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Original Research Article

## Retrospective analysis of maternal mortality: a paradigm shift from 2010 to 2020

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### ABSTRACT

**Background:** Maternal mortality is attributed usually to complications that generally occur during or around labour and these are mostly preventable through proper understanding, diagnosis and management of labour complications. The quality of health services women receive during pregnancy, intranatal and postnatal periods are crucial for the survival and well-being of the mother and her newborn baby. The objective was to analyse the changing trends in maternal mortality occurring over a decade, to assess factors associated with maternal mortality and propose effective interventions in preventing such mortality.

**Methods:** It was a retrospective study to analyse maternal mortality between January 2010 and January 2020 in Ramaiah medical college hospital. Data was collected the institutional medical and delivery records and patient details regarding obstetric history, pre-existing comorbidities, cause of death, interventions done was noted and review of maternal mortality was done.

**Results:** The maternal mortality in the present study was 432.73/1 lakh live births. There were 57 maternal deaths in the study period. Most deaths occurred in the 20-25 age group. 42.10% of deaths occurred ninety six hours after admission. Sepsis (42.1%), hypertensive disorders (12.30%) and haemorrhage (10.5%) are the most common direct causes of maternal death. Post-operative and post abortal sepsis, ARDS, cardiogenic shock, pulmonary embolism and AFLP are the other direct causes. Hypertensive disorders (9.64%) and haemorrhage (19.5) is the two leading indirect causes of maternal deaths.

**Conclusions:** Maternal health services should move beyond the focus on emergency obstetric care, to a broader approach that encompasses preventive and early interventions and integration with existing services. Most of the maternal deaths can be prevented if the high risk antenatal women are identified earlier and referred to the tertiary centre earlier for diagnosis and management.

**Keywords:** Maternal mortality, Haemorrhage, Hypertensive disorders

### INTRODUCTION

Maternal health has many valued outcomes but maintaining focus on maternal death is crucial in areas where the mortality burden is high.<sup>1</sup> The five most important direct causes of maternal mortality in developing countries are haemorrhage, sepsis, unsafe

abortion, eclampsia and obstructed labour. Maternal mortality in resource-poor nations has been attributed to the 3 delays like delay in deciding to seek care, delay in reaching care in time and delay in receiving adequate treatment.<sup>2</sup> Within India, there is a marked variation in healthcare access between regions and in socioeconomic factors, accordingly, there is also variation in maternal

deaths for various states, regions and demographics of women.<sup>3</sup>

The continuing burden of maternal mortality, especially in developing countries has prompted a shift in paradigm from the traditional risk assessment approach to the provision of access to emergency obstetric care services for all women who are pregnant. A continuous assessment of maternal mortality is required to assure the progress towards safe motherhood.<sup>4</sup>

The epidemiology of maternal mortality requires prioritisation of the intrapartum period. The other opportunities to alter the risk of maternal death include providing proper antenatal care, postpartum care, family planning and safe abortion. Better population-based sources on maternal mortality for local-level decision making are essential to achieving improved outcomes and reduce the mortality rates.

## METHODS

It was a retrospective study to analyse maternal mortality between January 2010 and January 2020 in Ramaiah medical college hospital. The data was collected from the institutional medical and delivery records. All relevant patient details regarding obstetric history, pre-existing comorbidities, cause of death, interventions done was noted and review of maternal mortality was done and preventive measures was proposed.

### Inclusion criteria

Death of all women while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management were the inclusion criteria.

### Exclusion criteria

Maternal death due to incidental or accidental causes were excluded from the study.

Statistical analysis was done using the statistical software namely IBM SPSS statistics version 18. All the quantitative parameters like age, BMI, scores was

presented using descriptive statistics such as mean and standard deviation or median and range.

All the qualitative parameters such as education, parity, socioeconomic status, occupation, subjective outcome was presented using frequency and percentages. Descriptive statistics were used and the univariate analysis was made using a Chi squared test for categorical data.

## RESULTS

A total of 57 cases of maternal mortality were encountered at our tertiary care referral hospital over the decade from January 2010 to January 2020. The maternal mortality ratio in 2010 was 445 and has shown drastic variation over the years. In the years 2010-2019 the live births were 13172 and death rate was 57 giving cumulative maternal mortality rate (MMR) of 432.73 per 100000 live birth.

### Demographic characteristics of the patients in the present study (Table 2)

Majority of the maternal mortality encountered in our hospital where of women of age group 20-25 years (49.1%) followed by women between 26-30 years of age (31.6%). 42.1% women were primiparous and 12.3% women had parity of 2. Majority of women belonged to upper lower socio-economic status as per modified Kuppaswamy classification. 59.6% of women lived within a radius of 10-100 km from the hospital with travel time being approximately less than or equal to two hours.

### Factors contributing to maternal mortality (Table 3)

A total 84.2% of mortality cases had history of regular antenatal visits which was a minimum of four antenatal visits with one visit in each in first and second trimester and two visits in the third trimester. 77.2% of the cases were referred to our tertiary care hospital from other peripheral hospitals and neighbouring districts including Tumkur, Kolar, Chikkaballapur, Nelamangala, Hassan. 37.9% of the cases were referred to our hospital after delivery or caesarean for management of complications. 61.4% women were antenatal cases at the time of admission in which 26.3% of the cases were of gestational age of 28-34 weeks, 15.8 % belonged to gestational age of 34 weeks 1 day to 37 weeks and 8.8% were term pregnancies.

**Table 1: Year wise maternal deaths and live births.**

Year	Maternal death	Live birth	MMR/100000
2010	4	897	445.63
2011	7	986	709.93
2012	5	1218	410.5
2013	1	1240	80.64
2014	11	1300	846.15
2015	7	1489	470.11
2016	4	1451	275.67

Continued.

Year	Maternal death	Live birth	MMR/100000
2017	7	1521	460.22
2018	6	1556	385.6
2019	5	1514	330.25
<b>Total</b>	<b>57</b>	<b>13172</b>	<b>432.73</b>

**Table 2: Demographic characteristics of the patient.**

Demographic characteristics	Frequency (N=57)	Percentage
<b>Age (in years)</b>		
<20	2	3.5
20-25	28	49.1
26-30	18	31.6
31-35	6	10.5
>35	3	5.3
<b>Parity</b>		
Primiparous	24	42.1
≤2	30	52.7
>2	3	5.1
<b>Socio-economic status</b>		
Upper middle	4	7.0
Lower middle	18	31.26
Upper lower	23	40.4
Lower	12	21.1
<b>Distance between home and hospital (in km)</b>		
<10	17	29.8
10-100	34	59.6
>100	6	10.5

The common complaints that patients presented with included history of high blood pressures with complaints of imminent symptoms, jaundice, breathlessness, fever with chills, labour pains, reduced or absent fetal movements and the rest were referred in shock. 7% of the cases had multiple gestation and remaining were all singleton pregnancies. Pre-existing co-morbidities in these women included RHD, chronic hypertension, type 1 diabetes mellitus and a rare case of Fanconi's anemia.

Mode of delivery was vaginal delivery and caesarean section in 78.9% of the cases (42.1% was vaginal mode and 36.8 % under LSCS mode). 6.9% cases had abortion and the remaining 13.8% of cases succumbed antenatally. 12 (21.05%) maternal deaths occurred within 24 hours of admission into the hospital. 6 (10.52%) died within 24-48 hours. 9 (15.78%) died within 48-72 hours and 12 (21.05%) within 72-96 hours. 24 (42.10%) died after 96 hours to <42 days.

**Table 3: Factors contributing to maternal mortality.**

Factors	Frequency (N=57)	Percentage
<b>Regular antenatal visits in present pregnancy</b>		
Yes	48	84.2
No	9	15.8
<b>Booked/referred</b>		
Booked	13	22.8
Referred	44	77.29
<b>Gestational age at admission (in weeks)</b>		
<28	6	10.5
28-34	15	26.3
34+1-37	9	15.8
>37	5	8.8
Delivered cases	22	38.6
<b>Presenting complaints at admission</b>		
High BP with imminent symptoms	15	26.3

Continued.

Factors	Frequency (N=57)	Percentage
Jaundice	4	7
Breathlessness	7	12.3
Fever with chills	8	14.0
Haemorrhage	3	5.3
Labour pains	4	7
Decreased/absent fetal movements	2	3.5
Cough with expectoration	5	8.8
Referred in shock	13	22
<b>Pre-existing comorbidities</b>		
RHD	2	3.6
Chronic hypertension	1	1.8
Fanconi's anaemia	1	1.8
Type 1 diabetes mellitus	1	1.8
<b>Singleton/multiple gestation</b>		
Singleton	53	93
Twin	4	7
<b>Mode of delivery</b>		
Abortion	4	7.0
Vaginal delivery	21	36.8
LSCS	24	42.1
Not delivered (antenatal)	8	14.0
<b>Time interval between maternal admission and death</b>		
0-24 hours	12	21.05
24-48 hours	6	10.52
48-72 hours	9	15.78
72-96 hours	6	10.52
>96 to <42 days	24	42.10

Table 4: Care and interventions taken to prevent maternal mortality.

	Frequency (N)	Percentage
<b>ICU admission</b>	57	100
<b>Ventilator support</b>	36	63.2
<b>Blood transfusion</b>	38	66.6
≤15 units	22	38.6
>15 units	16	28.1
<b>Inotrope support</b>	27	47.4
<b>Surgical intervention</b>	15	26.3
<b>Caesarean section</b>	11	19.2
<b>Exploratory laparotomy</b>	3	5.2
<b>Percutaneous nephrostomy</b>	1	1.7
<b>Caesarean hysterectomy</b>	1	1.7
<b>Uterine artery embolization</b>	1	1.7
<b>B lynch sutures</b>	1	1.7
<b>Other procedures-dialysis</b>	3	5.2

Table 5: Incidence and cause of maternal mortality over the decade.

Year	Incidence (N=59) (%)	Direct cause (N)	Indirect cause (N)
2010	4 (4)	Sepsis (2)	HDP (1)
		Pulmonary embolism (1)	Hemorrhage (1)
		HDP (1)	Swine flu (1)
			RHD with CCF(1)
2011	7 (11.9)	Sepsis (5)	HDP (4)
		Haemorrhage (1)	Swine flu (1)

Continued.

Year	Incidence (N=59) (%)	Direct cause (N)	Indirect cause (N)
		Sepsis+dengue shock syndrome (1)	CVA (2)
2012	5 (8.5)	Sepsis (2) (1)	HDP (3) Haemorrhage (1)
2013	1 (1.7)	Sepsis with DIC (2) Sepsis with DIC (1)	RHD with PAH (1) HDP (1)
2014	11 (18.6)	Sepsis (6) Sepsis with DIC (1) Haemorrhage (2) HDP (1) AFLP (1)	HDP (4) Haemorrhage (2) Metabolic encephalopathy (1) ARDS (3) DIC (1)
2015	7 (11.9)	Sepsis (2) Sepsis with DIC (1) Haemorrhage (2) HDP (1) ARDS (1)	HDP(5) PRES (1) DIC (1)
2016	4 (6.7)	Sepsis (1) Sepsis with DIC (1) Amniotic fluid embolism (1) Cardiogenic shock (1) HDP (1)	HDP (1) Haemorrhage (3) RHD with PAH (1)
2017	7 (11.9)	Sepsis with DIC (3) HDP (1) Unsafe abortion (2) Cardiogenic shock (1)	Haemorrhage (3) RHD with PAH (2) SLE (1) HDP (1)
2018	6 (10.2)	Sepsis (2) Sepsis with DIC (2) ARDS (1) Haemorrhage (1)	Haemorrhage (2) Swine flu (1) HDP (2) Hemolytic anemia (1)
2019	4 (6.7)	Sepsis (2) HDP (1) Unsafe abortion (1)	ARDS (3) ITP (1)

**Table 6: Direct and indirect causes of maternal mortality.**

Causes	Frequency (N=59)	Percentage
<b>Direct causes</b>		
Sepsis	24	42.1
Sepsis with DIC	10	17.5
Hypertensive disorders of pregnancy	7	12.3
Hemorrhage	6	10.5
Unsafe abortion	3	5.3
ARDS	2	3.5
Cardiogenic shock	2	3.5
Sepsis+dengue shock syndrome	1	1.8
Pulmonary embolism	1	1.8
AFLP	1	1.8
<b>Indirect causes</b>		
Hypertensive disorders of pregnancy	22	38.6
Hemorrhage	11	19.5
ARDS	7	12.3
RHD with PAH	4	7
Swine flu	3	5.3
CVA	2	3.4
DIC	2	3.4

Continued.

Causes	Frequency (N=59)	Percentage
Hemolytic anemia	1	1.8
RHD with CCF	1	1.8
Metabolic encephalopathy	1	1.8
Posterior reversible encephalopathy syndrome	1	1.8
Idiopathic thrombocytopenic purpura	1	1.8
Systemic lupus erythematosus	1	1.8

HDP-hypertensive disorders of pregnancy, ARDS-acute respiratory distress syndrome, AFLP-acute fatty liver of pregnancy, RHD-rheumatic heart disease, CVA-cerebrovascular accident, DIC-disseminated intravascular coagulation, PAH-pulmonary arterial hypertension, CCF-congestive cardiac failure.

#### **Care and interventions done to prevent maternal mortality (Table 4)**

All the patients were admitted in intensive care unit, the rate being 100%. 63.2% were intubated and 66.6% were required blood transfusion out of which 28.1% required massive transfusion. All measures like uterine messaging, bimanual compressions, ecbolics, uterine tamponade with condom catheter insertion were done to prevent PPH occurring due to atonic PPH. 47.4% was started on inotropic supports. 20.6% was surgically intervened out of which 17.4% underwent caesarean, 5.26% (3 patients) underwent exploratory laparotomy in which 1.7% underwent total abdominal hysterectomy. 1.7% underwent percutaneous nephrostomy due to left renal hydroureteronephrosis, 5.2% underwent dialysis and 1.7% underwent caesarean hysterectomy. 1.7% (1 patient) had undergone uterine artery embolization due to atonic PPH.

#### **Incidence and cause of maternal mortality over the decade (Table 5)**

Sepsis was the leading primary cause of death which was 42.1% followed by sepsis with DIC which was 17.5% followed by PPH which was 10.5%. Unsafe abortion and cardiogenic shock both were 5.5% and 3.5%. The indirect cause of maternal death was hypertensive disorders of pregnancy which accounted for 38.6% followed by PPH which was 19.3%. ARDS accounted for 12% and RHD with PAH accounted for 7% for indirect cause.

## **DISCUSSION**

India's present MMR is below the millennium development goal (MDG) target and puts the country on track to achieve the sustainable development goal (SDG) target of an MMR below 70 by 2030.<sup>5</sup> In the present study MMR varied from 33.0 (2010) to 44.5 (2019)/100000 live birth. In the last 15 years various studies in India have shown wide variation in MMR ranging from 47/100000 to 625/100000 births.<sup>6-10</sup> Jain et al has reported a very high MMR of 2270/100000.<sup>7</sup> The extent of maternal mortality is an indicator of disparity and inequity in access to appropriate healthcare and nutrition services throughout a lifetime, and particularly during pregnancy and childbirth.<sup>7</sup> Women who lived within a radius of 10-100 km from the hospital with travel time being approximately less than or equal to two hours were already in poor health condition when they were brought to hospital.

Women are referred too late to tertiary care centre when they develop life threatening complications which increases the maternal morbidity and mortality.

Most of the maternal death observed was 49% in 20-25 years of age group and 31% in 26-30 years it's similar to study by Surekha and Rao.<sup>12,13</sup> 42% of death occurred in >96 hours of admission and 21% death occurred with 24 hours admission to hospital, it was consistent with the studies done by Rao et al and by Surekha et al.<sup>12,13</sup> Women who were brought to hospital were already in critical health condition. All these deaths could have been avoided if they were transferred earlier emphasizing the need for adequate and quick transfer facilities.

Sepsis was the leading cause of maternal mortality in our study. The prevalence of maternal sepsis was estimated to be 16.5/10000 live birth consistent with reported rates of 0.1-0.3% for developed countries. Sepsis has very high fatality rate among pregnant women. 42% of women died of sepsis among which sepsis with DIC was seen in 17.5% and puerperal sepsis was 23%.

It is similar to the study done by Kumari in which mortality due to sepsis was very high (80% which 35 out of 45 cases) and 31% was puerperal sepsis.<sup>15</sup> In our study 5.3% (3 patients) died of septic abortion which was consistent with study of Khandal et al 12.5% of referral death were due to abortion many of these lives could be saved if all abortion could be performed by qualified medical personnels.

A total 12.3% of death were due to HDP in the present study which was direct cause and indirect cause being 38.6% which was similar study done by Khandal et al and by Rao et al.<sup>12,13</sup> Early diagnosis of HDP and treatment will prevent from life threatening complications. Use of drugs like Mg SO<sub>4</sub> in pre-eclampsia cases can prevent patient from developing convulsion.

The second most common indirect cause of deaths in present study was haemorrhage 20% which was similar to study by Agarwal et al.<sup>14</sup> Several publications have documented an increase in the incidence of obstetric haemorrhage particularly PPH over the recent years. It is important to identify the causative factors for obstetrical haemorrhage so that remedial measures can be taken to reduce their occurrence or severity. PPH also needs special attention because it can lead to death very rapidly in the absence of prompt life-saving care.<sup>16</sup> The time available for intervention being short, demands an efficient medical

back-up for all deliveries. Institutional deliveries should be reached to 100%.<sup>16</sup>

Rheumatic heart disease was the suspected cause of death in 4 cases which was 7% and pulmonary embolism was associated with 2% maternal death similar to study done by Rao et al.<sup>13</sup> Swine flu and pneumonia (swine flu not confirmed) also accounted for the maternal death due to epidemic of H1N1 virus.

Among ICU admission, 66% of cases required mechanical ventilation. The duration of hospital stay was less than 48 hours in 32% of the cases which is consistent with study by Archana et al.<sup>15</sup> An obstetrical procedure had to be performed in 15% of the cases similar to study by Archana et al.<sup>15</sup>

Exploratory laparotomy was required in 3 out of 57 patients as intraperitoneal haemorrhage was noted. Out of which 1 (1.7%) patient underwent total abdominal hysterectomy i/v/o DIC and uterine atony. 1 (1.7%) patient underwent caesarean hysterectomy due to central placenta previa i/v/o excessive bleeding intra operatively.

Haemorrhage, sepsis, eclampsia still remain the classical triad causing maternal death. All these are preventable causes of maternal mortality. Adequate treatment and timely referral services to tertiary care centres prevent most of the maternal deaths. Early detection of high risk cases, reference of these patients in time to tertiary care centre, encouraging 100% institutional delivery, improving transportation at every level can help in preventing maternal mortality rate.

## CONCLUSION

Pregnancy should be viewed as a window of opportunity into the current and future health of women. It offers critical entry points for women who may otherwise not seek or have access to health care. Maternal health services should move beyond the focus on emergency obstetric care, to a broader approach that encompasses preventive and early interventions and integration with existing services. Maternal deaths due to hypertensive disorders in pregnancy, obstetric haemorrhages and sepsis can be prevented to a large extent if pregnant women attend tertiary care centre for early diagnosis and treatment. High-quality obstetric care should be made available to all women through a system of professional midwifery and referral hospital care in accountability of health care providers.

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