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Original Research Article

Maternal Mortality Patterns and Determinants in a Tertiary Care Centre in South India: A Retrospective Study

Dr. Roshni R.[1], Dr. Geethanjali S. Mohan[2*], Dr. Renjini R.[3]

[1]Associate Professor, Department of Obstetrics & Gynaecology, Government Medical College, Thiruvanathapuram, Kerala, India.
[2*]Associate Professor, Department of Obstetrics & Gynaecology, Government Medical College, Thiruvanathapuram, Kerala, India.
[3]Associate Professor, Department of Obstetrics & Gynaecology, Government Medical College, Thiruvanathapuram, Kerala, India.

Corresponding Author: Dr. Geethanjali S. Mohan
Associate Professor, Department Obstetrics & Gynaecology, Government Medical College, Thiruvanathapuram, Kerala, India.

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ABSTRACT

Background: Maternal mortality remains a major public health challenge in developing countries despite significant improvements in maternal healthcare. Institutional reviews of maternal deaths provide valuable insight into demographic characteristics, referral patterns, and healthcare system gaps contributing to maternal mortality.[1,2]

Objective: To analyze the maternal mortality ratio (MMR), sociodemographic characteristics, and referral patterns among maternal deaths in a tertiary care centre in South India.

Methods: A retrospective hospital-based study was conducted in a tertiary care centre from January 2018 to December 2022. Data were obtained from case records, labour room registers, and hospital medical records. Maternal deaths were identified according to WHO criteria. Sociodemographic characteristics, referral patterns, and maternal mortality ratios were analyzed using descriptive statistics.

Results: A total of 66 maternal deaths were recorded during the study period. The maternal mortality ratio varied across the years, with values of 114.3 per 100,000 live births in 2018, 108.2 in 2019, 239.6 in 2020, 202.9 in 2021, and 123.0 in 2022. The highest maternal mortality ratio was observed in 2020, coinciding with the COVID-19 pandemic. The majority of maternal deaths occurred among women aged 26–30 years, representing the peak reproductive age group. Most women were housewives, indicating that maternal deaths were more common among economically dependent women. A large proportion of cases (87.9%) were referred from other healthcare facilities, predominantly government hospitals, highlighting the role of tertiary care centres in managing complicated obstetric cases. Late referrals accounted for nearly two-thirds of cases, indicating delays in recognition and referral of obstetric complications. Regarding mode of termination of pregnancy, emergency caesarean section was the most common mode of delivery, followed by vaginal delivery, while a small proportion of cases remained undelivered at the time of death. Analysis of the admission-to-death interval showed that the majority of deaths (84.8%) occurred more than 24 hours after admission, suggesting that many patients arrived in a critical condition requiring prolonged management.

Conclusion: Maternal mortality in this tertiary care centre was strongly influenced by referral delays and systemic healthcare factors. Strengthening referral systems and improving early detection of obstetric complications are essential to reduce maternal mortality.

Keywords: Maternal Mortality, Maternal Mortality Ratio, Tertiary Care Centre, Referral Delay, Obstetric Complications.

INTRODUCTION

Maternal mortality remains one of the most important indicators of the quality of healthcare systems and the health status of women in a society. Despite considerable progress in reducing maternal deaths globally, the burden

remains disproportionately high in low- and middle-income countries.[1]

According to the World Health Organization, approximately 287,000 women died from pregnancy-related causes in 2020, with the majority occurring in developing countries.[1,2]

Most maternal deaths are preventable with timely access to quality antenatal care, skilled birth attendance, and emergency obstetric services.[3]

India has made significant progress in reducing maternal mortality over the past two decades through improved institutional deliveries, expansion of maternal healthcare programs, and improved access to antenatal care services[4]. However, regional disparities persist, and maternal mortality remains a critical public health concern in several parts of the country.[4,5]

The causes of maternal mortality are multifactorial and include both direct obstetric complications and indirect medical conditions aggravated by pregnancy.[6]

Direct causes include postpartum haemorrhage, hypertensive disorders of pregnancy, sepsis, and obstructed labour.[6,7]

The three-delay model is commonly used to explain maternal mortality. The delays include:

- Delay in decision to seek care
- Delay in reaching healthcare facilities
- Delay in receiving adequate care at health facilities

This model was proposed by Thaddeus and Maine.[8]

Institutional maternal death reviews play an important role in identifying these delays and improving maternal healthcare services.[9]

MATERIALS & METHODS

Study Design

This was a retrospective hospital-based descriptive study conducted at a tertiary care centre in South India conducted from January 2018 to December 2022.

Study Population

All maternal deaths occurring in the institution during the study period were included.

Maternal death was defined according to WHO as: "The death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of pregnancy, from any cause related to or aggravated by the pregnancy or its management."

Ethical Considerations

Ethical approval for the study was obtained from the Institutional Ethics Committee of Government Medical College, Thiruvananthapuram prior to the commencement of the study. As the study was retrospective in nature and involved analysis of existing hospital records, informed consent from individual patients was waived by the ethics committee.

All data were collected from hospital medical records, labour room registers, and maternal death review records. Confidentiality and anonymity of patient information were strictly maintained throughout the study. Personal identifiers were removed during data collection and analysis to ensure privacy.

The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki for medical research involving human subjects.

Variables Studied

Sociodemographic Variables: Age/Occupation/Booking status

Referral Characteristics: Source, indication and timing

Obstetric Variables: Gravidity/Gestational age/ANC status/Mode of termination of pregnanacy

Clinical Variables: Condition at admission/presence of associated medical disorder

Outcome Variable: Maternal mortality ratio/Admission-to-death interval

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using appropriate statistical software. Descriptive statistical methods were used to summarize the data. Categorical variables such as age group, gravidity, referral status, occupation, and clinical condition at admission were expressed as frequencies and percentages**.**

Maternal deaths were identified according to WHO criteria[1].

MMR = (Number of maternal deaths ÷ Number of live births) × 100,000

RESULTS

Year	Live Births	Maternal Deaths	MMR (P births)
2018	10,499	12	114.3

2019	10,163	11	108.2
2020	7,930	19	239.6
2021	6,901	14	202.9
2022	8,129	10	123.0
Total	43,622	66	151.3

Table 1. MMR

The maternal mortality ratio showed considerable variation during the study period. A sharp increase was observed in 2020 and 2021, coresponding to the COVID-19 pandemic period, which may have contributed to delays in referral and reduced access to timely obstetric care. The subsequent decline in 2022 suggests partial restoration of maternal health services. Despite these fluctuations, the overall MMR of 151.3 per 100,000 live births indicates the continued need for strengthening referral systems and early identification of high-risk pregnancies.

Variables		**No**	**Percentage**
Age	<20	3	4.5
	21-25	14	21.2
	26-30	27	40.9
	31-35	18	27.3
	36-40	4	6.1
Occupation	House wife	57	86.4
	Working	9	13.6
Booking Status	Booked	7	10.6
	Booked outside	51	77.3
	Unbooked	8	12.1
	Total	66	100

Table 2. Sociodemographic Variables

The predominance of maternal deaths among women aged 26–30 years reflects the peak reproductive age group. The high proportion of women booked outside the institution suggests that many complicated cases were referred from peripheral healthcare facilities, highlighting the crucial role of tertiary centres in managing high-risk pregnancies.

		Frequency	**Percentage**
Referred	Yes	58	87.9
	No	8	12.1
Place of Referal	Government Hospitals	36	62.1
	Private Hospitals	22	37.9
Timing of Reference	Timely	18	31
	Late	40	69
	Total	58	100

Table 3. Refferal Status

The findings indicate that most maternal deaths occurred among referred cases, highlighting the role of tertiary care centres in managing complicated obstetric cases. The high proportion of late referrals (69%) suggests delays in the referral system and emphasizes the need for early recognition of high-risk pregnancies and timely referral from peripheral healthcare facilities.

Indications for Referral	**No**	**Percentage**
PPH	4	6.9
Placenta accrete	1	1.7
DIC	6	10.3
GHTN	2	3.4
Eclampsia	1	1.7

Severe preeclampsia	2	3.4
PPROM	2	3.4
IUC	2	3.4
Heart disease	6	10.3
Preterm	1	1.7
Respiratory distress	14	24.1
Fever	2	3.4
Fever (COVID)	6	10.3
Decreased FM	1	1.7
RTA	1	1.7
Burns	2	3.4
Loss of consciousness	1	1.7
Altered sensorium	2	3.4
IUGR	2	3.4
Total	52	100

Table 4. Indications for Referral

Respiratory distress emerged as the leading cause for referral, suggesting the significant contribution of systemic complications such as severe infection, pulmonary conditions, and COVID-19–related illness during pregnancy. The presence of conditions such as DIC, heart disease, and hypertensive disorders highlights the need for early identification and timely referral of high-risk pregnancies from peripheral healthcare facilities to tertiary care centres.

Variables		**Frequency**	**Percentage**
Gravidity	Primi	24	36.4
	Gravida 2	28	42.4
	Gravida 3	13	19.7
	Gravida ≥4	1	1.5
Gestational age	< 14	4	6.1
	14-28	13	19.7
	28-36	27	40.9
	>36	22	33.3
Antenatal Care	Regular	61	92.4
	Irregular	5	7.6
Status of pregnancy	Antepartum	40	60.6
	Intrapartum	1	1.5
	Postpartum	18	27.3
	Post abortal	4	6.1
	Ectopic	3	4.5
Condition at admission	Stable	25	37.9
	Unstable	38	57.6
	Brought dead	3	4.5
	Total	66	100

Table 5. Maternal Characteristics

The findings indicate that maternal deaths occurred predominantly among gravida 2 women and during the late second and third trimesters of pregnancy. The high proportion of women admitted in an unstable condition suggests delayed referral and late presentation to tertiary care facilities.

Complications	**No**	**Percentage**
GDM	12	18.2
GHTN	8	12.1
Severe preeclampsia	3	4.5
Anaemia	2	3

CHTN	1	1.5
Hypothyroid	9	13.6
Bronchial Asthama	3	4.5
Seizure disorder	5	7.6
Heart disease	5	7.6
Thrombocytopenia	4	6.1
Multiple pregnancy	2	3
DIC	3	4.5
LRTI	1	1.5
IUD	1	1.5
Fever	12	18.2
Obesity	2	3

Table 6. Complications in Present Pregnancy

The presence of complications such as GDM, hypertensive disorders, and hypothyroidism highlights the importance of early detection and management of medical disorders during pregnancy. The high proportion of systemic complications indicates that maternal deaths are often associated with multiple co-morbidities that increase the risk of adverse maternal outcomes.

Mode of Termination	No	Percentage
Undelivered	8	12.1
Normal/vaginal	16	24.2
Assisted vaginal	1	1.5
Emergency CS	24	36.4
Elective GS	8	12.1
MTP/abortion	2	3
Laparotomy	7	10.6
Total	66	100

Table 7. Mode of Termination

The predominance of emergency caesarean sections reflects the critical condition of many patients at the time of admission, often requiring urgent obstetric intervention. The presence of undelivered cases suggests that some maternal deaths occurred before delivery due to severe complications, highlighting the importance of early detection and timely management of high-risk pregnancies.

DISCUSSION

Maternal mortality continues to remain a significant public health concern, particularly in low- and middle-income countries where healthcare resources and access to emergency obstetric services may be limited[1]. The present study evaluated maternal mortality patterns over a five-year period in a tertiary care centre and identified important demographic, clinical, and systemic determinants associated with maternal deaths.

The overall maternal mortality ratio observed in the present study was 151.3 per 100,000 live births, which is higher than the national maternal mortality ratio reported in the *Sample Registration System (SRS) report for India (97 per 100,000 live births).*[4] This difference may be explained by the fact that tertiary care centres often function as referral centres for complicated pregnancies and critically ill patients from peripheral hospitals. Several studies conducted in tertiary referral hospitals have similarly reported higher institutional maternal mortality ratios compared with national averages.[10]

A notable observation in this study was the increase in maternal mortality during 2020 and 2021, which coincided with the COVID-19 pandemic. Disruption of healthcare services, transportation difficulties, fear of hospital visits, and reduced antenatal care access during the pandemic have been reported to contribute to increased maternal morbidity and mortality globally.[11,12] Similar observations have been reported from several centres where delays in seeking care and referral barriers increased maternal complications during the pandemic period.

Age distribution in the present study showed that the majority of maternal deaths occurred

among women aged 26–30 years, followed by those aged 31–35 years. This finding reflects the peak reproductive age group and is consistent with observations reported by Pal et al. and Kumar et al., who noted that maternal mortality frequently occurs among women in the most active reproductive years.[13,14] The high number of deaths in this age group may be attributed to increased pregnancy exposure and higher likelihood of complications associated with multiparity.

Socio-demographic analysis revealed that the majority of women were housewives, indicating that maternal mortality was more common among economically dependent women. Limited socioeconomic independence and reduced healthcare decision-making autonomy may contribute to delays in seeking timely medical care. Similar findings have been reported in other studies, where maternal deaths were more common among women from lower socioeconomic backgrounds with limited access to healthcare resources.[10]

Referral patterns in the present study highlight the critical role of tertiary care centres in managing complicated obstetric cases. A large proportion of women (87.9%) were referred from peripheral healthcare facilities, and nearly 69% of referrals were late. These findings indicate gaps in early identification and timely referral of high-risk pregnancies from primary and secondary healthcare centres. Delayed referrals have been widely recognized as an important contributor to maternal mortality in developing countries.[15]

Respiratory distress was identified as the most common indication for referral in the present study. This observation may reflect the increased incidence of respiratory illnesses during pregnancy, particularly during the COVID-19 pandemic. Previous studies have reported that respiratory complications, including severe viral infections and pulmonary complications, can significantly increase the risk of adverse maternal outcomes.[11]

Analysis of maternal characteristics revealed that gravida 2 women constituted the largest proportion of maternal deaths, followed by primigravida women. This finding suggests that maternal mortality is not limited to first pregnancies and may also occur in subsequent pregnancies due to cumulative obstetric risks or underlying medical disorders.

The gestational age distribution showed that most maternal deaths occurred during the third trimester and late pregnancy, which is considered a critical period for the development of severe obstetric complications. Previous studies have similarly reported that maternal mortality is most frequent during the late antenatal period and early postpartum period, when complications such as postpartum haemorrhage, hypertensive crises, and sepsis are more likely to occur.[6]

Interestingly, a substantial proportion of women in the present study had received antenatal care, suggesting that maternal mortality cannot be attributed solely to lack of antenatal visits. Instead, the quality of antenatal care, early detection of high-risk conditions, and timely referral play a more significant role in preventing maternal deaths. Similar findings have been reported by Puri et al., who emphasized the importance of comprehensive antenatal screening and monitoring.[16]

Another important observation was that more than half of the women were admitted in unstable condition, and a small proportion were brought dead. This finding reflects delays in seeking care, reaching healthcare facilities, and receiving appropriate treatment. These delays correspond to the "three delays model" described by Thaddeus and Maine, which remains a widely accepted framework for understanding maternal mortality in developing countries.[8]

The presence of multiple medical and obstetric complications, including gestational diabetes mellitus, hypertensive disorders, infections, and respiratory illnesses, further increased the risk of maternal mortality. The coexistence of multiple comorbidities during pregnancy has been shown to significantly increase the risk of adverse maternal outcomes in several studies on maternal morbidity and mortality.[16]

Mode of termination analysis revealed that emergency caesarean section was the most common mode of delivery, followed by vaginal delivery. This reflects the critical clinical condition of many patients at the time of admission, necessitating urgent obstetric intervention. Similar trends have been reported in tertiary care centres where critically ill patients often require emergency surgical management.[10]

Overall, the findings of this study emphasize that maternal mortality in tertiary care centres is largely influenced by late referrals, delayed recognition of obstetric complications, and underlying medical disorders during pregnancy. Strengthening peripheral obstetric services, improving early identification of high-risk

pregnancies, ensuring regular antenatal monitoring, and enhancing referral systems are essential strategies for reducing maternal mortality.

CONCLUSION

The present study highlights important patterns and determinants of maternal mortality in a tertiary care centre in South India. The overall maternal mortality ratio observed during the five-year study period was relatively high, reflecting the role of tertiary centres as referral hubs for complicated and high-risk obstetric cases. The majority of maternal deaths occurred among women in the 26–30 years age group, predominantly among housewives, and most were referred from peripheral healthcare facilities. A significant proportion of these referrals were delayed, indicating gaps in the referral system and the need for timely recognition and transfer of high-risk cases. The study also demonstrated that many women were admitted in unstable condition, highlighting the impact of delays in seeking care, reaching healthcare facilities, and receiving appropriate treatment. Medical comorbidities and pregnancy-related complications such as gestational diabetes, hypertensive disorders, infections, and systemic illnesses contributed significantly to maternal mortality. Emergency caesarean section was the most common mode of termination, reflecting the critical condition of patients requiring urgent obstetric intervention. A proportion of women remained undelivered at the time of death, emphasizing the severity of maternal complications.

Overall, the findings suggest that strengthening peripheral obstetric services, improving early identification of high-risk pregnancies, ensuring regular antenatal monitoring, and enhancing referral systems are essential steps to reduce maternal mortality. Timely intervention, better coordination between healthcare facilities, and improved access to emergency obstetric care can significantly improve maternal outcomes.

RECOMMENDATIONS

Based on the findings of the present study, the following recommendations are suggested to reduce maternal mortality:

1. Strengthening antenatal care services is essential for early identification and management of high-risk pregnancies.
2. Improving referral systems between peripheral health centres and tertiary care hospitals can help ensure timely transfer of critically ill patients.
3. Training healthcare providers at primary and secondary care levels in the early recognition and management of obstetric complications should be prioritized.
4. Enhancing emergency obstetric care facilities at district and secondary level hospitals may reduce the burden of critically ill referrals to tertiary care centres.
5. Strengthening maternal death review systems can help identify preventable factors and guide policy interventions to improve maternal healthcare services.
6. Community awareness programs should be promoted to encourage early healthcare seeking behavior among pregnant women.
7. Improving transport and emergency medical services can reduce delays in reaching healthcare facilities.

Authors Contribution

All authors contributed to the conception and design of the study, collection, analysis and interpretation of data, drafting and critical revision of manuscript and approved the final version.

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Nil.

Conflict of Interest

Authors declared no conflict of interest.

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