was the leading cause of maternal deaths [Table/Fig-7]. Even studies from developed countries like Australia and Netherlands have reported obstetric haemorrhage as the most frequent cause of severe acute maternal morbidity [20,21].

A detailed analysis of women in haemorrhage group reveals that most of the critically bleeding women were in the postpartum phase with PPH (39.3%). This observation is similar to other Indian studies by Roopa PS et al., and an Australian study by Jayaratnam S et al., which have also observed PPH as the most common cause of MNM [10,20].

In the hypertensive group, there were higher proportion of eclampsia versus pre-eclampsia (13.2 and 8.4%, respectively), hence reaffirming that timely initiation of magnesium sulphate therapy and termination of pregnancy can salvage these women.

Obstetrical sepsis (54.2%) and medical disorders like cardiac disease (53.6%), continue to pose a major threat to the health of the women. They have the highest mortality index [Table/Fig-5] also reported in other studies [Table/Fig-7]. Puerperal sepsis was most common (6.8%) cause of sepsis. This is in spite, of launch of Janani Suraksha Yojana (JSY), a cash incentive scheme launched by the Government of India to promote institutional deliveries [7,28]. Though there has been an increase in the institutional deliveries to 84.44% as per the recent National Family Health Survey-4 (NFHS 4 2015-16) in Delhi state, the increased load to health facility may compromise the quality of care due to limited infrastructure or trained health personnel [29].

Indirect causes (medical disorders) too pose a major challenge to the health of the women. A multi-disciplinary approach and timely detection and referral of the high risk women to a tertiary care centre, through good quality antenatal coverage and referral linkage, may help optimise the health of these women.

In this study, a significant association was demonstrated with lower socioeconomic status and illiteracy and occurrence of maternal mortality, ($p<0.0001$, $p<0.01$, respectively). Also, the most common delay identified were type 1 delay (delay in the decision to seek care; 67.9-77.9%) and type 2 delay (delay arrival at the health facility;70-74.8%) [26]. Thus, highlighting the role of social factors and cost in a women's health and how education may play a role in changing attitudes and promoting a health seeking behaviour.

Limitation(s)

The interview of all the maternal near cases and verbal autopsy for maternal death cases could not be done.

CONCLUSION(S)

The MNM IR in this study was 8/1000 live births and the MMR was 421/100,000 live births. The MNM: MM ratio was 1.9:1. Overall Mortality Index (MI) was 34%. Severe Maternal Outcome Ratio (SMOR) was 12.2/1000 live births. The most common cause of MNM was haemorrhage, mostly, post-partum haemorrhage. Lower socio-economic status and illiteracy were associated with occurrence of maternal mortality. The most common cause of maternal deaths were hypertensive disorders of pregnancy. Hence, from the present study it is concluded, that mothers may benefit by upgradation of the infrastructure of the peripheral health centres (like ensuring availability of blood banks, round the clock operation theatre facility, magnesium sulphate for seizure prophylaxis etc.) along with a network of referral linkage to ensure speedy and appropriate referrals. Inspite of a high percentage of institutional delivery, obstetrical sepsis and medical disorders continue to challenge the health system as they have the highest mortality index.

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