e-ISSN: 0975-9506, p-ISSN: 2961-6093

Available online on www.ijpqa.com

International Journal of Pharmaceutical Quality Assurance 2026; 17(3); 248-254

Original Research Article

A Retrospective Study to Determine Maternal Mortality Ratio, Associated Risk Factors, and Causes of Maternal Mortality at a Tertiary Care Centre

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Received: 12-01-2026 / Revised: 20-02-2026 / Accepted: 21-03-2026
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Conflict of interest: Nil

Abstract:

Background: Maternal mortality remains a major public health problem and reflects the quality of maternal healthcare services. Preventable obstetric complications and delayed healthcare access contribute significantly to maternal deaths in developing countries.

Aim: To determine the maternal mortality ratio, associated risk factors, and causes of maternal mortality at a tertiary care centre.

Methodology: A retrospective descriptive observational study was conducted in the Department of Community Medicine at Lord Buddha Koshi Medical College and Hospital from January 2025 to December 2025. A total of 90 maternal death cases were analyzed using hospital records, maternal death review forms, and case sheets. Data were analyzed using descriptive statistics.

Results: Most maternal deaths occurred among women aged 21–25 years (37.8%), unbooked cases (71.1%), rural residents (75.6%), and referred cases (65.6%). Hemorrhage (26.7%) was the leading cause of maternal mortality followed by hypertensive disorders/eclampsia (22.2%) and sepsis (16.7%). The postpartum period accounted for the majority of deaths (56.7%). Lack of antenatal care (68.9%), poor socioeconomic status (63.3%), and delayed referral (54.4%) were the major associated risk factors.

Conclusion: Maternal mortality was mainly associated with preventable obstetric complications and inadequate maternal healthcare utilization. Strengthening antenatal care, referral systems, and emergency obstetric services may help reduce maternal deaths.

Keywords: Maternal mortality, maternal mortality ratio, hemorrhage, hypertensive disorders, antenatal care, risk factors, tertiary care centre.

DOI: 10.25258/ijpqa.17.3.42

Introduction

Maternal mortality occurs when a pregnant woman dies during her pregnancy or within 42 days after her pregnancy ends because of any health condition that existed during her pregnancy or its treatment but not because of any unexpected medical event [1]. Maternal mortality remains one of the most serious public health challenges worldwide and reflects the quality of maternal health care services available in a country. The maternal mortality ratio (MMR), which measures maternal deaths that occur per 100,000 live births, serves as an essential measurement tool to evaluate both the success of healthcare systems and the social standing of women within a community [2]. High maternal mortality rates occur when people face problems that prevent them from accessing medical services and when they experience economic hardship and when their nutritional needs remain unmet and when they lack basic education and when medical help during pregnancy and childbirth is delayed.

The world has achieved substantial success in decreasing maternal death rates during the past thirty years. The United Nations inter-agency estimates show that between 2007 and 2017 the worldwide maternal mortality ratio decreased from 342 to 211 deaths per 100000 live births which represents a reduction of 38% [3]. The maternal mortality rate shows improvement yet low and lower-middle-income countries continue to face higher death rates because 94% of all maternal fatalities happen in these nations. In 2017, low-income countries had an

MMR of 462 per 100,000 live births, while high-income countries had an MMR of 11 per 100,000 live births. The different death rates demonstrate how various regions around the world experience different challenges when it comes to obtaining proper maternal health care services and emergency obstetric treatment and assistance during childbirth.

The Sustainable Development Goals through their third goal aim to decrease the worldwide maternal death rate to less than 70 deaths per 100000 live births by the target year of 2030. The World Health Organization recommends that no nation should exceed a maternal mortality ratio of 140 deaths per 100000 live births which stands at double the international standard. The objectives require countries to enhance their maternal health services while they should increase institutional birth rates and provide qualified obstetric staff and develop efficient patient transfer systems [4]. The first two steps to decrease preventable maternal deaths require the detection of high-risk pregnancies and their subsequent medical treatment.

The Government of Nepal has established multiple programs which aim to enhance maternal health services and decrease maternal death rates. The Hospital-based Maternal Perinatal Death Surveillance and Response (MPDSR) programs have been established at 77 hospitals, while the community-based MPDSR programs have been launched across 12 districts. The programs exist to establish better maternal health care services through the process of identifying and reviewing all maternal and perinatal death cases. The Nepal Demographic and Health Survey (NDHS) 2016 reported a substantial decline in maternal mortality from 539 maternal deaths per 100,000 live births in 1996 to 239 maternal deaths per 100,000 live births in 2016 [5]. The study found that maternal causes accounted for approximately 12 percent of deaths in women who were of reproductive age. The District Health Information Software (DHIS) 2 monthly reports from Health and Family Services (HFS) confirmed that MMR decreased from 114 per 100,000 live births in 2016-17 to 53 per 100,000 live births in 2019-20. The results show major advancements in both maternal health care services and educational programs.

The World Health Organization WHO reports that over 70 percent of maternal deaths result from hemorrhage and infection and unsafe abortion and hypertensive disorders of pregnancy and obstructed labor. The medical system can effectively prevent and treat these complications when doctors deliver their services within the correct time frame and medical staff execute their duties with suitable medical protocols. The major causes of maternal mortality in Nepal have been identified through previous research which showed that hypertensive disorders of pregnancy and obstetric hemorrhage and sepsis and anemia constitute the most common causes. The management of hemorrhage serves as one of the major causes of maternal death because doctors must treat severe blood loss to prevent instant shock and organ failure. The maternal death rate increases because preeclampsia and eclampsia and other hypertensive disorders cause various organ system complications [6]. The nutritional deficiencies of women and their lack of proper prenatal care led to increased maternal health risks from sepsis and severe anemia.

Various socioeconomic factors and health system factors impact maternal mortality rates. The combination of poverty and illiteracy and the low status of women and the lack of antenatal care awareness and health-seeking delays and insufficient transportation systems create major risks that negatively impact maternal health outcomes. The process of referring patients to tertiary care centers and the time needed to reach these facilities both create increased mortality risks for pregnant women who face obstetric complications. Almost 65 percent of maternal deaths happen to women who postpone their medical treatment until they develop severe health problems. The main strategies to reduce maternal mortality require the improvement of antenatal care services and should focus on community-level high-risk pregnancy identification and medical facility referral processes to higher health care centers [7].

Tertiary care centers perform essential functions for managing both high-risk pregnancy situations and medical emergencies that occur during childbirth. The medical facilities provide advanced treatment options which include both medical and surgical procedures for patients who need specialized attention from other health establishments. Tertiary care centers undergo retrospective studies which help researchers find out about the patterns maternal mortality rates. The studies provide essential data which helps to build maternal health policies and develop referral systems and improve obstetric care service quality. The study named "A Retrospective Study to Determine Maternal Mortality Ratio, Associated Risk Factors, and Causes of Maternal Mortality at a Tertiary Care Centre" aimed to investigate the patterns of maternal deaths together with their risk factors and death causes which occur within a tertiary care environment.

Methodology

Study Design: The present study was conducted as a retrospective descriptive observational study to determine the maternal mortality ratio (MMR), associated risk factors, and causes of maternal mortality at a tertiary care centre. The retrospective design was selected to evaluate previously recorded hospital data related to maternal deaths and obstetric admissions during the study period. This design helped in assessing the pattern, distribution, and determinants

of maternal mortality among women receiving obstetric care at the institution.

Study Area: The study was conducted in the Department of Community Medicine, Lord Buddha Koshi Medical College and Hospital, Saharsa, Bihar, India.

Study Duration: The duration of the study was from January 2025 to December 2025.

Study Participants: The study participants included women who were admitted to the obstetrics and gynecology department during pregnancy, delivery, or within 42 days of termination of pregnancy and who suffered maternal death during the study period.

Inclusion Criteria

- Women who died during pregnancy, childbirth, or within 42 days of termination of pregnancy due to obstetric or pregnancy-related causes.
- Maternal death records available in hospital case sheets and medical records.
- Women admitted and managed in the hospital for obstetric complications.
- Referred obstetric emergency cases resulting in maternal mortality during hospital management.

Exclusion Criteria

- Women who were brought dead to the hospital.
- Deaths due to accidental or incidental causes unrelated to pregnancy.
- Cases with incomplete or missing medical records.
- Non-obstetric deaths not directly or indirectly associated with pregnancy.

Sample Size: The sample size for the present study was 90 maternal mortality cases selected from the hospital records during the study period.

Procedure: The study was conducted using retrospective data collected from hospital records, maternal death review forms, admission registers, labor room registers, intensive care unit records, and case sheets available in the medical records department of the hospital. Detailed information regarding maternal deaths occurring during the study period was retrieved and reviewed systematically. Data collection was performed after obtaining permission from the concerned departmental authorities and institutional ethical approval. Confidentiality and privacy of patient information were strictly maintained throughout the study.

Information collected from the records included socio-demographic variables such as age, residence, educational status, socioeconomic condition, and parity. Obstetric variables including antenatal care status, booking status, gestational age, mode of delivery, obstetric complications, referral status, and duration of hospital stay were also recorded. Variables related to maternal mortality included primary cause of death, contributory causes, timing of death (antenatal, intrapartum, or postpartum), and associated risk factors such as anemia, hypertensive disorders, hemorrhage, sepsis, obstructed labor, and other medical or surgical complications associated with pregnancy.

The total number of live births and maternal deaths recorded during the study period were noted for the calculation of maternal mortality ratio. Maternal mortality ratio was calculated as the number of maternal deaths per 100,000 live births during the study period. Additional verification of maternal death cases was carried out through review of departmental records and maternal death audit reports to ensure completeness and accuracy of the collected data.

Statistical Analysis: The collected data were entered into Microsoft Excel and analyzed using Statistical Package for Social Sciences (SPSS) version 27.0. Descriptive statistical methods such as frequency, percentage, mean, and standard deviation were used for data analysis. The findings were presented in the form of tables, charts, and graphs wherever appropriate. Maternal mortality ratio and distribution of risk factors and causes of maternal mortality were calculated and interpreted using suitable statistical methods.

Result

Table 1 shows the distribution of maternal deaths according to age group among 90 cases. The highest proportion of maternal deaths was observed in the age group of 21–25 years, accounting for 34 cases (37.8%), followed by the 26–30 years age group with 28 cases (31.1%). Maternal deaths were comparatively lower among women aged below 20 years, contributing 12 cases (13.3%), and those aged 31–35 years with 11 cases (12.2%). The least number of maternal deaths was reported in women aged more than 35 years, comprising 5 cases (5.6%). Overall, the findings indicate that the majority of maternal deaths occurred among women in the reproductive age group of 21–30 years.

Table 1: Distribution of Maternal Deaths According to Age Group (n=90)		
Age Group (Years)	**Number of Cases**	**Percentage (%)**
<20 years	12	13.3
21–25 years	34	37.8
26–30 years	28	31.1
31–35 years	11	12.2
>35 years	5	5.6
Total	**90**	**100**

Table 2 shows the distribution of maternal deaths according to obstetric characteristics among 90 cases. The majority of maternal deaths were observed in unbooked cases, accounting for 64 (71.1%) cases, whereas booked cases constituted only 26 (28.9%) cases, indicating a higher risk among women who did not receive adequate antenatal care. With respect to parity, multigravida women represented a slightly higher proportion of maternal deaths with 52 (57.8%) cases compared to primigravida women with 38 (42.2%) cases. Regarding place of residence, most maternal deaths occurred among women from rural areas, comprising 68 (75.6%) cases, while urban residents accounted for 22 (24.4%) cases, suggesting greater vulnerability among the rural population. In terms of referral status, referred cases constituted the majority with 59 (65.6%) maternal deaths, whereas non-referred cases accounted for 31 (34.4%) cases, reflecting the increased burden of complicated cases being referred to the tertiary care centre.

Table 2: Distribution of Maternal Deaths According to Obstetric Characteristics (n=90)		
Variables	**Number of Cases**	**Percentage (%)**
Booking Status		
Booked	26	28.9
Unbooked	64	71.1
Parity		
Primigravida	38	42.2
Multigravida	52	57.8
Place of Residence		
Rural	68	75.6
Urban	22	24.4
Referral Status		
Referred Cases	59	65.6
Non-referred Cases	31	34.4

Table 3 shows the distribution of maternal deaths according to causes of mortality among 90 cases. Hemorrhage was identified as the leading cause of maternal mortality, accounting for 24 cases (26.7%), followed by hypertensive disorders/eclampsia with 20 cases (22.2%). Sepsis contributed to 15 maternal deaths (16.7%), while severe anemia was responsible for 12 cases (13.3%). Obstructed labor accounted for 6 cases (6.7%), and complications related to unsafe abortion were observed in 5 cases (5.6%). Cardiac disease in pregnancy and other miscellaneous causes each contributed 4 cases (4.4%). The findings indicate that direct obstetric complications, particularly hemorrhage and hypertensive disorders, were the major contributors to maternal mortality in the present study population.

Table 3: Distribution of Maternal Deaths According to Causes of Mortality (n=90)		
Causes of Maternal Mortality	**Number of Cases**	**Percentage (%)**
Hemorrhage	24	26.7
Hypertensive Disorders/Eclampsia	20	22.2
Sepsis	15	16.7
Severe Anemia	12	13.3
Obstructed Labor	6	6.7
Unsafe Abortion Complications	5	5.6
Cardiac Disease in Pregnancy	4	4.4
Other Causes	4	4.4
Total	**90**	**100**

Table 4 shows the distribution of maternal deaths according to the timing of death among 90 cases included in the study. The majority of maternal deaths occurred during the postpartum period, accounting for 51 cases (56.7%), indicating that the post-delivery phase was the most critical period for maternal survival. Antepartum deaths constituted 19 cases (21.1%), while intrapartum deaths were observed in

14 cases (15.6%). Post-abortal maternal deaths were comparatively lower, comprising 6 cases (6.6%). The findings suggest that postpartum complications contributed predominantly to maternal mortality, highlighting the importance of effective postnatal monitoring, timely management of complications, and improved maternal healthcare services during the immediate post-delivery period.

Table 4: Distribution of Maternal Deaths According to Timing of Death (n=90)		
Timing of Maternal Death	**Number of Cases**	**Percentage (%)**
Antepartum	19	21.1
Intrapartum	14	15.6
Postpartum	51	56.7
Post-abortal	6	6.6
Total	**90**	**100**

Table 5 shows the distribution of associated risk factors among maternal death cases included in the study (n=90). The findings revealed that lack of antenatal care was the most common risk factor, observed in 62 (68.9%) cases, followed by poor socioeconomic status in 57 (63.3%) cases and delay in referral in 49 (54.4%) cases. Severe anemia was present in 41 (45.6%) cases, while delay in seeking treatment was reported in 38 (42.2%) cases. Hypertensive disorders were identified in 28 (31.1%) cases and lack of institutional delivery was observed in 25 (27.8%) cases. Previous obstetric complications constituted the least common associated risk factor, reported in 17 (18.9%) cases. Overall, the findings indicate that inadequate maternal healthcare utilization, delayed access to medical services, and poor socioeconomic conditions were the major contributing risk factors associated with maternal mortality in the present study.

Table 5: Distribution of Associated Risk Factors Among Maternal Death Cases (n=90)		
Associated Risk Factors	**Number of Cases**	**Percentage (%)**
Lack of Antenatal Care	62	68.9
Delay in Referral	49	54.4
Severe Anemia	41	45.6
Hypertensive Disorders	28	31.1
Poor Socioeconomic Status	57	63.3
Delay in Seeking Treatment	38	42.2
Previous Obstetric Complications	17	18.9
Lack of Institutional Delivery	25	27.8

Discussion

The present study results match the findings of multiple national and international studies which took place in developing countries' tertiary care centers. The study found that maternal deaths occurred most frequently among women aged 21 to 25 years at a rate of 37.8% while the 26-to-30-year age group showed the second highest rate at 31.1%. Shrestha J et al. found similar results when they reported that most maternal deaths occurred in women between reproductive age groups who had a mean maternal age of 28 years (Shrestha et al. 2017) [8]. Rijal P et al. and Rodríguez-Aguilar R found that maternal mortality occurred more frequently in women aged 20 to 34 years which matched the current study results (Rijal et al. 2014 and Rodríguez-Aguilar 2018) [9,10]. Women in this age group experience higher mortality rates because they have more opportunities to become pregnant and face obstetric complications.

Unbooked cases and rural area women contributed to a significant share of maternal deaths which occurred in the current research study. The study results show that women fail to use antenatal healthcare services because they face difficulties accessing medical facilities. Sundari K et al. made similar observations which showed that maternal mortality results from two main factors including absence of antenatal care and postponing medical treatment (Sundari et al., 2016) [11]. Upadhyaya, I discovered that women who receive insufficient antenatal care face higher chances of developing preventable maternal health issues (Upadhyaya, 2014) [12]. The study demonstrates that hospitals must conduct routine antenatal examinations together with early detection of high-risk pregnancies to decrease maternal deaths.

Research results showed that multiple pregnancy experienced women had a higher death rate than first-time mothers. The research conducted in Nepal and Tanzania showed that repeated pregnancies and inadequate birth spacing resulted in higher maternal health problems and death rates (Shrestha et al., 2017; Maro et al., 2016) [13]. The process of having multiple pregnancies results in maternal depletion syndrome which leads to anemia and poor nutritional status that increases the risks of obstetric

complications. The research study from this present study found that hypertensive disorders and obstructed labor during first pregnancies resulted in maternal deaths for first-time mothers.

The study discovered that most maternal deaths happened in cases that doctors had sent to hospitals. The three main reasons behind the problem included patients arriving at hospitals without proper medical treatment, patients waiting too long to reach hospitals, and doctors assessing patients for tertiary health facilities after their arrival. The research conducted by Sageer R et al. in Nigeria discovered that a major portion of maternal deaths resulted from women who reached medical facilities from local treatment centers in serious condition (Sageer et al., 2019) [14]. The report by Yego F et al. showed that referral hospitals experienced high maternal mortality because patients failed to reach emergency obstetric care on time (Yego et al., 2013) [15]. The present study found that 54.4 percent of all cases experienced delayed referral which matches the previous studies and demonstrates that rural areas need better referral systems and transportation services.

The present study found that hemorrhage was the main reason for deaths among mothers. Sageer et al. (2019) reported findings that showed hemorrhage as the cause of 43.4% of maternal fatalities which occurred in Nigeria. The researchers Pasha O et al. identified obstetric hemorrhage as a primary factor which leads to maternal deaths in developing countries according to their study from 2018 (Pasha et al., 2018) [16]. The high death rate from hemorrhages in the study shows that blood transfusion facilities need improvement because medical personnel take too long to reach patients who require obstetric treatment at remote locations. The results of the study demonstrate that hospitals require two resources for effective treatment of postpartum hemorrhage: emergency obstetric services and timely management capabilities for this condition.

The study found that hypertensive disorders together with eclampsia became the second most frequent cause of maternal deaths. Shrestha et al. (2017) found similar results because they identified hypertension and sepsis as the main causes of maternal fatalities in Western Nepal. The study by Sundari et al. (2016) found that anemia (53.57%) emerged as the primary maternal health issue whereas hypertensive disorders remained less prevalent. The research found that 45.6% of maternal death cases showed severe anemia, which demonstrates that anemia still acts as a significant indirect cause of maternal death. The ongoing problem of anemia in pregnant women results from their poor nutritional status combined with the absence of iron supplements and insufficient antenatal care.

The present study found that sepsis served as a major contributor to maternal deaths. The research conducted by Maro et al. (2016) and Pasha et al. (2018) showed that sepsis worked as a major factor which led to maternal deaths in tertiary care centres. The combination of inadequate hygiene standards and delayed infection treatment and extended labor duration leads to sepsis-related fatalities. The findings indicate that maternal deaths from sepsis require hospitals to implement delivery services and infectious disease control measures and provide antibiotics without delay.

The present study further revealed that the postpartum period accounted for the highest proportion of maternal deaths. Shrestha et al. (2017) found that 73.3% of maternal deaths occurred during the postpartum period which matches their results. Sundari et al. (2016) found that approximately 93% of maternal deaths happened after delivery. The similar results show that postpartum period still stands as the most dangerous time for mothers because of heightened dangers from postpartum hemorrhage and sepsis and hypertensive complications. The findings show that hospitals should monitor patients closely during the first hours after childbirth while also developing their postnatal healthcare system.

The present study results show high accordance with research results from developing countries which were conducted in previous studies. Maternal mortality continues to be associated with preventable causes such as hemorrhage, hypertensive disorders, sepsis, anemia, delayed referral, and inadequate antenatal care. The similarities between the present study and earlier studies indicate persistent gaps in maternal healthcare services, particularly in rural and resource-limited settings. The process of reducing maternal mortality and achieving better maternal health results requires hospitals to strengthen their antenatal and postnatal care services and provide institutional delivery services and develop better emergency obstetric services and establish better referral systems and raise public understanding of maternal health.

Conclusion

The present retrospective study highlights that maternal mortality continues to remain a major public health concern, particularly among women from rural areas, unbooked pregnancies, and referred obstetric emergencies. The majority of maternal deaths occurred among women aged 21–30 years and during the postpartum period. Hemorrhage, hypertensive disorders, sepsis, and severe anemia were identified as the leading causes of maternal mortality, while lack of antenatal care, poor socioeconomic status, delayed referral, and delayed treatment seeking were the major associated risk factors. The findings indicate that most maternal deaths were preventable with timely diagnosis, adequate antenatal care, institutional delivery, effective referral systems, and proper emergency obstetric management.

Strengthening maternal healthcare services, improving awareness regarding antenatal and postnatal care, and ensuring early intervention may significantly reduce maternal mortality and improve maternal health outcomes.

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