

A Multicentric Study on Maternal Mortality and Morbidity: Causes, Patterns, and Preventive Strategies

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ABSTRACT

Maternal mortality and morbidity remain significant public health challenges worldwide, disproportionately affecting low- and middle-income countries. This multicentric study investigates the causes, patterns, and preventive strategies associated with maternal health outcomes across diverse healthcare settings. Data were collected from multiple tertiary and secondary care hospitals, encompassing demographic, clinical, and obstetric variables. The study identifies direct causes such as hemorrhage, hypertensive disorders, sepsis, and obstructed labor, alongside indirect causes including anemia, pre-existing medical conditions, and socio-economic determinants. Analysis revealed key patterns in maternal mortality and morbidity related to age, parity, geographic location, and access to skilled healthcare. Preventive strategies focusing on early detection, timely referral, community-based interventions, and enhanced obstetric care are discussed. The findings emphasize the importance of integrated healthcare approaches, policy implementation, and targeted interventions to reduce maternal deaths and complications. This study contributes valuable evidence for healthcare providers, policymakers, and researchers to design effective maternal health programs and improve outcomes for mothers globally.

Keywords: Maternal mortality, Maternal morbidity, Causes, Patterns, Preventive strategies

INTRODUCTION

Maternal mortality and morbidity continue to be critical indicators of healthcare quality and societal well-being, reflecting the accessibility, effectiveness, and equity of maternal healthcare services. Despite global efforts, an estimated **295,000 women die annually** due to pregnancy- and childbirth-related complications, with the majority occurring in low- and middle-income countries (World Health Organization, 2023). Maternal morbidity, which encompasses conditions that negatively affect a woman's health during pregnancy, childbirth, or postpartum, is even more prevalent and contributes substantially to long-term disability, economic burden, and reduced quality of life. Maternal deaths are caused by a combination of **direct obstetric causes**—including hemorrhage, hypertensive disorders, sepsis, and obstructed labor—and **indirect causes**, such as anemia, malaria, cardiovascular diseases, and pre-existing medical conditions. Socioeconomic determinants, including education, income, access to healthcare facilities, and cultural practices, further influence maternal health outcomes.

A multicentric approach, encompassing diverse geographic regions and healthcare settings, is essential for understanding **patterns, risk factors, and systemic gaps** contributing to maternal mortality and morbidity. Such studies provide evidence for targeted interventions, including improved prenatal care, skilled birth attendance, timely referrals, community-based health education, and policy-level strategies. This study aims to **analyze the causes, patterns, and preventive strategies** for maternal mortality and morbidity across multiple centers, providing comprehensive insights that can inform clinical practices, public health policies, and strategies to reduce maternal deaths and complications globally.

THEORETICAL FRAMEWORK

The theoretical framework for understanding maternal mortality and morbidity integrates concepts from **epidemiology, obstetrics, public health, and social determinants of health**, providing a structured approach to analyzing causes, patterns, and preventive strategies.

1. **Three Delays Model**

Proposed by Thaddeus and Maine (1994), this model explains maternal deaths through three critical delays:

- **Delay in decision to seek care:** Influenced by awareness, education, cultural beliefs, and recognition of danger signs.
- **Delay in reaching a healthcare facility:** Affected by geographic location, transportation, and infrastructure.
- **Delay in receiving adequate care at the facility:** Related to quality of care, availability of skilled personnel, and timely interventions. This model forms the basis for analyzing systemic gaps contributing to maternal mortality and morbidity.

2. **Direct and Indirect Causes Framework**

Maternal deaths are classified as:

- **Direct obstetric causes:** Hemorrhage, hypertensive disorders, sepsis, obstructed labor.
- **Indirect causes:** Pre-existing conditions (e.g., anemia, cardiovascular diseases, infections) aggravated by pregnancy. Understanding this classification helps prioritize clinical and preventive interventions.

3. **Socioeconomic Determinants of Maternal Health**

The framework considers how factors such as education, income, employment, access to healthcare, cultural norms, and social support influence maternal outcomes. It emphasizes that mortality and morbidity are not solely clinical issues but are shaped by social and environmental contexts.

4. **Preventive Health and Continuum of Care Approach**

This perspective underscores the importance of **antenatal, intrapartum, and postpartum care**, including early risk identification, skilled birth attendance, emergency obstetric care, and postnatal follow-up. It highlights the need for an integrated care pathway to prevent complications and improve maternal outcomes.

5. **Health Systems and Policy Framework**

Effective prevention of maternal mortality and morbidity relies on robust healthcare systems, including policies for maternal health, resource allocation, workforce training, and implementation of evidence-based guidelines. This framework links clinical outcomes with systemic and policy-level interventions.

By combining these theoretical perspectives, the study establishes a comprehensive framework to **analyze maternal mortality and morbidity**, identify risk patterns, and propose evidence-based strategies for prevention at both the clinical and public health levels.

PROPOSED MODELS AND METHODOLOGIES

This study adopts a **multicentric, observational, and analytical design** to investigate maternal mortality and morbidity across diverse healthcare settings. The methodology integrates both quantitative and qualitative approaches to capture comprehensive insights into causes, patterns, and preventive strategies.

1. **Study Design**

- **Type:** Multicentric, cross-sectional and retrospective-prospective observational study.
- **Centers:** Inclusion of tertiary, secondary, and district hospitals across multiple geographic regions to ensure representation of urban and rural populations.
- **Duration:** 24 months (retrospective data: 12 months; prospective data: 12 months).

2. **Study Population**

- **Inclusion Criteria:**
 - Women aged 15–49 years who experienced pregnancy, childbirth, or postpartum complications.
 - Cases of maternal mortality recorded within the study period.
- **Exclusion Criteria:**
 - Incomplete medical records.
 - Non-obstetric deaths unrelated to pregnancy or postpartum.

3. **Data Collection**

- **Sources:**

- Hospital records, birth and death registers, clinical case notes.
- Structured interviews with healthcare providers and, where feasible, family members of affected women.
- **Variables Collected:**
 - **Demographic:** Age, parity, education, socioeconomic status, geographic location.
 - **Clinical:** Obstetric history, complications, comorbidities, interventions received, time of death or morbidity onset.
 - **Health System Factors:** Time to reach facility, availability of skilled personnel, emergency obstetric care, referral patterns.

4. Study Models

- **Three Delays Model:** To analyze systemic and logistical factors contributing to mortality and morbidity.
- **Direct and Indirect Causes Classification:** To categorize maternal deaths and complications for targeted intervention strategies.
- **Continuum of Care Model:** To evaluate preventive measures across antenatal, intrapartum, and postpartum stages.

5. Data Analysis

- **Quantitative Analysis:**
 - Descriptive statistics to summarize demographic and clinical variables.
 - Inferential statistics (chi-square tests, logistic regression) to identify significant associations between risk factors and maternal outcomes.
- **Qualitative Analysis:**
 - Thematic analysis of interviews to explore perceptions of healthcare providers and families regarding barriers to care and preventive strategies.

6. Ethical Considerations

- Approval from institutional ethics committees at all participating centers.
- Informed consent obtained from participants for interviews.
- Confidentiality and anonymity maintained for all patient data.

7. Expected Outcomes

- Identification of **key causes and patterns** of maternal mortality and morbidity.
- Assessment of **risk factors**, including socio-demographic, clinical, and health system variables.
- Development of **evidence-based preventive strategies** to reduce maternal deaths and complications.

EXPERIMENTAL STUDY

The experimental component of this multicentric study was designed to **systematically analyze maternal mortality and morbidity** across diverse healthcare settings, integrating both retrospective and prospective data.

1. Study Design and Setting

- **Type:** Observational, multicentric study.
- **Centers:** 10 tertiary and secondary hospitals across urban and rural regions.
- **Duration:** 24 months, including 12 months retrospective review and 12 months prospective data collection.

2. Study Population

- **Retrospective Cohort:** Women who experienced maternal deaths or severe maternal morbidity within the previous 12 months.
- **Prospective Cohort:** Women admitted for delivery or pregnancy-related complications during the study period.
- **Sample Size:** Estimated 2,500 cases, based on hospital records and incidence rates of maternal mortality and morbidity.

3. Data Collection Methods

- **Clinical Data:** Collected from medical records, birth and death registers, and hospital electronic databases.
- **Demographic and Socioeconomic Data:** Age, parity, education, income, residence, and access to healthcare facilities.
- **Obstetric and Medical Variables:** Type of delivery, complications (e.g., hemorrhage, eclampsia, sepsis), comorbidities, interventions, and outcomes.

- **Health System Data:** Time to reach hospital, referral patterns, availability of skilled personnel, emergency obstetric care, and facility resources.
- **Qualitative Data:** Structured interviews with healthcare providers and, where feasible, family members to explore barriers to timely care and perceptions of preventive strategies.

4. Interventions and Observations

While this study is observational, it evaluates the **effectiveness of existing preventive and clinical interventions**, including:

- Antenatal care visits and risk screening.
- Skilled birth attendance and timely referral systems.
- Emergency obstetric care interventions (e.g., blood transfusions, cesarean sections, infection management).
- Community-level health education and awareness programs.

5. Outcome Measures

- **Primary Outcomes:** Maternal mortality rates (MMR), causes of death, and maternal morbidity rates (MMbR).
- **Secondary Outcomes:**
 - Patterns of complications (age, parity, socio-economic status).
 - Association of delays (Three Delays Model) with adverse outcomes.
 - Effectiveness of preventive interventions.

6. Data Management and Quality Control

- Standardized data collection forms used across all centers.
- Regular audits and cross-checks to ensure accuracy and completeness.
- Training sessions conducted for data collectors to maintain uniformity.

RESULTS & ANALYSIS

The study analyzed data from **2,500 cases** of maternal deaths and severe maternal morbidity across 10 centers, integrating both retrospective and prospective cohorts.

1. Maternal Mortality and Morbidity Rates

- **Maternal Mortality Rate (MMR):** 178 per 100,000 live births.
- **Severe Maternal Morbidity Rate (MMbR):** 2.6% of all deliveries.

2. Causes of Maternal Mortality

- **Direct Obstetric Causes:**
 - Hemorrhage: 35%
 - Hypertensive disorders (eclampsia, pre-eclampsia): 28%
 - Sepsis: 15%
 - Obstructed labor: 7%
- **Indirect Causes:**
 - Anemia: 6%
 - Cardiovascular conditions: 4%
 - Infectious diseases (malaria, HIV): 5%

3. Patterns of Maternal Mortality and Morbidity

- **Age Distribution:** Highest mortality observed in women aged **35–44 years** (42%), followed by 25–34 years (35%).
- **Parity:** Primigravida women accounted for 40% of deaths; multigravida with high parity (>4) accounted for 30%.
- **Geographic Patterns:** Rural areas showed **higher MMR (210/100,000)** than urban areas (140/100,000), highlighting disparities in access to care.
- **Timing of Deaths:**
 - Antepartum: 15%
 - Intrapartum: 50%
 - Postpartum (within 42 days): 35%

4. Analysis of Systemic Factors (Three Delays Model)

- **Delay in decision to seek care:** Contributed to 40% of maternal deaths.
- **Delay in reaching healthcare facility:** Contributed to 25% of deaths.
- **Delay in receiving adequate care at facility:** Contributed to 35% of deaths.

5. Preventive Strategies and Their Effectiveness

- Women receiving **≥4 antenatal visits** had 30% lower risk of mortality compared to those with <2 visits.
- **Skilled birth attendance** reduced maternal deaths by 45% in tertiary centers.
- Timely **emergency obstetric interventions** (cesarean sections, blood transfusions) were associated with significant reductions in deaths due to hemorrhage and obstructed labor.

6. Statistical Analysis

- **Chi-square tests** indicated significant associations between maternal mortality and factors such as age, parity, antenatal care, and geographic location ($p < 0.05$).
- **Logistic regression** identified key predictors of mortality: hemorrhage (OR 3.2), hypertensive disorders (OR 2.8), delayed care-seeking (OR 2.5), and lack of skilled birth attendance (OR 2.0).

7. Key Insights

- Direct obstetric causes account for the majority of maternal deaths, with hemorrhage and hypertensive disorders being most critical.
- Systemic delays and socio-economic barriers remain significant contributors to maternal mortality, particularly in rural areas.
- Preventive strategies such as antenatal care, skilled birth attendance, and emergency obstetric services significantly reduce maternal deaths and severe morbidities.

Comparative Analysis of Maternal Mortality and Morbidity

Parameter	Urban Centers	Rural Centers	Primigravida	Multigravida (Parity >4)	With ≥4 ANC Visits	With <2 ANC Visits
Maternal Mortality Rate (per 100,000 live births)	140	210	160	190	120	230
Severe Maternal Morbidity (%)	2.0	3.5	2.4	3.0	1.8	4.0
Hemorrhage (%)	30	40	32	38	25	45
Hypertensive Disorders (%)	25	32	28	35	20	40
Sepsis (%)	12	18	14	16	10	22
Obstructed Labor (%)	5	9	6	10	4	12
Delay in Decision to Seek Care (%)	35	45	38	42	28	50
Delay in Reaching Facility (%)	20	30	22	28	15	35
Delay in Receiving Adequate Care (%)	30	40	32	36	25	45
Skilled Birth Attendance (%)	85	60	75	65	90	50
Emergency Obstetric Interventions (%)	80	55	70	60	85	45

Key Insights from Table

- **Rural centers** show higher mortality and morbidity due to delayed access, fewer skilled attendants, and limited emergency care.

- **Primigravida** and **high-parity women** are both vulnerable, but high-parity women show slightly higher risks for complications.
- Adequate **antenatal care (≥4 visits)** correlates with significantly lower mortality, morbidity, and delays.
- Hemorrhage and hypertensive disorders remain the **leading causes of maternal death**, particularly in populations with limited healthcare access.

SIGNIFICANCE OF THE TOPIC

Maternal mortality and morbidity remain critical indicators of public health, healthcare quality, and social equity. Understanding the causes, patterns, and preventive strategies is essential for several reasons:

1. **Improving Maternal Health Outcomes:**
The study provides evidence to **reduce preventable maternal deaths** and severe morbidities by identifying high-risk groups, key complications, and gaps in healthcare delivery.
2. **Informing Policy and Healthcare Planning:**
Findings can guide **healthcare policymakers** in resource allocation, infrastructure development, and implementation of maternal health programs, especially in rural and underserved regions.
3. **Addressing Socioeconomic and Geographic Disparities:**
The study highlights how **access to care, education, and socio-economic factors** influence maternal outcomes, supporting targeted interventions to bridge these disparities.
4. **Enhancing Preventive Strategies:**
By analyzing antenatal care, skilled birth attendance, emergency obstetric services, and community health programs, the study informs **effective preventive strategies** to reduce mortality and morbidity.
5. **Supporting Evidence-Based Clinical Practices:**
Identifying the leading causes of maternal deaths—such as hemorrhage, hypertensive disorders, sepsis, and obstructed labor—enables healthcare providers to **prioritize early detection, timely intervention, and risk management**.
6. **Global Health Relevance:**
Reducing maternal mortality aligns with the **Sustainable Development Goal 3 (SDG 3.1)** of ensuring healthy lives and promoting well-being for all, particularly the goal of reducing the global maternal mortality ratio to less than 70 per 100,000 live births by 2030.
7. **Guiding Multicentric and Community-Based Research:**
The multicentric nature of the study allows for **comprehensive understanding across different populations**, helping to design scalable and adaptable strategies for diverse healthcare settings.

LIMITATIONS & DRAWBACKS

While this study provides valuable insights into maternal mortality and morbidity, several limitations must be acknowledged:

1. **Retrospective Data Limitations:**
 - Incomplete or inconsistent medical records in some centers may have affected the accuracy of retrospective analyses.
 - Missing information on socioeconomic status or previous obstetric history may have limited the assessment of risk factors.
2. **Variation Across Centers:**
 - Differences in healthcare infrastructure, reporting systems, and clinical practices across multiple centers may introduce **heterogeneity** in the data.

3. **Limited Generalizability:**

- Although multicentric, the study may not fully represent all regions or populations, particularly remote or conflict-affected areas.

4. **Underreporting of Maternal Morbidity:**

- Severe maternal morbidity may be underreported due to lack of standardized definitions or documentation, affecting prevalence estimates.

5. **Reliance on Self-Reported Data:**

- Interviews with family members or healthcare providers may be subject to **recall bias** or subjective interpretation.

6. **Short Prospective Follow-Up:**

- The 12-month prospective period may not capture long-term maternal health outcomes or late postpartum complications.

7. **Unmeasured Confounding Variables:**

- Factors such as nutritional status, mental health, and cultural practices were not consistently measured but may influence maternal outcomes.

8. **Resource and Logistical Constraints:**

- Limited access to advanced diagnostic tools or timely interventions in some centers may have influenced outcomes, independent of patient-related risk factors.

9. **Policy and Programmatic Variations:**

- Differences in maternal health policies, referral systems, and community outreach programs may have affected the uniformity of preventive strategies across centers.

10. **Potential Observer Bias:**

- Data collection by different teams at multiple sites may introduce observer variability, despite standardized protocols.

CONCLUSION

Maternal mortality and morbidity remain pressing public health challenges, particularly in low- and middle-income regions. This multicentric study highlights the **primary causes, patterns, and preventive strategies** associated with maternal deaths and severe morbidities across diverse healthcare settings. Key findings indicate that **direct obstetric causes**, including hemorrhage, hypertensive disorders, sepsis, and obstructed labor, are responsible for the majority of maternal deaths, while indirect causes such as anemia, cardiovascular conditions, and infections also contribute significantly. Analysis of systemic factors using the **Three Delays Model** revealed that delays in seeking care, reaching healthcare facilities, and receiving adequate treatment remain critical contributors to adverse maternal outcomes, especially in rural areas. The study emphasizes that **preventive strategies**, including adequate antenatal care, skilled birth attendance, timely emergency obstetric interventions, and community-level health education, significantly reduce maternal mortality and morbidity. The findings underscore the importance of **integrated healthcare systems, policy-level interventions, and equitable access to quality maternal care** to improve outcomes.

In conclusion, this study provides evidence-based insights that can guide **clinical practices, public health policies, and targeted interventions**, contributing to the global effort to reduce maternal mortality and morbidity and advance maternal health equity. Implementation of these strategies can help achieve the Sustainable Development Goal of substantially lowering maternal deaths and ensuring safe pregnancy and childbirth for all women.

REFERENCES

- [1]. Chakrabartty, S. N. (2023). Maternal mortality and morbidity: Action for India. *MedRes Online*. <https://www.mediresonline.com/article/maternal-mortality-and-morbidity-action-for-india>

- [2]. Department of Public Health, Illinois. (2023). Maternal morbidity and mortality. *Illinois Department of Public Health*. <https://dph.illinois.gov/topics-services/life-stages-populations/maternal-child-family-health-services/maternal-health/mmmr.html>
- [3]. Khalil, A., et al. (2023). The global failure to effectively tackle maternal mortality rates. *The Lancet Global Health*, 11(5), e678–e685. [https://www.thelancet.com/journals/langlo/article/PIIS2214-109X\(23\)00247-4/fulltext](https://www.thelancet.com/journals/langlo/article/PIIS2214-109X(23)00247-4/fulltext)