

Original Research Article

MATERNAL AND FETAL OUTCOME IN SEVERE ACUTE MATERNAL MORBIDITY IN A TERTIARY CARE HOSPITAL

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Received : 10/06/2026
Received in revised form : 27/07/2026
Accepted : 13/08/2026

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DOI: 10.70034/ijmedph.2026.3.581

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2026; 16 (3); 3720-3729

ABSTRACT

Background: Severe acute maternal morbidity (SAMM) has been an indicator of measurement of maternal health. Understanding their risk factors may result in better treatment solutions and preventive measures for maternal health. Thus, the present study assessed the maternal and fetal outcomes in SAMM in a tertiary care hospital.

Materials and Methods: This cross-sectional, observational study was conducted over the period of 12 months (August 2022 to July 2023) in the Department of Obstetrics and Gynaecology of a tertiary care institute. The study involved 111 women in their antepartum, intrapartum, and postpartum period.

Results: Majority of patients belongs to antepartum 3rd trimester (70.27%). Overall, the predominant SAMM was hypertensive disorder (63.06%) and haemorrhage (22.42%). The most common SAMM in antepartum 1st trimester, 2nd, and 3rd trimester were ectopic pregnancy (72.72%), severe preeclampsia (50%), severe preeclampsia (57.69%), respectively. The maternal mortality rate was 5.41% with eclampsia (33.3%) being the leading cause. Around 54% neonates required NICU admissions were respiratory distress (81.67%) being the leading cause. SAMM were not significantly associated with maternal age (p value=0.908), gravidity (p value=0.130), booking status (p value=0.299), referral status (p value=0.236), hospital stay (p value=0.488), HDU admission (p value=0.079), ICU stay (p value=0.553), maternal organ dysfunction (p value=0.611), APGAR score at 5min (p value=0.066) and NICU admission (p value=0.520).

Conclusion: Hypertensive disorders were the most common SAMM. The maternal mortality is still high, and half of the neonates born to mothers with SAMM require NICU admission. The duration of pregnancy was significantly associated with mode of delivery.

Keywords: SAMM, MMR, HDU, ICU, NICU.

INTRODUCTION

Historically, maternal mortality rates (MMR) have been a key indicator of maternity care safety.^[1] From 1990 to 2015, the global MMR decreased by 44%, from 385 to 216 maternal deaths per 100,000 live births.^[2] Due to this significant decline, monitoring 'Maternal Near Miss' (MNM) or 'severe acute maternal morbidity' (SAMM) has become increasingly important as a clinical measure of maternal health.^[1] SAMM cases are now recognized

more frequently than maternal deaths, reflecting their growing relevance. In India, the MMR for 2014-2016 has dropped to 130 per 100,000 live births, with states like Kerala and Maharashtra achieving even lower rates of 46 and 61, respectively.^[3]

The World Health Organization (WHO) defines SAMM case as "a woman who nearly died, but survived a complication that occurred during pregnancy, childbirth or within 42 days of termination of pregnancy." SAMM refers to a life-threatening disorder that can end up in near miss with

or without residual morbidity or mortality. MNM is a situation in which a woman would have died had she not received quality medical care.^[4]

As per a recent meta-analysis, the prevalence of SAMM was 2.45%.^[5] Based on another meta-analysis, the total proportion of MNM miss events was 4.4 per 1000 total births. Low income countries displayed the greatest proportion of near misses (13.4), followed by lower-middle income countries (11.1), while high-income countries had the lowest proportion (2.2).^[6] In India, the incidence of MNM varied widely from 7.6-60.4 per 1000 deliveries.^[3] For every maternal death, there are many serious life-threatening complications of pregnancy.^[7]

The most important causes are hemorrhage (early pregnancy loss, ante-partum hemorrhage, post-partum hemorrhage), hypertension (pre-eclampsia, eclampsia), dystocia, uterine rupture.^[8]

Morbidity during pregnancy can range from excellent health to death, with varying degrees of severity including uncomplicated, complicated, severely complicated, or life-threatening conditions. Outcomes can vary, with women potentially recovering fully, facing temporary or permanent disability, or dying.^[9] Cases of maternal near-miss (MNM) and maternal deaths are collectively termed severe maternal outcomes.^[10] In the literature, three criteria have been proposed to identify SAMM or near-miss cases. Disease-specific criteria are useful for well-defined clinical conditions but may be challenging to apply in complex cases like multiple organ dysfunction syndrome (MODS) or disseminated intravascular coagulation (DIC). Organ-system-based criteria provide a clear definition of life-threatening complications by focusing on severe endpoints, but their accuracy can be influenced by the quality of management, such as the availability of intensive care unit (ICU) facilities. Management-specific criteria, such as ICU admission, are commonly used due to their simplicity, consistency, and ease of documentation.^[9] Several risk factors for severe acute maternal morbidity (SAMM) have been identified, including advanced maternal age (over 35 years), low socio-economic status, hypertension, a history of postpartum hemorrhage (PPH), emergency cesarean sections, multiple pregnancies, cardiac disease, and sepsis. Women with low socio-economic status who do not seek antenatal care but are referred to health facilities only when facing severe obstetric complications contribute significantly to maternal morbidity. Additionally, induced abortions performed by untrained village midwives remain a major cause of morbidity in developing countries.^[10,11]

Severe acute maternal morbidity (SAMM) not only endangers the woman's life but also has serious implications for the fetus or neonate, leading to higher rates of morbidity and mortality. Adverse delivery outcomes, including preterm delivery, stillbirth, and both neonatal and maternal deaths, are more common among women with SAMM.

Addressing and reducing preventable severe maternal morbidity can decrease maternal mortality and enhance newborn health. SAMM cases often involve frequent hospital admissions, ICU stays, extended hospitalizations, and serious postpartum complications such as massive hemorrhage, cardiac arrest, organ failure, stroke, and the need for major medical interventions like transfusions or surgeries. Neonatal outcomes also suffer, with higher rates of fetal death, NICU admissions, preterm births, low Apgar scores, and low birth weight among infants born to women experiencing SAMM.^[2]

A recent meta-analysis found that severe acute maternal morbidities (SAMMs) related to obstetric hemorrhage, severe hypertensive disorders, hepatic disorders, and thromboembolic conditions were significantly linked to an increased risk of preterm birth. Specifically, SAMMs caused by hypertensive or thromboembolic disorders were associated with a higher likelihood of delivering small for gestational age (SGA) infants and experiencing perinatal deaths, including both stillbirths and neonatal deaths.^[12]

Low resource countries like India carry the highest risk of maternal mortality and morbidity. Critically ill obstetric patient represents an interesting group with unique characteristics whose management is challenged by the presence of a fetus, an altered maternal physiology and disease specific to pregnancy.^[1] Maternal mortality is still a significant public health problem, and now SAMM has emerged as an important indicator in maternal health care to review the cause of maternal death.^[13] The present study was undertaken to determine the causes of SAMM, their outcomes, and association between them.

MATERIALS AND METHODS

Aims: To assess maternal and fetal outcome in severe acute maternal morbidity in a tertiary care hospital

Objectives

- To determine the causes of Severe Acute Maternal Morbidity.
- To determine the maternal outcome in cases of Severe Acute Maternal Morbidity.
- To determine the fetal outcome in cases of Severe Acute Maternal Morbidity.

Study design: A Cross-sectional observational study done over a period of one year among all critically ill pregnant, laboring, postpartum and post-abortion women admitted in ICU/HDU, labor room in the Department of OBG at SIMS and RH, Tumkur, during period of August 2022 to August 2023.

Inclusion criteria:

Critically ill pregnancy specific complications like

- Obstetric hemorrhage-Abortion, Ectopic Pregnancy, Gestational Trophoblastic Disease, Placenta Previa, Placental abruption, Scar dehiscence.
- Obstetric sepsis.

- Hypertensive disorder of pregnancy-Gestational Hypertension –Severe, Pre-eclampsia – Severe, Eclampsia.
- Labour related Disorders- Prolonged / Obstructed / Rupture uterus, Inversion of Uterus, Retained placenta.
- Cardiovascular collapse- Amniotic fluid embolism.
- Liver dysfunction/failure- Acute fatty liver of pregnancy, Acute fulminant hepatic failure.
- Cardiac dysfunction/failure- Cardiomyopathy.

Based on Minister of Health and Family Welfare criteria guidelines 20141 in first trimester, second trimester, third trimester, intrapartum and postpartum upto 6 weeks.

Exclusion criteria:

- Pre-existing medical disorders (hypertension, renal disease, cardiovascular disease, neurological disorder, hepatological disorder, hematological disorder).
- Pre-existing endocrine disorders (diabetes mellitus, thyroid disorder).

Among all cases, potentially life-threatening obstetric conditions were diagnosed and those who met Minister of Health and Family Welfare criteria (14) 2016 were selected. Maternal mortality during the same period were analyzed. Patient characteristics including age, parity, gestational age at admission, booked. (More than three antenatal visits to our hospital irrespective of the gestational age), mode of delivery, ICU admission, duration of ICU stays, total hospital duration and surgical intervention to save the life of mother were considered. Patients were categorized by final diagnosis with respect to hemorrhage, hypertension, sepsis, dystocia, cardiovascular collapse, liver dysfunction/failure, cardiac dysfunction/failure contributing to SAMM and deaths.

Maternal outcome was be studied in terms of Five factor scoring system to identify the SAMM11 cases from all the severe obstetric morbidity.

- Nature of obstetric complication(s)

- Units of blood transfusion
- Presence of organ-system dysfunction/ failure
- High dependency unit and ICU admission
- Length of hospital stay.

Foetal outcomes were studied in terms of births (live/dead/still birth), APGAR score, NICU admission, morbidity and mortality.

Sample Size Estimation: The sample size was calculated using a study conducted in India by Sinha M et al,^[9] in 2016. The study found the prevalence of severe acute maternal morbidity (SAMM) to be 1.87%. At a 95% confidence level and an absolute allowable error of 4%. The sample size was,

$$\text{Sample size}(n) = \frac{Z^2 \frac{p}{1-p} \frac{q}{p+q}}{d^2}$$

Where,

q = 1-p

= Is standard normal variate (at 5% type I error (p<0.05) it is 1.96 and 1% type I error (p<0.01) it is 2.58). As in majority of studies P values are considered significance below 0.05 hence 1.96 is used in formula.

P = Expected prevalence in population based on previous studies or pilot studies. d = Absolute error or precision.

Sample size (n) = 78.33

Total samples included in the study in this study was 111.

Sampling method: A non-probability sampling method.i.e, purposive convenience sampling method.

Statistical Analysis: All the data collected will be compiled and entered into a Microsoft Excel worksheet. The Qualitative variables will be presented in frequency, percentages, and graphs. The Quantitative variables will be presented in Mean with SD, Median with Interquartile range, and graphs. The statistical tests will be analyzed using statistical software like R – 4.1.3 version. Where deemed necessary. P value of < 0.05 will be considered statistically significant.

RESULTS

Table 1: Distribution of patients

	1st Trimester	2nd Trimester	3rd Trimester	Intrapartum	Postpartum
Total (N=111)	11	8	78	2	12
Percentage	9.90%	7.20%	70.27%	1.80%	10.81%

Table 2: Distribution of patients according to age

Age groups (years)	1st Trimester	2nd Trimester	3rd Trimester	Intrapartum	Postpartum	Total N=111	Percentage
≤ 20	0	0	11	0	1	12	10.81%
21 – 25	5	3	38	1	6	53	47.74%
26 – 30	3	4	17	1	5	30	27.02%
31 – 35	2	0	9	0	0	11	9.9%
36 – 40	1	1	3	0	0	5	4.50%

Chi-square value- 0.0132, p value-0.908

Table 3: Distribution of patients according to booking status

Status	1st Trimester	2nd Trimester	3rd Trimester	Intrapartum	Postpartum	Total N=111	Percentage
Booked	8	4	78	2	12	104	93.69%
Unbooked	3	4	0	0	0	7	6.30%

Chi-square value- 1.08, p value-0.299

Table 4: Distribution of patients according to reason of referral status

	Reason of referral	Total N=63	Percentage
1st TRIMESTER	Abortion	2	3.1%
2nd TRIMESTER	Severe preeclampsia	3	4.7%
3rd TRIMESTER	Severe preeclampsia	27	75%
	Abruptio placenta	6	16%
	Eclampsia	11	17.4%
	Peripartum cardiomyopathy	3	4.7%
	Placenta previa	1	1.5%
Intrapartum	Obstructed labour	1	1.5%
	Deep transverse arrest	1	1.5%
Postpartum	Eclampsia	2	3.1%
	PPH	2	3.1%
	Shock	1	1.5%
	DIC	1	1.5%

Table 5: Length of hospital stay

Hospital (Days)	Stay	1st Trimester	2nd Trimester	3rd Trimester	Intrapartum	Postpartum	Total N=111	Percentage
1-5		10	8	51	3	9	81	72.97%
6-10		1	0	23	0	3	27	24.32%
11-15		0	0	2	0	0	2	1.80%
16-20		0	0	1	0	0	1	0.90%

Chi-square value 0.482, p-value0.488

Table 6: HDU/ICU admission

Admission	1st Trimester	2nd Trimester	3rd Trimester	Intrapartum	Postpartum	Total N=42	Percentage
HDU	3	4	56	2	4	69	62.1%
ICU	8	4	22	0	8	42	37.9%

Table 7: Length of ICU stay

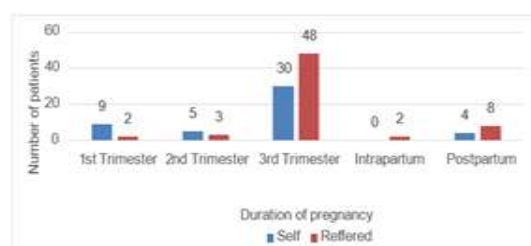
ICU STAY	1st Trimester	2nd Trimester	3rd Trimester	Intrapartum	Postpartum	Total N=42	Percentage
1	4	1	3	0	1	9	21.4%
2	3	3	13	0	6	25	59.5%
3	1	0	4	0	1	6	14.2%
4	0	0	1	0	0	1	2.38%
5	0	0	1	0	0	1	2.38%

Chi-square value- 0.352, p value-0.553

Table 8: Distribution of patient according to gravidity

Status	1st Trimester	2nd Trimester	3rd Trimester	Intrapartum	Postpartum	Total N=111	Percentage
1	0	2	38	1	3	44	39.64%
2	6	5	23	0	4	38	34.23%
3	5	3	7	1	1	17	15.32%
4	0	0	6	0	2	8	7.21%
5	0	0	0	0	1	1	0.90%
>5	0	0	3	0	0	3	2.70%

Chi-square value- 2.30, p value-0.130

**Figure 1: Distribution of patients according to referral status**

[Figure 2] depicts SAMM in Antepartum 1st trimester. Majority (8 cases) of 1st trimester SAMM were Ruptured Ectopic (72.72%). All patients were managed with exploratory laparotomy as their vitals were not stable. After procedure 2 patient were shifted to ICU and others were shifted to HDU. Out of 8 patients, 4 patients were managed with 2 units of PRBC and 1 patient was managed with 1 unit PRBC.

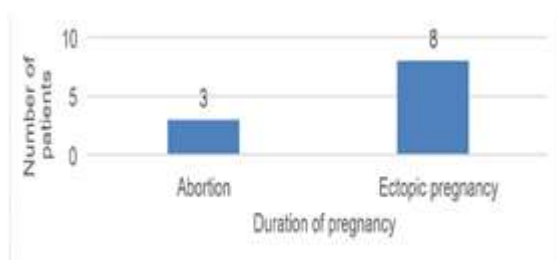


Figure 2: SAMM in Antepartum 1st Trimester

There were 3 cases (27.27%) of incomplete abortion with severe anemia in which 2 patients were referred from PHC. All 3 abortion cases underwent surgical evacuation of retained products of conception. Post procedure all patients were shifted to ICU. Out of 3 patients, 2 patients were managed with 2 units of PRBC. One patient had hypovolemic shock and acute kidney injury and was managed with 3 units of PRBC and 3 units of FFP.

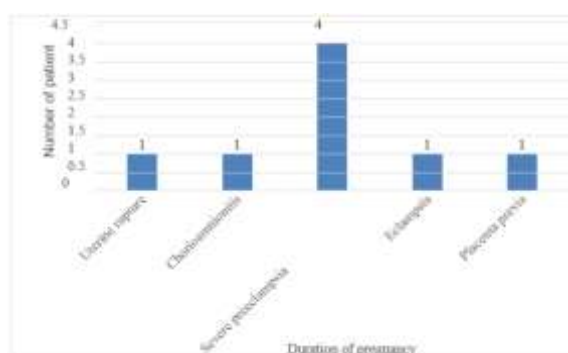


Figure 3: SAMM In Antepartum 2nd Trimester

[Figure 3] depicts SAMM in Antepartum 2nd trimester. All patients were more than 24 weeks period of gestation. Majority of patients (4 out of 8 cases) were severe preeclampsia, out of which 2 were referred and 2 were unbooked. All 4 patients (50%) of severe pre-eclampsia had still birth and underwent preterm vaginal delivery and later shifted to HDU. One patient was managed with 2 units of RDP and One patient was managed with 1 unit of FFP. Three patients had deranged LFT (liver injury). One patient had pleural effusion who was managed with pleural tapping. One patient out of 8 cases came with eclampsia had stillbirth and underwent preterm vaginal delivery. Patient was diagnosed with PRES (brain injury).

One case came with uterine rupture with stillbirth, who was unbooked underwent emergency exploratory laparotomy followed by repair of uterus and later shifted to ICU. Patient was managed with 3 units of PRBC.

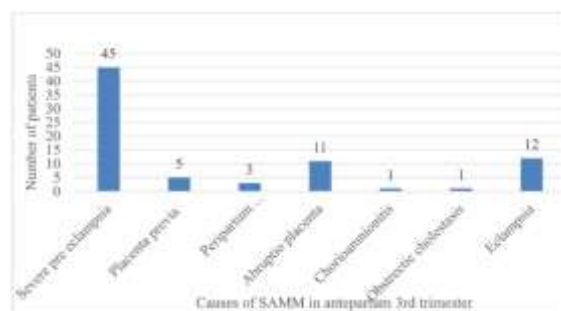


Figure 4: SAMM in Antepartum 3rd Trimester

One patient in 2nd trimester was referred in view of chorioamnionitis underwent emergency hysterotomy and later shifted to ICU. Patient was put on mechanical ventilator with vasopressin. Patient died after 18 hours due to septic shock with cardiac arrest. Baby died after 2 hours of delivery due to respiratory distress.

One patient came with placenta previa (placenta accreta spectrum) underwent emergency hysterotomy followed by hysterectomy. Patient was shifted to ICU and was put on mechanical ventilator with vasopressin. Patient had acute kidney injury and hypovolemic shock and was managed with 8 units of PRBC, 10 units of FFP and 10 units of RDP. Patient died due to hypovolemic shock. baby was alive and shifted to NICU in view of respiratory distress.

[Figure 4] depicts SAMM in antepartum 3rd trimester.

Majority of patients 57.69% belong to severe pre-eclampsia. One patient was unbooked, 28 cases were referred. One patient had twin pregnancy. Thirty nine patients underwent LSCS and 6 patients had preterm vaginal delivery. Seven patients have atonic PPH after delivery, 2 cases developed HELLP syndrome and 2 patients had PPH with HELLP syndrome. One patient was managed with uterine artery ligation and Blynch, 3 cases managed with only B lynch suture and 2 cases were managed with only uterine artery ligation. 7 patients only managed with 2 units of FFP, 3 patients with 2 units of RDP, 4 patients with 2 units of PRBC, 2 patients with 2 units FFP, 2RDP, 1PRBC. 4 patients had liver dysfunction, and 2 patients had acute kidney injury. There were 42 live births, 4 still birth and 2 neonatal deaths. Out of 78 patients, 11 patients (14.10%) had abruptio placenta. One patient had twin pregnancy. 6 patients were referred. Nine patients underwent emergency LSCS and 2 patients had preterm vaginal delivery. Abruptio placenta had bad neonatal outcome with 5 stillbirth, 5 livebirth and 2 neonatal deaths. 5 patients were managed with 1-unit PRBC, 2 managed with 2 units PRBC and one managed with 2 units FFP. One patient had bilateral uterine artery ligation because of PPH.

Out of 78 patients, 5 patients (6.41%) had placenta previa. One patient was referred. All 5 patients underwent LSCS. Intraoperatively, 2 patients managed with only Bilateral uterine artery ligation and 2 patients managed with B lynch and Bilateral uterine artery ligation. After delivery all patients shifted to ICU. Four patients managed with 2 units of

PRBC, and 1 patient managed with 1 unit of PRBC. There was one neonatal death due to respiratory distress.

Out of 78 patients, 3(3.85%) patients had peripartum cardiomyopathy in which 2 patients were referred. All 3 patients underwent emergency LSCS. After deliver patients were shifted to ICU and was managed with mechanical ventilator. One patient had still birth and patient died due to cardiac arrest within 12 hours after delivery.

One case was with chorioamnionitis and one with obstetric cholestasis. Both underwent LSCS later shifted to HDU.

[Figure 5] depicts events during intrapartum. Out of 2 patients, one was referred in view of obstructed labour. She underwent emergency LSCS and later shifted to HDU. Baby was fine.

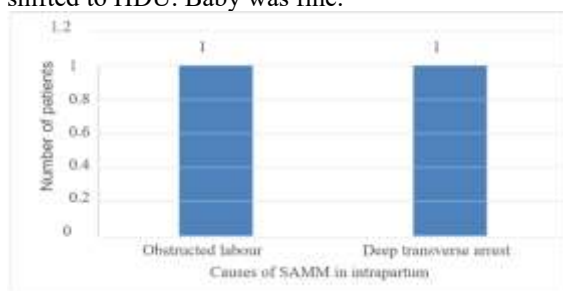


Figure 5. SAMM In Intrapartum

Another case was referred in view of deep transverse arrest. She underwent emergency LSCS and later shifted to HDU. Baby died after 2 days of delivery due to respiratory distress.

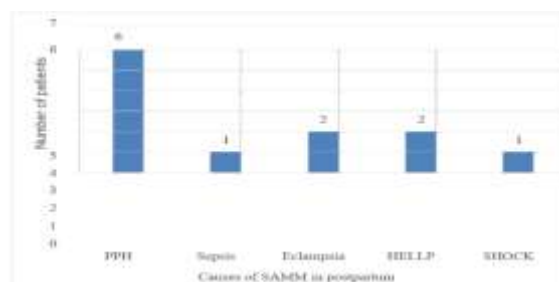


Figure 6: SAMM In Postpartum

Table 9: Distribution of patients according to underlining cause of SAMM

	SAMM	Total	Total	Percentage
Hypertensive Disorder In Pregnancy	Severe Pre-Eclampsia	49	66	59.4%
	Eclampsia	14		
	HELLP	2		
Hemorrhage In Pregnancy	Placenta Previa	6	33	29.7%
	Abruptio Placenta	11		
	Postpartum Hemorrhage	5		
	Abortion	3		
	Ruptured Ectopic Pregnancy	8		
Obstetric Sepsis	Chorioamnionitis	2	3	2.70%
	SEPSIS	1		
Labour Related Disorder	Obstructed Labour	1	3	2.70%
	Deep Transverse Arrest	1		
	Uterine Rupture	1		
Cardiac Dysfunction	Peripartum Cardiomyopathy	3	3	2.70%
Liver Dysfunction	Obstetric Cholestasis	1	1	0.90%
	DIC	1	1	0.90%
	Shock	1	1	0.90%

Table 10: Distribution of patients according to mode of delivery

Mode	2nd Trimester	3rd Trimester	Intrapartum	Total N=98	Percentage
Emergency LSCS	0	70	2	72	73.4%
Elective LSCS	0	5	0	5	5.10%
PTVD	5	8	0	13	13.2%
Emergency hysterotomy	3	0	0	3	3.06%
FTVD	0	4	0	4	4.08%
Vacuum assisted vaginal delivery	0	1	0	1	1.02%

Chi-square value- 34.3, p value - <0.001

Table 11: Management in 1st trimester

Management in 1st Trimester	Total (N=11)	Percentage
Evacuation of product of conceptus	3	27.2%
Exploratory laparotomy	8	72.2%

Table 12: Intervention in SAMM

Intervention	Total (N=23)
Uterine artery ligation with B lynch suture	5 (21.74%)
Uterine artery ligation	5 (21.74%)
B lynch suture	3 (13.04%)
Uterine repair	1 (4.35%)
Mechanical ventilator	6 (26.09%)
Hysterectomy	2 (8.70%)
Pleural tap	1 (4.34%)

Table 13: Distribution of patients according to presence of organ dysfunction

Organ	1st Trimester	2nd Trimester	3rd Trimester	Intrapartum	Postpartum	Total N=22	Percentage
Heart	0	1	3	0	0	4	18.1%
Brain	0	0	1	0	0	1	4.54%
Kidney	1	1	2	0	2	6	27.27%
Multi organ	0	3	4	0	3	10	45.45%
Lung	0	1	0	0	0	1	4.54%

Chi-square value- 2.62, p value-0.105

Table14: Blood components in patients of SAMM

Blood component	Total (N=53)	Percentage
1 UNIT PRBC	8	15.09%
2 UNITS PRBC	22	41.51%
1 UNIT FFP	1	1.89%
2 UNITS FFP	8	15.09%
2 UNITS RDP	5	9.43%
2 UNITS FFP, 2 UNITS PRBC	2	3.77%
3 UNITS FFP AND 3 UNITS PRBC	1	1.89%
2 UNITS FFP, PRBC, RDP	3	5.66%
2 UNITS PRBC AND RDP	1	1.89%
3 UNITS PRBC & FFP	1	1.89%
8 UNITS PRBC, 10 UNITS FFP & RDP	1	1.89%

Table 15: Causes of Maternal mortality

Maternal mortality	Total (N=6)	Percentage
Peripartum cardiomyopathy	1	16.6%
Eclampsia	2	33.3%
Placenta previa	1	16.6%
DIC	1	16.6%
Chorioamnionitis	1	16.6%

Table 16: depict the distribution of Neonates according to period of gestation

Period of gestation in weeks	Total (N= 100)	Percentage
>37 WEEKS	37	37%
<37 - 34 WEEKS	29	29%
<34 -28 WEEKS	26	26%
<28-24 WEEKS	8	8%

Table 17: Distribution of neonates according to APGAR status at 5 minutes

Apgar At 5 Minuts	2nd Trimester	3rd Trimester	Intrapartum	Total (N=84)	Percentage
Good (9/10)	0	52	0	52	61.90%
Bad (<9/10)	2	28	2	32	38.09%

Chi-square value- 3.39, p value-0.066

Table 18: Distribution of neonates according to NICU admission

NICU	2nd trimester	3rd trimester	Intrapartum	Total (N= 60)	Percentage
Respiratory Distress	2	45	2	49	81.67%
HIE	0	1	0	1	1.67%
MAS	0	4	0	4	6.67%
SGA	0	2	0	2	3.33%
SEPSIS	0	4	0	4	6.67%

Chi-square value- 0.414, p value-0.52

DISCUSSION

In the present study, majority of the patients belonged to the age group of 21 – 25 years (47.74%) and 26 –

30 years (27.02%), while least number of patients belonged to the age group of > 40 years (4.50%). This is similar to the study done by Chhabra et al,^[15] where the majority of women with SAMM were in the age

group of 21 – 25 years (41.5%) followed by 26 – 30 years (33.2%), and least number of patients were in the age group of >35 years (3.5%).^[1]

Similarly, the majority of women with SAMM were in the age group of 21 – 30 years in the study by Umadevi et al,^[16] Yelikar et al.^[17]

In the present study, majority of the patients belonged to Antepartum 3rd trimester (70.27%), while least number of patients belonged to intrapartum (1.80%). This is on par with the study done by Gopinath et al.^[18] where the majority of the patients belonged to antenatal (70%) followed by postpartum (20%) and least number of patients belonged to intrapartum (10%). In the studies by Vandana et al,^[19] Yelikar et al,^[17] majority of patients had a gestational age of >28 weeks were in 75.8%, 60.56% respectively. Thus, SAMM is most commonly observed in the third trimester of pregnancy.

In the present study, majority of the patients were booked (93.69%), while remaining were unbooked (6.30%). This is in contrast to the studies by Yelikar et al,^[17] Kushwah et al,^[20] Kamal et al,^[21] Singh et al,^[22] the majority of women with SAMM were unbooked (82.21%, 74%, 80%, 92.1%). Many of the patients in our study were booked in PHCs.

In the present study, majority of the patients were referred from another hospitals (56.75%), while remaining reported to the study site on their own (48.24%). This is in concordance with the study by Cham et al,^[23] the majority of women with SAMM were referred from peripheral health centers (65.9%) while remaining reported to the study site on their own (34.1%). In agreement with the findings of the present study, Chhabra et al,^[15] found that more than half (54%) of near-miss cases and 43% of severe morbidity cases were referred from another facility.

In the present study, 73% of the referred cases were Hypertensive disorders (Severe Preeclampsia, Eclampsia, HELLP Syndrome). This agrees with the study done by S Gopinath et al,^[18] where the maximum patients were referred with Hypertensive disorders (50%).

In the present study, majority of the patients (89.91%) stayed between 1 – 5 days and (31.08%) stayed between 6 – 10 days, while least number of patients stayed between 16 to 20 days (1.11%). The mean of hospital stay is 5.12 ± 2.28 days. In agreement with the findings of the present study, Yelikar et al,^[17] found that majority of the patients (62.5%) stayed between 7 – 14 days, while least number of patients >14 days (17.30%). Kumari et al,^[28] Gu et al,^[24] Mummadi et al,^[8] depict the mean hospital stay of 3.27 ± 6.9 days, 11.7 ± 8.8 days, 7.8 days respectively. Sixty-nine patients in the study (62%) were admitted in HDU. Remaining 38% were ICU admission. Similarly, Dattaray et al,^[25] found that majority of women with obstetric morbidity stayed in HDU (68.42%).

In the present study, 42 cases stayed in ICU, in that only 59.5% stayed for 2 days and (21.4%) stayed for 1 day in ICU, while least number of patients stayed for >4 days (2.38%). The mean ICU stay is $1.93 \pm$

0.77. It is in contrast to study done by, Gu et al,^[24] found that mean ICU stay is 4.5 ± 6.6 days. This is coincidence with Godeberge et al. (26), where the majority of women with SAMM stayed for >48 hours (47.3%) followed by 24 – 48 hours (37.9%) while least number of women stayed for <24 hours (14.8).

In the present study, majority of patients were multigravida (60%). Similarly, Chhabra et al,^[15] Kushwah et al,^[20] Singh et al,^[22] Sultana et al,^[27] found that majority of women with SAMM were multigravida.

In the present study, the most common SAMM was hypertensive disorder in pregnancy (59.4%). Hemorrhage in pregnancy causes (29.7%) of SAMM. Other causes of SAMM were Cardiomyopathy, Sepsis, Labour related disorder (2.70%) each. Moreover, other maternal morbidities included Shock, DIC, obstructed labor and obstetric cholestasis (0.9%) each. This was similar to study done by Vandana et al,^[19] found that hypertensive disorders (66.54%) followed by sepsis (11.15%) and hemorrhagic disorders (10.78%) were the most common maternal morbidities. In another study done by, Yelikar et al,^[17] observed that majority of women with SAMM had eclampsia with organ dysfunction (47.11%) and obstetric hemorrhage (41.35%), while least number of patients had sepsis (11.54%). This is on par with Chhabra et al,^[15] the majority of patients with SAMM had pre-eclampsia (87.6%) which coincide with present study (57.69%). In the contrast, study done by Kumari S et al,^[28] found that hemorrhage (83%) is leading cause of maternal morbidity. The causes of mortality in the present study were Hypertensive disorders (33%), Hemorrhage (33%), Sepsis (16%), Cardiomyopathy (16%). Hypertensive disorder (26%) and hemorrhage (61.75%) were the most common underlying conditions in the women who died in the study by Chhabra et al.^[15]

In the present study, 2 patients were referred postpartum. Out of 109 cases, 80 cases (73%) underwent LSCS, 18 cases (16%) had vaginal delivery, 8 cases (7.3%) underwent laparotomy, and 3 cases (2.7%) underwent evacuation of retained products of conceptus. Umadevi et al,^[16] found that majority of patients underwent to Caesarean section (60%) followed by vaginal delivery (42.3%) and least number of patients underwent to abortion and MTP (3.8%). Also, Vandana et al,^[19] found that majority of patients underwent to LSCS (64.52%) followed by vaginal delivery (19.35%) and least number of patients underwent laparotomy, elective LSCS, Evacuation (each 3.23%).

In the present study, majority of patients (26.09%) underwent to mechanical ventilator. In agreement with the findings of the present study, Umadevi et al,^[16] found that majority of patients (32.61%) underwent to ventilator. No one went to dialysis.^[2] In their study, Yelikar et al,^[17] found that majority of patients (82.69%) underwent to blood and blood component therapy followed by mechanical ventilation (41.34%) and least number of patients use

vasoactive agents therapy.^[3] In another study, Vandana et al,^[19] found that majority of patients underwent to Inotropes and intubation (each 91.6%).^[6] Moreover, Kumari et al,^[28] found that majority of patients underwent to Resuscitative procedure/intubation (74.8%) followed by ICU (68.7%) and least number of patients underwent to laparotomy with B lynch suture (0.8%).^[29]

In the present study, majority of patients have no organ dysfunction (80%). Multi organ dysfunction were maximum cases (45.45%) in the study. Similar to, Singh et al,^[22] found that majority of patients have multiorgan dysfunction (36.8%) followed by hematological dysfunction (21%) while least number of patients had hepatic dysfunction (5.3%) and no one have respiratory, renal and uterine dysfunction.^[13] In another study, Mummadi et al,^[8] found that neurologic dysfunction (5%), cardio vascular dysfunction (1%), and remaining (94%) had no organ system dysfunction.

In the present study, majority of patients (22 out of 53) had shown 2 units PRBC get transfused. In agreement with the findings of the present study, Veerabhadrapa et al,^[29] found that majority of patients had <5units of PRBC transfused.

In the present study, majority of neonates had live births (74%). stillbirth accounts for 16% and neonatal death is 10%. The leading cause of still birth is abruption. This is in concordance with the study by Umadevi et al,^[16] where the majority of neonates had a live birth (73.07%), with the least number of neonates accounting for death (19.23%).^[2] In another study, Gopinath et al,^[18] found that the majority of neonates had a live birth (65.63%), with the least number of neonates accounting for stillbirth (4.69%).^[16] In contrary, Quereshi et al,^[30] found that the majority of neonates had a still-born (53.8%), followed by live birth and discharge (41.75%), with the least number of neonates accounting for death (4.39%).

In the present study, majority of neonates belongs to >2.5 kg criteria which is 36% and least number of neonates belongs to <1kg which is 12%. The study by Seppänen et al,^[31] also reports that majority of neonates belongs to 2.5 – 4 kg (37.4%).

In the present study, majority of neonates had APGAR 9/10 at 5 minutes (61.90%). In consensus with the findings of the present study, Morse et al,^[32] reported that 88% of the neonates born to mothers with SAMM and NM had normal APGAR score.

In the present study, the majority of neonates had NICU admission (71.4%). Main cause was respiratory distress. Seppänen et al.^[31] found that (56.1%) neonates admitted into NICU department which is similar to the present study. Yelikar et al,^[17] Verma et al,^[34] Qureshi et al,^[30] illustrated NICU admission were 38.5%, 13.6% and 36.4% respectively.

CONCLUSION

Maternal mortality mostly occurred in cases that reached delayed or moribund. It is necessary to boost referral services so that patients can reach the hospital in time and lives can be saved. Programmes to increase the awareness and the knowledge regarding regular antenatal care needed should be conducted by Health care workers. As the SAMM analysis indicates the quality of health care and causes are almost similar to maternal mortality, its registry should be done.

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