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Original Research Article

Maternal mortality unveiled: insights from a tertiary care hospital in western India

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ABSTRACT

Background: Maternal mortality remains a significant public health issue, especially in resource-constrained settings. Despite national and global efforts, India still contributes substantially to the global maternal death burden. Objectives were to evaluate patterns along with socio-demographic and clinical factors linked to maternal mortality, and to analyze types of delay that contribute to maternal deaths.
Methods: This cross-sectional study was conducted in the obstetrics and gynaecology department of tertiary care center, from March 2023 to August 2024. All maternal deaths during this period (n=47) were analyzed. Data were extracted from case records and analyzed using descriptive statistics. The maternal mortality ratio (MMR) was calculated per 100,000 live-births.
Results: Total 47 maternal deaths were reported among 12,356 live births, giving an MMR of 380.38. Most deaths occurred in the 20-30-year age group (74.46%), among illiterate (72.34%) and rural (59.57%) women. More than half of the maternal deaths (57.44%) were in multigravida and in unregistered cases (57.44%). 68.1% of women were referred from other centres, often critically ill. A significant number of women died [33 (70.21%)] during postnatal period of pregnancy. Hemorrhage (43.3%), sepsis (33.3%), and hypertensive disorders (23.3%) were the leading direct causes. Indirect causes included heart and nervous system disorders. Type 1 delays (59.6%) were the most common, followed by type 3 (27.7%).
Conclusions: Adequate and quality antenatal care, early identification of high-risk pregnancies, and strengthening referral systems are crucial. A multifaceted approach including health education, infrastructure improvement, and continuity of care is necessary to reduce maternal mortality.

Keywords: Maternal mortality, Pattern and causes of maternal deaths, Tertiary care centre

INTRODUCTION

Motherhood is one of the most cherished and important stage in a woman's life. It is a stage where women require special care, attention, support, and nutrition. But the road to safe motherhood is not a smooth one for every woman across the globe. Maternal mortality is a key indicator of a nation's healthcare quality. Despite these progresses, approximately 2,60,000 women die every year i.e. 700 women die every day (approximately one woman is dying every two minutes) during pregnancy and childbirth all over the world of which almost 95% of all maternal deaths occurred in low and lower-middle-income countries, and most could have been prevented.[1]

According to the World Health Organization (WHO), the global maternal mortality ratio (MMR) was estimated at 197 deaths per 100,000 live births in 2023.[1] According to

Special bulletin on maternal mortality in India 2020-22, MMR in India is 88 deaths per 100,000 live births and Gujarat's MMR has seen a significant reduction i.e. 160 per 100,000 live births in 2016 to 55 in 2023.[2] Sustainable development goal 3 aims to reduce global MMR to less than 70 per 100,000 live births by 2030. In India, although the MMR has decreased, regional disparities persist, particularly in underserved areas.[3]

The causes of maternal mortality are diverse and often interconnected. Direct causes such as hemorrhage, sepsis and hypertensive disorders are responsible for the majority of maternal deaths globally.[1] Indirect causes, including pre-existing medical conditions exacerbated by pregnancy also contribute significantly. Furthermore, socio-economic factors such as poverty, lack of education and cultural practices influence women's access to healthcare services and their ability to seek timely medical assistance during pregnancy and childbirth.[3] The most significant contributor to maternal mortality is the time needed to provide adequate care. According to Thaddeus and Maine, the three-delay model can be applied to understand the causes of delays in emergency obstetric care which leads to maternal deaths, eventually calling for interventions to avoid those delays.[4]

The government of India had launched several national programmes to decrease the maternal mortality ratio and despite all the efforts, maternal mortality ratio in India continues to remain high. Hence the present study was carried with objectives to determine the maternal mortality ratio (MMR) in a tertiary care centre, to analyze socio-demographic, clinical, and obstetric profiles of deceased mothers and to identify delays and health system gaps contributing to maternal mortality.

METHODS

This hospital-based retrospective cross-sectional study was conducted in the department of obstetrics and gynecology at tertiary care centre, western India from March 2023 to August 2024. The study population included all maternal deaths during study period that occurred during pregnancy or within 42 days following the termination of pregnancy, in accordance with the WHO definition of maternal mortality. However, maternal deaths due to accidental or incidental causes, as well as cases brought dead to the hospital, were excluded from the analysis to ensure that only medically relevant deaths were studied. Ethical clearance from the institutional ethics committee was obtained.

Data for each case were meticulously collected from available hospital records, including antenatal, labor records, ICU records, operative notes and death records. A semi-structured data collection tool consisted of five parts was used to extract information. First part contained socio-demographic details (age, address, education, occupation, socio-economic status). Second part included obstetric profile- antenatal check up information, gestation period at the time of admission/presentation, condition on admission, referral information, outcome of pregnancy, period of gestation at the time of death. Third part included risk factors details (at the time of pregnancy, complications during antenatal period and complications developed during labour, mode of delivery and details regarding postnatal period). Fourth part consisted questions regarding causes of maternal deaths (direct obstetric causes and indirect causes along with other contributory causes of maternal death) and fifth part focused on the social factors responsible for the maternal deaths.

The 'three D' delay model by Thaddeus and Maine to identify the gap for maternal death has divided the causes for delay into three subgroups. The first level is the delay in decision to seek care which is reflected by the problems related to family and personal in the proforma. These are refusal for treatment or admission in previous facility. The second level of delay occurs in identifying and reaching health facility which was assessed by the factors like lack of transport from home to home, healthcare facility and between healthcare facilities. There may be delay or breakdown of communication in between health services. The third level of delay is delay in receiving adequate and appropriate treatment. It was assessed by factors like lack of facilities equipment, blood, operation theatres and expertise.

The collected data entered in MS office excel 2013. The analysis was done using Epi-info software (version 7.2.2.6). Descriptive statistics were used to summarize frequencies, percentage and measure of central tendency for demographic variables and questionnaire subscales.

RESULTS

During the study period, a total of 47 maternal deaths were recorded out of 12,356 live births. Using this data, the Maternal Mortality Ratio (MMR) was calculated using the standard formula: MMR = (Number of maternal deaths / Number of live births) × 100,000.

Accordingly, the MMR for the study setting was found to be 380.38 per 100,000 live births.

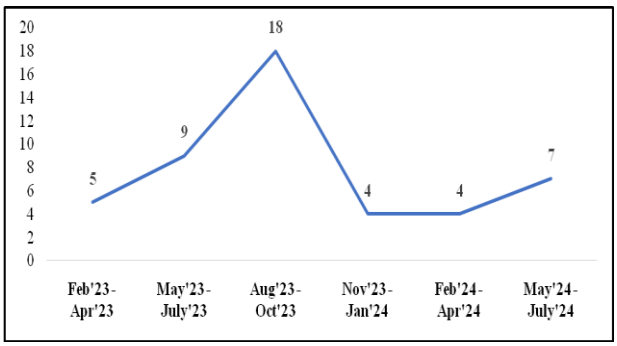

Figure 1: Trend of quarterly maternal deaths (February 2023 - July 2024).

Table 1: Socio-demographic, clinical, and obstetric profile of deceased mothers (n=47).

Variables	No. of cases	Percentage
Socio-economic profile		
Age groups (in years)		
<20	3	6.38
20-30	35	74.46
>30	9	19.14
Education		
Illiterate	34	72.34
Literate	13	27.65
Occupation		
Housewife	25	53.19
Agricultural worker	11	23.40
Labourer	08	17.02
Industrial worker	03	6.38
Residence		
Rural	28	59.57
Urban	19	40.42
Socio-economic status		
Class I	01	2.12
Class II	24	51.06
Class III	19	40.42
Class IV	03	6.38
Clinical and obstetric profile		
Parity		
Primigravida	20	42.55
Multigravida	27	57.44
Antenatal registration		
Booked	20	42.55
Unbooked	27	57.44
Referral status		
Referred from healthcare facility	32	68.08
Directly from home	15	31.19
Condition on admission		
Stable	04	8.51
Unstable	43	91.48
High-risk factors (any)		
Yes	22	46.81
No	25	53.19
Timing of death		
Antepartum	09	19.14
Postpartum	33	70.21
Post-abortal	05	10.63
Mode of delivery*		
Vaginal	12	36.36
LSCS	21	63.63
Outcome of delivery*		
Live birth	19	57.57
Still birth	14	42.43

*14 women - undelivered status.

Trend of quarterly maternal deaths during February 2023-July 2024 reveals significant temporal fluctuations, suggestive of seasonal fluctuation along with an overall upward trend. There was consistent increase in maternal deaths across successive quarters, notably reaching a significant peak of 18 deaths during the August - October 2023 quarter. The most common cause of death during this period was obstetric hemorrhage (5 cases), followed by dengue, eclampsia, and septicaemia, each accounting for 3 cases (Figure 1).

Sociodemographic characteristics

Out of the 47 deaths studied, three-fourth of the maternal deaths [35 (74.46%)] were in the 20-30-year age group, most of the deceased women were illiterate [34 (72.34%)], and the majority were housewives [25 (53.19%)]. Most of the maternal deaths were from rural area [28 (59.57%)] including 5 deaths from Vadi Vistar and 15 (31.91%) were migrants from other states whereas 32 (68.08%) were native to Gujarat. Half of the deceased women belonged to class II [24 (51.06%)] socio-economic status (Table 1).

Obstetric profile

More than half of the maternal deaths [27 (57.44%)] were in multigravida and in unbooked cases in terms of antenatal care [27(57.44%)]. Among 47 maternal deaths, majority [32 (68.08%)] were referred from healthcare facilities of which 14 (29.78%) had visited one referral centre and 18 (38.29%) had visited multiple referral centre. Among referrals, most were referred from government health facilities [20 (62.50%)]. One-third of the maternal deaths [15 (31.91%)] reported directly to the tertiary care hospital. Most of the deceased women admitted were medically unstable [(43(91.48%)]. Majority women died [33(70.21%)] during postnatal period of pregnancy, followed by antenatal period [9 (19.14%)] and least in post-abortal period [(5 10.64%)] (Table 1).

Risk factors and outcome

22 (46.81%) women had identifiable risk factors of which most common was previous LSCS [9 (40.91%)] followed by hypertension [6 (27.27%)], anemia, diabetes-mellitus and breech. Majority [21(36.63%)] of women underwent caesarean section and 12 (36.36%) women delivered spontaneously by normal vaginal delivery. The outcome of the delivery among 33 women was live birth in [19 (57.57%)], stillbirth among [14 (42.43%)] and 14 women were in undelivered status (Table 1).

Admission to death interval

Maximum deaths [17 (36.17%)] had occurred within the first 24 hours of admission and between 1-7 days [23 (48.94%)] (Table 2).

Table 2: Admission to death interval.

Time interval	No. of cases	Percentage
<1 day	17	36.17
1-7 days	23	48.94
>7 days	07	14.89

Cause of maternal deaths

Among 47 cases, 26 (55.31%) deaths were due to direct causes and 21 (44.69%) deaths were due to indirect causes.

Major direct cause of maternal mortality (26 cases) was obstetric hemorrhage [13 (50%)] of which 6 (46.15%) attributed to antepartum hemorrhage (abruptio placenta- 5; placenta previa with placenta-accreta spectrum-2), 6 (46.15%) were due to post- partum hemorrhage and 1 (7.69%) were due to ruptured uterus. Sepsis accounts for 6 (23.08%) cases. Hypertensive disorders attributed for nearly one-fourth [7 (26.92%)] of maternal deaths of which includes 3 (42.86%) had severe preeclampsia and remaining 4 (57.14%) cases had eclampsia (antepartum-3 and postpartum eclampsia-1) (Figure 2).

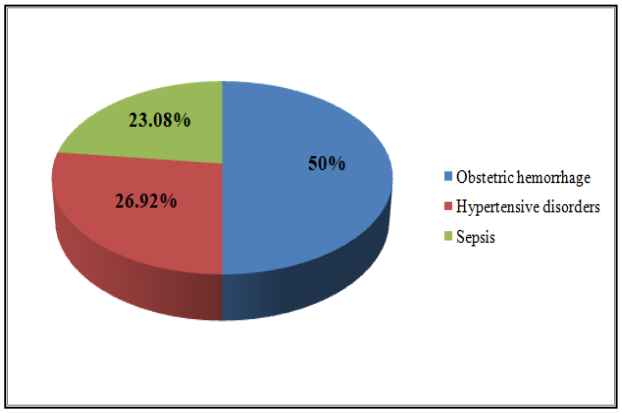

Figure 2: Direct causes of maternal death (n=26).

Among indirect causes (21 cases), it is evident that anemia [5 (23.81%)], heart disease [4 (19.05%)] and nervous system involvement [4 (19.05%)- e.g., meningitis, myoclonic seizure, encephalitis] represent the most prevalent indirect cause of maternal mortality. Additionally, dengue [(3 (14.29%)], respiratory disorders [2 (9.52%)], hepatic failure, renal system disorder and bacterial gastro-intestinal infection were also reported as indirect causes of maternal mortality (Figure 3).

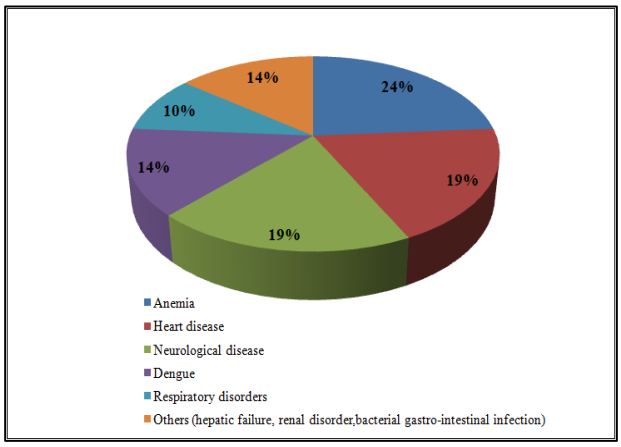

Figure 3: Indirect causes of maternal death (n=21).

Types of delay

Majority (89.36%) of maternal deaths were having delays of which maximum [28 (66.67%)] were associated with type 1 delay, while 13 (30.95%) were attributed to type 3 delay. Only 1 fatality was linked to type 2 delay (Table 3).

Table 3: Three delays in maternal mortality.

Delay in care	No. of cases	%
No	05	10.63
Yes	42	89.36
Types of delay (n=42)		
Type 1 (delay in decision to seek care)	28	66.67
Type 2 (delay in reaching healthcare facility)	01	2.38
Type 3 (delay in receiving appropriate care at the facility)	13	30.95

Type I delay (28 cases), predominantly includes delays in seeking care [21 (75%)], non-compliance to treatment [3 (10.71%)], no/irregular ANC visits [2 (7.14%)], delay in following doctor's advice and non-disclosure of medical history. Type II delay encompasses a single case attributed to a delay in the availability of transport facilities between two healthcare centres. Type III delay comprises delays in referral to tertiary healthcare centres and diagnosis at primary healthcare centres [3 (23.08%)], non-identification of high-risk factors at primary healthcare centres [2 (15.38%)], and non-availability of ventilators, complications of management, delay in intervention at the initial facility, delay in pre-referral stabilization and non-availability of blood products at primary healthcare centres [each 1 (7.69%)].

DISCUSSION

The observed MMR of 380.38 is higher than the national average (~97 per 100,000) with significant fluctuations over time, with a notable increase in fatalities during specific periods (August - October 2023 quarter, reaching 18 deaths), largely due to the tertiary referral nature of the study center accommodating the referral of most of the critical and unstable patients. Various studies done in India in the last 15 years have shown wide variation in MMR ranging from 90/100000 to 1000/100000 births.[5-8] Findings from the present study align with studies by NFHS-5 (2021), Singh et al, Shobha et al in Bengaluru, Kaur et al in Punjab, Murthy et al in western Maharashtra and Devi et al in Manipur indicating that young age (20-30 years), illiteracy, rural residence, and lower socioeconomic status significantly elevate maternal death risk.[5-10]

Obstetric profile

In the present study, 57.44% of maternal deaths occurred among multigravida women, while 42.55% involved

primigravida. Devi et al, Murthy et al and Kaur et al found higher maternal mortality among multigravida women due to obstetric complications frxom previous pregnancies.[5-7] Shobha et al, Singh et al and Say et al emphasized that both groups face different risks, with tailored healthcare interventions necessary to address targeted care for both multigravida and primigravida women.[8,10,11]

The present study shows higher maternal deaths among unbooked (57.44%) cases, possibility of high-risk factors being unidentified and lack of birth preparedness. Sreekumari et al found that women who missed antenatal care in Kerala had higher mortality rates.[12] The findings also aligns with the result obtained in studies conducted by Devi et al, Murthy et al, Kaur et al, Shobha et al, Singh et al and Mitra et al emphasized that lack of antenatal care in low- and middle-income countries is a major contributor to adverse maternal outcomes.[5-8,10,13]

The present study reveals that 68.08% of maternal deaths involved women referred from other healthcare facilities including more than one referral centre contributing to poor outcomes. Kaur et al noted that maternal deaths were often due to delayed referrals and improper management at lower-tier facilities.[7] Say et al also found that inadequate management at the point of initial care and delayed referrals were significant contributors to global maternal mortality. Studies emphasize the critical role of timely and efficient referral systems in preventing maternal deaths.[11]

The present study shows that 91.48% of women were in an unstable state upon arrival reflecting systemic delays in seeking care. Singh et al noted similar trends in low- and middle-income countries, emphasizing the need for improved antenatal care and timely healthcare access to reduce maternal mortality.[10] Kaur et al similarly found that most maternal deaths in occurred among women admitted in critical conditions, stressing the importance of early recognition and intervention.[7]

High-risk factors such as previous cesarean sections and preeclampsia were seen in nearly half the cases, mirroring findings in studies by Khan et al. Timely screening, vigilant monitoring and timely interventions for both low- and high-risk pregnancies is an equally important to reduce maternal mortality.[14]

The current study reveals that 68.08% of maternal deaths occurred during the postpartum period. This was due to high-risk patients being referred and delivered at the present institute, as well as patients who delivered outside being referred from other health centers with inadequate, infrastructure and trained staff in critical condition. Kauret al, Shobha et al, Singh et al, and Mitra et al found that many maternal deaths in low- and middle-income countries occurred in the postpartum period, stressing the need for healthcare systems to prioritize postpartum care and follow-up to mitigate risks.[7,8,10,13]

The present study shows 62.5% of maternal deaths followed LSCS as most in high-risk and complicated pregnancies mode of delivery is LSCS. Similarly, the presence of live births among postpartum deaths suggests that maternal health issues can impact the neonate's immediate well-being, emphasizing the importance of maternal health during and after pregnancy. The significant proportion of stillbirths (37.14%) indicates underlying complications that may have affected fetal health.

Admission to death interval: In the present study, maximum deaths (36.17%) had occurred within the first 24 hours of admission and between 1-7 days, 32 (46.80%) mirroring the findings reported by Devi et al and Kaur et al (58.16%).[5,7]

Causes of maternal mortality

The study shows that 55.31% were attributed to direct causes, and 44.69% to indirect causes. The study identifies hemorrhage (50%), eclampsia (26.92%) and sepsis (23.07%) as the leading direct causes of maternal mortality, emphasizing the need for timely intervention, infection control, and management of hypertensive disorders. Hemorrhage is linked to conditions like abruption placenta, uterine atony, and rupture. Sepsis highlights the importance of infection control in delivery-related procedures, while eclampsia requires vigilant monitoring. The most common indirect causes of maternal death were anemia (23.81%), heart disease (19.05%) and neurological disorders (19.05%). Other indirect causes included dengue respiratory disorders, and hepatic and renal failure. The study emphasizes the complex relationship between pre-existing health conditions and pregnancy-related complications, highlighting the need for specialized care and early identification of high-risk pregnancies to reduce mortality. Similarly, World Health Organization (2019) data highlight direct causes of maternal mortality remain high in low-resource settings, emphasizing the need for improved healthcare facilities to manage complications effectively. A comprehensive study on maternal mortality in India emphasized the significant role of indirect causes, particularly cardiovascular diseases and neurological disorders.[16] Kaur et al reported the classical triad of hemorrhage (22.4%), eclampsia/ preeclampsia (21.2%), and sepsis (18.78%) were the major direct causes of maternal deaths and 29.1% of maternal deaths were due to indirect causes like respiratory diseases (6.06%), liver disease (10.9%), heart disease (3.03%), CNS problems (5.45%) and anemia (3.63%).[7] Almost similar findings reported by Devi et al, Murthy et al, Shobha et al, Singh et al and Mitra et al.[5,6,8,10,13]

Three delays in maternal mortality

The study reveals that type 1 and type 3 delays majorly contributed to maternal deaths, highlighting the importance of early recognition of complications and timely decision making. Similarly, Say et al identified both

type 1 and type 3 delays as major contributors to maternal mortality globally, supporting the findings that delays in decision-making and inadequate healthcare delivery are common issues in many regions.[11] Campbell et al also focused on rural India, where delays in decision-making, inadequate transportation, and lack of resources in healthcare centers were found to be major contributors to maternal deaths.[15] The Global Burden of Disease Study (2013) similarly identified type 3 delays related to healthcare infrastructure and lack of skilled care as prominent factors in maternal mortality in developing countries.[17]

Present study is a retrospective cross-sectional study, relied on secondary data from hospital records; there are chances of missing data. As the study was conducted in one tertiary care centre, the findings may not be generalizable to the wider population or to different healthcare settings. Being a tertiary referral hospital, most cases admitted were complicated and critically ill, leading to an overestimation of the maternal mortality ratio compared to the community setting.

CONCLUSION

Maternal mortality at the study center is alarmingly high. Most deaths occurred among young, illiterate, rural, un-booked women, highlighting systemic gaps in antenatal engagement and emergency response. A combination of direct causes (hemorrhage, sepsis and eclampsia) and indirect causes (anemia, heart and neurological disorders) were responsible. Delays in care, particularly in recognizing complications and timely referrals, were common.

The findings highlight that maternal mortality remains a multifactorial challenge requiring an integrated and comprehensive approach. Strengthening community outreach and antenatal services, with emphasis on early registration, complete antenatal care, and postpartum follow-up, is crucial to reduce preventable deaths. Healthcare facilities must be upgraded with skilled obstetricians, functional critical care units, and robust referral linkages to minimize delays and ensure timely interventions. Priority should be given to early identification and management of high-risk women, addressing both direct and indirect causes. In addition, public health strategies must focus on overcoming barriers within the three-delay model by enhancing maternal health literacy, ensuring affordable and accessible transportation, and equipping facilities with adequate staff, supplies, and emergency preparedness. Ultimately, reducing maternal mortality necessitates a multifaceted, continuum-of-care approach that integrates community engagement, efficient referral networks, and quality tertiary-level services.

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