

Maternal Mortality Indices in Tertiary Care Center of Central India

Varsha B Nimbalkar¹, Harshada Thakur², Angad Ranadive³, Kimaya Mali⁴

Received on: 19 January 2024; Accepted on: 27 June 2024; Published on: 23 October 2024

ABSTRACT

Introduction: Maternal mortality remains a pressing global concern, with various potential adverse implications for women and their families. The relatively higher maternal mortality rate in India underscores the need for focused attention on maternal health. There is a dearth of relevant actionable data from Central India, which is important for formulating focused recommendations.

Methodology: This research paper presents a retrospective observational study conducted over 2.5 years in a tertiary care center in urban India. It included all cases of maternal mortality recorded during the period. Data was collected retrospectively, and statistical assessment was performed using frequency calculations. Demographic characteristics, risk factors, causes of maternal deaths (direct and indirect), obstetric history, management approaches, and preventive measures were studied.

Results: Risk factors associated with maternal mortality included severe anemia, postpartum hemorrhage, disseminated intravascular coagulation, severe preeclampsia or eclampsia, septicemia, respiratory diseases, and COVID-19 positivity. A significant majority (88.3%) were unregistered, with no visit to the health center. Direct causes were responsible for 45 (37.5%) deaths, majorly responsible being postpartum hemorrhage (76%), preeclampsia/eclampsia (67%), and sepsis (67%). Indirect causes accounted for 75 (62.5%) maternal deaths, including respiratory diseases (20.8%), cardiovascular diseases (9.2%), gastrointestinal diseases (1.3%), CNS diseases (4%), autoimmune diseases (7%), malignancies (4%), and infections (9%).

Conclusion: Strategies and interventions toward improved access to antenatal care even in peripheries, strengthening of referral services, early diagnosis and treatment of medical complications, prevention of infectious diseases, community outreach programs for maternal anemia prevention and further strengthening of tertiary care centers are recommended.

Keywords: Clinical audit, Maternal mortality, Risk factors, Tertiary care center.

Journal of South Asian Federation of Obstetrics and Gynaecology (2024): 10.5005/jp-journals-10006-2472

INTRODUCTION

Maternal mortality, the loss of a woman's life during pregnancy/within 42 days of the termination, continues to be a pressing global concern.¹ A woman dies every 90 seconds worldwide due to complications arising from pregnancy and childbirth, with India alone witnessing a maternal death every 7 minutes.^{1,2} Majority of them are preventable, highlighting the urgent need for focused attention on maternal health.³ Not only does maternal mortality impact the socio-economic status of a nation but it also infringes upon an individual's right to the highest attainable health standards.

In India, the leading causes of maternal mortality are hemorrhage, sepsis, toxemia of pregnancy, abortions, and obstructed labor.^{2,4} These factors contribute to the existing maternal mortality ratio (MMR) in India, which stands at 97 deaths per 1,00,000 live births, as per the latest estimates from the Special Bulletin on MMR of the Registrar General of India (RGI).² Such statistics underscore the stark reality that with each pregnancy, the risk of maternal mortality is 200 times compared to women in developed nations.⁵ Even within the country, the regional disparities in MMR are noteworthy, with Maharashtra and Kerala having the lowest maternal mortality rates.² Amongst other reasons, the disparities may be partly attributable to inequitable access to health care across regions and hence exploring them further will be useful for planning targeted efforts for respective regions:

Reducing maternal mortality is an important goal aligned with the Millennium Development Goals (MDGs) and represents a crucial

¹⁻⁴Department of Obstetrics & Gynecology, GS Medical College & KEM Hospital, Mumbai, Maharashtra, India

Corresponding Author: Varsha B Nimbalkar, Department of Obstetrics & Gynecology, GS Medical College & KEM Hospital, Mumbai, Maharashtra, India, Phone: +91 7620140585, e-mail: drvarshanimbalkar@rediffmail.com

How to cite this article: Nimbalkar VB, Thakur H, Ranadive A, *et al.* Maternal Mortality Indices in Tertiary Care Center of Central India. *J South Asian Feder Obst Gynae* 2024;16(5):500–503.

Source of support: Nil

Conflict of interest: None

step toward achieving sustainable development. Therefore, it is imperative to assess the causes contributing to the alarmingly high maternal mortality numbers in our country. Maternal death audit, a systematic review of maternal deaths, serves as a valuable tool in examining the medical and socio-economic factors, etc. leading to these tragic outcomes. By analyzing the lessons learned from such audits, recommendations can be formulated for the prevention of deaths of a similar kind.

With the present study, we aimed to assess the causes and risk factors related to maternal deaths in India, while exploring viable strategies relevant to the region to reduce the incidence of such deaths.

Table 1: Age-wise distribution of study participants (n = 120)

Age (in years)	Frequency (n)	Percentage (%)
18–25	49	40.8
26–30	41	34.2
31–35	16	13.3
36–40	8	6.7
41–45	6	5.0
Total	120	100%

METHODOLOGY

The present study was an observational retrospective study, carried out over a period of 2.5 years (June 2019 to December 2021) in the form of an audit at a tertiary care government center in India. The study focused on maternal mortality and aimed at identification of causes, and risk factors, followed by potential interventions. Permission from the organizational Ethics Committee (EC) was taken before the start of the study.

A universal sampling technique was employed, including all cases of maternal mortality at the institute, including referred cases. The inclusion criteria for the study included all pregnant and postnatal women within 42 days of delivery, who succumbed to direct/indirect causes at the study center. Cases of ectopic pregnancy deaths were also included. Deaths that did not fit the definition of maternal mortality were excluded. All maternal mortality data were fetched from the hospital records, ensuring patient identity confidentiality. At no point was there an attempt to contact the patients or their relatives, and no interventions were performed anytime during the study.

Data were collected regarding demographic features, detailed history, current or previous fetal anomalies, family history for genetic disorders, and past obstetrical history. Routine antenatal profiles, including complete hemoglobin, blood group, and Rh typing, urinalysis, VDRL, HBsAg, and HIV serology carried out for all subjects were recorded for the study purpose. The data were collected using a case record proforma, and various pregnancy outcomes such as medical termination of pregnancy, miscarriage, mode of delivery, and mode of medical termination were recorded.

The sample size was determined using Open Epi, version 3. With a 99% confidence interval and a frequency of 0.6%, the sample size for the study was determined to be 120. Statistical analysis involved the use of frequency and percentage calculations for qualitative analysis; while mean median, and interquartile range were used for quantitative data. The MMR was calculated as follows:

$$\text{MMR} = \frac{\text{Number of maternal deaths} \times 1,00,000}{\text{Number of live births.}}$$

Values were recorded in an MS Excel sheet. Graphical representation was used when necessary. Statistical analysis was undertaken via SPSS Version 19 for most analyses and MS Excel for graphs.

RESULTS

The mean age of the eligible participants was 27.66 years. Approximately 41% belonged to the 18–25 years age-group followed by another 34% in the 26–30 years bracket (Table 1).

The MMR was noted at 1023 for every 1,00,000 live births, estimated for the period of study. A significant proportion of women (95.8%) were referred to the tertiary care center from peripheral hospitals and only 4.2% were registered in-house. Regarding antenatal care, a large number of women (88.3%) were unregistered,

Table 2: Distribution of causes of maternal mortality (n = 120)

Causes	Frequency (n)	Percentage (%)
Direct causes		
DIC	40	89
PPH	34	76
Preeclampsia/eclampsia	30	67
Sepsis	30	67
Ectopic pregnancy	3	7
MTP	1	2
Indirect causes		
Respiratory causes	23	29
COVID	15	20
Non-COVID	8	9
Cardiac causes	10	13
Ischemic heart disease	3	4
Valvular heart disease	7	9
Infections	5	7
Gastrointestinal causes	4	5
CNS causes	3	4
Malignancy	3	4
Burns	3	4
Autoimmune causes	1	1
Other	7	9

PPH, post-partum hemorrhage

with not a single visit to the health center. A total of 40.8% patients was multigravida, while 37.5% (45) patients were multiparous. Thus, more than half (59.2%) of them were primigravida.

Maternal mortality causes were assessed; distinguishing between direct and indirect causes. Direct causes were responsible for 45 (37.5%) deaths, with the leading ones being postpartum hemorrhage (76%), preeclampsia/eclampsia (67%), and sepsis (67%). Indirect causes accounted for 75 (62.5%) maternal deaths, including respiratory diseases (20.8%), cardiovascular diseases (9.2%), gastrointestinal diseases (1.3%), CNS diseases (4%), autoimmune diseases (7%), malignancies (4%), and infections (9%) (Table 2).

The study also identified risk factors associated with maternal mortality, which were overlapping in many cases. Disseminated intravascular coagulation (45%) was the most prevalent risk factor in the present study, followed by severe anemia (43.3%), severe preeclampsia or eclampsia (40%), and postpartum hemorrhage (28.3%). Other risk factors included septicemia (25%), respiratory diseases (20.8%), COVID-19 positivity (12.5%), and cardiovascular diseases (9.20%) (Table 3).

The obstetric history of the women revealed that a significant proportion of them had experienced previous adverse pregnancy outcomes. About 11.7% had a history of stillbirths, 4.2% had a history of ectopic pregnancy, and 9.2% had a history of genital tear or trauma post-delivery.

In terms of management, apart from the multidisciplinary medical management (including blood/blood component transfusions) in the indirect causes as well as direct causes, as relevant; uterotonic drugs were administered to 30% of the women, while interventions such as balloon tamponade (10%), uterine/internal iliac artery ligation (5%), B-Lynch sutures (2.5%), Heyman's patch (1.7%), and obstetric hysterectomy (1.7%) were performed in cases of severe postpartum hemorrhage (Table 4).

Table 3: Maternal mortality associated risk factors

Risk factors	Frequency (n)	Percentage (%)
Disseminated intravascular coagulation	54	45.0
Severe anemia	52	43.3
Severe preeclampsia (46) or eclampsia (2)	48	40.0
Postpartum hemorrhage	34	28.3
Septicemia	30	25.0
Respiratory diseases	25	20.8
COVID-19 positivity	15	12.5
Cardiovascular disease	10	9.2

Table 4: Management in the cases of eventual outcome of maternal death (n = 120)

Management	Frequency (n)	Percentage (%)
Uterotonic drugs	35	29.2
Balloon tamponade	12	10
Uterine/Internal Iliac artery ligation	6	5
B-Lynch sutures	2	1.7
Heyman's patch	3	2.5
Obstetric hysterectomy	2	1.7

DISCUSSION

The present study was an exercise in the estimation of the incidence of maternal mortality and assessment of factors/characteristics associated with it; namely demographic characteristics, risk factors, causes, and management cues in the cases of maternal deaths.

Maternal mortality is defined by the WHO as the death of a woman whilst pregnant or within 42 days of delivery or termination of pregnancy, from any cause related to, or aggravated by pregnancy or its management, but excluding deaths from incidental or accidental causes.⁹ Globally, the MMR has shown a decline from 342 per 1,00,000 births in 2000 to 211 in 2017.¹ The MMR has also decreased in India from 398 per 1,00,000 live births in 1998 to the latest available figure of 97 per 1,00,000 live births in 2020.² However, regional variations exist, with Maharashtra and Kerala having the lowest maternal mortality rates.² The MMR in the state of Maharashtra went down from 68 maternal deaths per 1,00,000 live births in 2016 to 33 maternal deaths per 1,00,000 live births in 2020; achieving the Sustainable Development Goals (SDGs) laid down by the United Nations.^{2,7} The present study analyzed data from a total of 120 maternal deaths, resulting in an MMR of 1,023 per 1,00,000 live births, relatively higher than the latest globally or nationally or state-wise estimated averages. The higher maternal mortality in the present study could be due to the admission of serious cases referred from centers from the periphery late in the course of management. Another related reason could be the very low antenatal Care (ANC) registration rate amongst the present study participants. Previous studies from other similar tertiary care centers from India have been reporting MMRs in the similar range of 554–915 per 1,00,000 live births, also much higher than the national figure of 97.^{8–11} Although the reason for the disparity between the observations of the present and quoted studies and the national figures is not clear, the study centers being referral hubs for rural and under-served areas and some under-reporting at national level could have played a role as well.

Most of the deaths (40.8%) were in the 18–25 years category, followed by 34.2% in the 25–30 years age-group; which is mostly in line with previous studies from similar tertiary care centers from India.^{12,13} Results from the present study showed that 45 (37.5%) women out of a total of 120 died due to direct causes. The commonest of those causes were postpartum hemorrhage (76%), preeclampsia/eclampsia (67%), and puerperal sepsis (67%). Montgomery et al. noted nearly 82% of the deaths were attributable to direct causes like hemorrhage, puerperal sepsis, and a prolonged rupture of membranes.¹⁴ Singla et al. observed that the commonest direct cause of maternal mortality was preeclampsia or eclampsia in 24.4%, obstetric hemorrhage in 19%, and puerperal sepsis in 14.5%. A higher proportion of maternal deaths in the present study was due to obstetric hemorrhage, obstructed labor, and severe preeclampsia or eclampsia in comparison to other studies which may be partly attributed to a failure in the identification of risk factors like severe anemia, placental abnormalities, and an active management during the second and third stage of labor.

Indirect causes of death were responsible in 75 of the 120 (62.5%) women. Cardiac diseases were seen in 10 (13%) women, with 3 deaths due to ischemic heart disease in post-delivered and post-lower segment cesarean section (LSCS) patients and 7 being due to valvular heart diseases, all of them involving the mitral valve. Respiratory infections were seen in 29% of women with 15 deaths due to COVID-19 infection, mainly due to the then ongoing pandemic. COVID-19 deaths were seen in incidental COVID-19-positive women, women in active labor, and women on assisted ventilatory support who couldn't be referred to a dedicated COVID center. Infectious diseases such as dengue and malaria were found to be the cause in 7% of women. The indirect causes were mostly on similar lines to previous studies from similar tertiary care centers in India, except higher contribution by the COVID-19 pandemic, expected for the times.^{9–11}

With regards to the risk factors, disseminated intravascular coagulation (45%) was the most prevalent risk factor in the present study, followed by severe anemia (43.3%), severe preeclampsia or eclampsia (40%) and postpartum hemorrhage (28.3%). The gravity of the mentioned risk factors increased mainly due to the delay in reaching the study center, presumably either due to inertia or patient latency in decision-making. Also, 1 (0.8%) patient was found to have a molar gestation, while 2 patients had a multi-fetal gestation out of 120 patients. In comparison to the present study, molar gestation contributed to 6% of the deaths in a study by Agan et al.¹⁵ These differences are probably due to a small sample size and the rare nature of the disease. Thirty (25%) out of the 120 patients had puerperal sepsis as a complication. In 2006, a WHO review on maternal deaths observed sepsis to be the responsible cause of death in Africa (10% of cases) and Asia (12% of cases).¹⁶ In our study twice the proportion of the mentioned estimate was observed.

Out of the 120 patients registered, only 1.7% of patients had less than 3 ANC visits. The majority (88.3%) had no ANC visits while 0.8% of the patients had 6 ANC visits. This again is suggestive of the fact that our institute being a referral center, more mothers were being referred with complications for advanced care and who unfortunately could not make it. A total of 40.8% of patients were multigravida, while 37.5% (45) patients were multiparous. Thus, more than half (59.2%) of them were primigravida.

These findings resembled the results of a few studies while contrasted with a few other studies probably due to the differences in the socio-demographic settings of the centers in which these studies were conducted. Yadav et al. observed that 43% of the

total maternal deaths occurred in primigravida, while 34% of deaths were seen in multigravida and 23% in grand multipara.¹⁷ Bangal et al. observed that 16 (42.10%) and 22 (57.89%) out of the total 38 deaths were among primigravidas and multigravidas, respectively.¹⁸ The study by Fernandes et al. reported results on the same lines.¹⁹

Out of the total 120 patients, 35 (29.2%) patients received uterotonic drugs while data from 3 was unavailable. Balloon tamponade was used in 12 (10%) out of the 120 patients, while data from 3 patients was not known. Internal Iliac/Uterine artery ligation was performed in 6 (5%) out of the 120 patients. The uterine compression sutures consisted of the Lynch stitch, the Heyman stitch, and the Pereira stitch. In the present study, 2 (1.7) patients out of the 120 got a Lynch stitch, while 3 (2.5) patients got the Heyman stitch. Data from 3 patients was unknown for all the above-mentioned interventions. All these management strategies are well known to stop deterioration in the maternal clinical condition. For instance, Gizzo et al. noted that active management of the third stage of labor with prophylactic uterotonic drugs decreases the post-partum hemorrhage (PPH) risk by 60%.²⁰ A study by Herrick et al. estimated that simple usage of a uterine balloon tamponade resulted in 6,547 lesser lives being lost (MMR decreased by 11%) and helped avoid 10,823 operations in the whole of sub-Saharan Africa yearly.²¹ Nauman et al. observed that in 39 out of the 40 patients treated for uncontrollable post-partum post-hemorrhage with the Heyman stitch, the PPH was controlled while only one patient needed a hysterectomy later.²² Two (1.7%) patients had undergone subtotal hysterectomy, while no patient underwent total hysterectomy in the present study.

There are a few inherent limitations of the study. The study had a comparatively smaller sample size which limits the power to estimate risk factors and other characteristics accurately. Since it was a single-center study, the external validity of the study is limited. Further, as the study center was a tertiary care referral center and teaching hospital, there could be a likely bias in only the high-risk patients being referred. Finally, as the study was carried out during the COVID-19 pandemic period, it impacted the observations in more ways than one.

CONCLUSION

Based on observations and insights from the present study, strategies, and interventions in the form of improved access to antenatal care even in peripheries, strengthening of referral services, early diagnosis and treatment of medical complications, prevention of infectious diseases, community outreach programs for maternal anemia prevention and further strengthening of tertiary care centers for effective management of the referred cases are much required and are recommended to achieve an effective reduction in maternal mortality.

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