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

Available online on www.ijpqa.com doi: 10.25258/ijpqa.16.12.67

International Journal of Pharmaceutical Quality Assurance 2025; 16(12); 401-406

Original Research Article

Retrospective Analysis of Maternal Mortality Rate, Epidemiological Patterns, and Causes in a Tertiary Care Center

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Received: 15-10-2025 / Revised: 27-11-2025 / Accepted: 29-12-2025
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Conflict of interest: Nil

Abstract:

Background: Maternal mortality is a key indicator of women's health and healthcare system performance. Despite advances, preventable maternal deaths remain high in developing countries, including India.

Aim: To analyze the maternal mortality rate (MMR), epidemiological patterns, and causes of maternal deaths in a tertiary care hospital.

Methodology: A retrospective record-based observational study was conducted at Nalanda Medical College, Patna. Data on 80 maternal deaths recorded during the study period were extracted from hospital registers and case records. Epidemiological characteristics, causes of death, and MMR were analyzed using descriptive statistics.

Results: The MMR was 320 per 100,000 live births (80 deaths among 25,000 live births). Most deaths occurred in women aged 20–24 years (42.5%), multiparous women (56.2%), rural residents (67.5%), unbooked cases (82.5%), illiterate women (62.5%), and those from low socioeconomic status (80%). Direct obstetric causes accounted for 72.5% of deaths, mainly hemorrhage (27.6%), eclampsia (25.9%), and sepsis (19%). Indirect causes constituted 27.5%, with anemia (36.4%) being the leading factor.

Conclusion: Maternal mortality was predominantly due to preventable causes associated with poor antenatal care, socioeconomic disadvantage, and delayed referral. Strengthening antenatal services, early risk identification, and timely emergency obstetric care is essential to reduce maternal deaths.

Keywords: Maternal Mortality, MMR, retrospective Study, Epidemiology, Obstetric Causes, Tertiary Care Hospital.

Introduction

Maternal mortality is one of the most delicate measurements of the overall efficiency of health care system and indicates the social, economic, and cultural status of women in a given society. Although there is a lot of improvement in medical science and health infrastructure, maternal mortality remains one of the greatest health issues affecting people especially in the developing world. The World Health Organization (WHO) defines a maternal death as a death of a woman during pregnancy or within 42 days of pregnancy termination regardless of the duration and site of pregnancy according to International Classification of Diseases, 10th Revision (ICD-10) [1] as follows. This definition brings out the fact that maternal mortality does not just include the deaths that happen during birth but also those that are as a result of the complication that arise during pregnancy and after giving birth.

More than a half a million women are dying annually around the globe as a result of pregnancy related complications and childbirth complications. Worryingly, approximately 99 percent of these fatalities happen in the third world with more than 90 percent of them being in Africa and Asia [2]. These statistics highlight the terrible inequalities in maternal health care in developing and developed nations. Although developed nations have made significant progress in terms of maternal mortality by enhancing antenatal care, presence of skilled birth personnel and efficient referral systems, low- and middle-income countries still grapple with preventable maternal deaths [3].

Maternal mortality in India is a big concern in the world. In India, the present maternal mortality rate (MMR) is estimated to be 212 per 100,000 live births. Even though MMR gradually decreases over the last several decades, the rate of its occurrence is too high compared with developed countries [4,5]. The most unfortunate thing about this case is that the majority of deaths of the mother can be averted with

the help of timely interventions, proper obstetric care, identifying high-risk pregnancies early and effective systems of referrals. The continuation of high maternal mortality points to the loopholes in health care delivery, disparities in accessing health care services, and ignorance and socio-economic factors [6,7].

The advancements made in enhancing the health of mothers have been highlighted as imbalanced, unequal, and unsatisfactory. The lifetime risk to maternal death is dissimilar between different parts of the world. As an example, a woman is estimated to face the risk of dying during her lifetime because of pregnancy and childbirth related complications at an average rate of 1 in 6 in Afghanistan and 1 in 30,000 in Northern Europe [8]. This difference highlights that the strength of health systems, access to qualified care, education and social-political stability have an impact on maternal outcomes.

A United Nations (UN) report card on Millennium Development Goal-5 (MDG-5), which sought to enhance maternal health, found out that little gains were made in the sub-Saharan Africa where almost half of all maternal deaths are recorded [9]. The developments made by the South Asian nations, such as India that alone takes up about 25 per cent of the total number of maternal deaths in the world have also not been satisfactory. These results indicate that the decrease in maternal mortality rates has not been evenly distributed across the world, and there are still serious challenges to attain the objectives.

The causes of maternal mortality are a complicated combination of medical, social, economic, and health system-related causes and factors. Direct obstetric etiologies including hemorrhage, hypertensive disorders, sepsis and unsafe abortion complications are still significant causes. There are also indirect causes such as anemia, cardiac disease as well as other existing medical conditions that are aggravated by pregnancy. In most instances, failure to seek care, time wastage in accessing proper health facilities, and time wastage in obtaining proper treatment which is often referred to as the three delays is a critical factor in maternal death [10].

Majority of the material evidence available concerning maternal mortality is based on hospital-based information and community-based information that most of the time is located in urban settings. Nevertheless, a significant number of maternal deaths is in the rural areas, where there is low access to quality health care services. Some of the challenges that rural populations have to deal with include the inability to access transportation, absence of a proper referral system, insufficient health practitioners, and the insufficiency of the infrastructure [8]. Subsequently, the actual magnitude and causes of maternal mortality might be incomplete because maternal deaths in these settings might be underreported and insufficiently recorded.

The tertiary care hospitals are very important in the treatment and management of high-risk pregnancies and complicated obstetric cases especially within the areas where the peripheral health facilities do not have the advanced diagnostic and therapeutic equipment [11]). A big proportion of referred to such institutions often come to rural and semi-urban areas, most of them late with complicated results. Consequently, it is worthwhile given that through retrospective analysis of maternal deaths in tertiary care centers, the epidemiological trends, mortality causes, and gaps in the referral and health care delivery system can be understood.

The main aim of conducting a retrospective analysis was to determine the maternal mortality in the institution over a specified period as the exercise aimed to determine the local epidemiological trends and causes of maternal deaths. The research aims to produce evidence that can be used by creating targeted interventions and decisions in policy making by assessing demographic factors, obstetric factors, and causes of death. It is necessary to understand data particular to the institution to develop effective measures to decrease maternal mortality, enhance the quality of care, and referral systems.

Methodology

Study Design: This study was a retrospective observational (record-based) study conducted to analyze the maternal mortality rate, epidemiological patterns, and causes of maternal deaths in a tertiary care hospital.

Study Area: The study was carried out in the Department of Community Medicine, Nalanda Medical College, Patna, Bihar, India.

Study Duration: The study was conducted over a period of 7 months, from February 2025 to August 2025.

Sample Size: The total sample size was 80, comprising all recorded maternal deaths during the study period.

Study Population: The study population included all maternal deaths that occurred in Nalanda Medical College during the defined study period. Maternal death was defined according to the World Health Organization (WHO) definition 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.

Data Collection: Data for the present retrospective study were collected from institutional records maintained at Nalanda Medical College, Patna. After obtaining necessary administrative permission from the Medical Superintendent, information

related to maternal deaths was extracted from the Maternal Mortality Register maintained by the hospital. Wherever required, additional details were obtained from labor room registers and individual medical case records to ensure completeness and accuracy of the data.

The collected information included demographic characteristics such as place of residence and literacy status, obstetric variables including gravidity and antenatal care status, and socioeconomic details of the deceased mothers. Clinical information pertaining to the causes of maternal deaths was also recorded. Data regarding the total number of live births during the study period were obtained from the labor ward records, which were used for the calculation of the maternal mortality rate.

All relevant data were systematically recorded using a structured data extraction format to minimize errors and maintain uniformity. The collected data were subsequently compiled and prepared for statistical analysis.

Inclusion Criteria

- All maternal deaths recorded in Nalanda Medical College during the study period
- Deaths fulfilling the WHO definition of maternal mortality
- Complete records available in the maternal mortality register

Exclusion Criteria

- Deaths occurring beyond 42 days of termination of pregnancy
- Accidental or incidental deaths not related to pregnancy or its management
- Records with incomplete or missing essential information

Procedure

All eligible maternal death records were identified from the maternal mortality register. Relevant demographic, obstetric, and clinical details were extracted using a structured data extraction format. The total number of live births during the same period was recorded to calculate the maternal mortality rate.

The Maternal Mortality Rate (MMR) was calculated using the formula:

$$\text{MMR} = \frac{\text{Total number of maternal deaths}}{\text{Total number of live births}} \times 100{,}000$$

The mean maternal mortality ratio for the study period was calculated by determining the average of the yearly MMR values.

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using appropriate statistical software. Descriptive statistics were used to summarize the data. Results were expressed as frequencies, percentages, and rates, and presented in the form of tables and charts for clear interpretation."

Result

Table 1 describes the epidemiological characteristics of 80 maternal deaths. The majority of deaths occurred in women aged 20–24 years, accounting for 34 cases (42.5%), followed by the 25–29 years age group with 18 cases (22.5%). Multiparous women constituted a higher proportion of maternal deaths (45 cases, 56.2%) compared to primiparous women (35 cases, 43.8%). Most maternal deaths were among women residing in rural areas (54 cases, 67.5%). A large majority of the women were unbooked, with 66 cases (82.5%) having received no regular antenatal care. Illiteracy was common, observed in 50 cases (62.5%), and most deaths occurred among women belonging to a low socioeconomic status (64 cases, 80%). Overall, Table 1 highlights that maternal mortality was predominantly associated with young age, rural residence, lack of antenatal care, low educational level, and poor socioeconomic conditions.

Table 1: Epidemiological Characteristics of Maternal Deaths (n = 80)

Patient Characteristics	Number (n=80)	Percentage (%)
Age (years)		
<20	6	7.5
20–24	34	42.5
25–29	18	22.5
30–34	13	16.3
≥35	9	11.2
Parity		
Primipara	35	43.8
Multipara	45	56.2
Residence		
Urban	26	32.5
Rural	54	67.5
Antenatal Care Status		

Booked	14	17.5
Unbooked	66	82.5
Education Status		
Literate	30	37.5
Illiterate	50	62.5
Socioeconomic Status		
Low	64	80
Middle	13	16.3
High	3	3.7

Table 2 shows the distribution of maternal deaths according to the type of causes among 80 cases. Direct causes accounted for the majority of maternal deaths, with 58 cases (72.5%), while indirect causes were responsible for 22 deaths (27.5%). Overall, Table 2 indicates that direct obstetric complications were the predominant contributors to maternal mortality in the study population.

Table 2: Distribution of Maternal Deaths According to Type of Causes (n = 80)		
Type of Cause	**Number**	**Percentage (%)**
Direct causes	58	72.5
Indirect causes	22	27.5
Total	**80**	**100**

Table 3 presents the distribution of direct causes of maternal deaths among 58 cases. Hemorrhage was the leading direct cause, responsible for 16 deaths (27.6%), closely followed by eclampsia in 15 cases (25.9%) and sepsis in 11 cases (19.0%). Obstructed labor or ruptured uterus accounted for 6 deaths (10.3%), while embolism and other causes contributed 5 deaths each (8.6%). Overall, Table 3 highlights that obstetric emergencies such as hemorrhage, hypertensive disorders, and sepsis were the major direct contributors to maternal mortality.

Table 3: Distribution of Direct Causes of Maternal Deaths (n = 58)		
Direct Causes	**Number**	**Percentage (%)**
Hemorrhage	16	27.6
Eclampsia	15	25.9
Sepsis	11	19
Obstructed labor / Ruptured uterus	6	10.3
Embolism	5	8.6
Others	5	8.6
Total	**58**	**100**

Table 4 depicts the distribution of indirect causes of maternal deaths among 22 cases. Anemia was the leading indirect cause, accounting for 8 deaths (36.4%), followed by jaundice in 6 cases (27.3%) and heart disease in 4 cases (18.2%). Respiratory infections and miscellaneous causes contributed 2 deaths each (9.1%). Overall, Table 4 indicates that preventable and medically manageable conditions, particularly anemia and jaundice, were major contributors to indirect maternal mortality.

Table 4: Distribution of Indirect Causes of Maternal Deaths (n = 22)		
Indirect Causes	**Number**	**Percentage (%)**
Anemia	8	36.4
Jaundice	6	27.3
Heart disease	4	18.2
Respiratory infections	2	9.1
Miscellaneous	2	9.1
Total	**22**	**100**

Table 5 shows the maternal mortality rate during the study period. Out of a total of 25,000 live births, there were 80 maternal deaths recorded, resulting in a maternal mortality rate of 320 per 100,000 live births. Overall, Table 5 indicates a relatively high maternal mortality rate in the study population, highlighting the need for improved maternal healthcare services and timely obstetric interventions.

Table 5: Maternal Mortality Rate During the Study Period	
Parameter	**Number**
Total live births	25,000
Total maternal deaths	80
Maternal Mortality Rate (per 100,000 live births)	320

Discussion

The MMR rate of maternal mortality in the current study is 320 per 100,000 live births, which is quite high compared to the national average of 212 per 100,000 live births of MMR in India in a similar period (Office of the Registrar General of India, 2011) [12]. Like other tertiary care-based studies, this increased MMR could be explained by the fact that the institution is a referral center that receives only complicated and critically ill patients who are referred by the rural and peripheral health centers. Similar high MMRs have also been cited by Jain and Maharahaje, who noted an MMR of 2270 per 100,000 live births in a tertiary hospital setting, which is indicative of the way referral bias greatly inflates mortality in a tertiary hospital setting (Jain and Maharahaje, 2003) [13]. A broad spectrum of MMRs of 47 to 625 per 100 000 live births is reported in other Indian studies that support the irregularity of the outcome of maternal health variability in locales and healthcare services (Puri et al., 2011; Jadhav and Rote, 2007) [14,15]."

The age-wise analysis of the present study revealed that most of all maternal deaths were among the women aged between 20-24 years (42.5 percent) and those aged between 25-29 years (22.5 percent) and almost 65 percent of maternal deaths fell within the ranges of 20-29 years. This observation is similar to other earlier research that found the highest rate of maternal mortality in women in their prime reproductive years which is mainly due to the fact that this age group comprises the highest number of pregnancies (Jadhav & Rote, 2007; Pal et al., 2005) [15,16] . Jain and Maharahaje also revealed that about 70 percent of deaths occurring in mothers fell in the 20-29 age group, and this is very similar to the current findings (Jain and Maharahaje, 2003) [13]. Even though the percentage of adolescent pregnancies was lower (7.5) in this research, it is still an issue of concern given the biological and social risks which accompany them as noted in literature on the issue in the world by Ronsmans and Graham (2006) [17].

Price distribution showed that there was a more significant number of deaths of the maternal type among multiparous women (56.2%), than among the primiparous women (43.8%). This trend is in line with other investigators like Pal et al. and Onakewhor and Gharoro who identified that there was indeed increased maternal mortality in multiparous women, perhaps as a result of an accumulated obstetric risks, anemia and poor health-seeking behaviour in women with more than one prior pregnancy (Pal et al., 2005; Onakewhor and Gharoro, 2008) [16,18] . Nonetheless, there are studies that have shown a comparatively high risk in the case of primiparous women because of other complications like eclampsia and protracted birth, implying that risk, based on parity, depends on the aspects of a population and access to healthcare (Shah et al., 2008) [19].

The sociodemographic factors were also instrumental in maternal mortality as in the current study. Most of the maternal deaths were among the rural (67.5%), unbooked (82.5%), illiterate (62.5%), and low socioeconomic status (80) women. Such results are surprisingly close to those of Jain, Jadhav, Pal, and Onakewhor who also highlighted the close correlation between low literacy levels, poor use of antenatal care, rural living, and high maternal mortality (Jain and Maharahaje, 2003; Jadhav and Rote, 2007; Pal et al., 2005; Onakewhor and Gharoro, 2008) [13-18]. This high rate of unbooked cases indicates the absence of care to identify high-risk pregnancies so that these complications could be managed at their early stages and therefore eliminate most of the deaths.

Cause of maternal mortality was analyzed, and the direct obstetric causes were found to be 72.5 causes of maternal mortality with 27.5 being the indirect causes. This distribution is quite similar to that of other Indian and global studies, in which direct causes are normally the ones that contribute 6075 percent of all maternal deaths (Jain and Maharahaje, 2003; Ronsmans and Graham, 2006) [13, 2]. The most common direct cause in the current study was hemorrhage (27.6%) then eclampsia (25.9%), and sepsis (19%). These figures compare to the ones reported by Jadhav and Rote who found hemorrhage (26.66 percent) and eclampsia (26.66 percent) to be the most common causes and by Pal et al., who also detected sepsis to be one of the most common causes (Jadhav and Rote, 2007; Pal et al., 2005) [15,16]. The continuity of such classical tripartite hemorrhage, eclampsia, and sepsis is a teller of the preventability of majority of maternal deaths under the circumstances of timely and suitable care.

One of the contributors that were most common among indirect causes included anemia (36.4%), jaundice (27.3%), and heart disease (18.2%). The same has been reported by Jain and Maharahaje and Onakewhor and Gharoro who also cited anemia as a significant indirect cause of maternal deaths especially in low-resource conditions (Jain and Maharahaje, 2003; Onakewhor and Gharoro, 2008) [13,18]. The excessive prevalence of anemia indicates nutritional deficiencies in the long run, recurrence of

pregnancy, and inefficient antenatal supplement. The presented findings underline the necessity to reinforce preventive measures, such as nutritional interventions and early diagnoses of medical conditions during pregnancy.

In general, the results of the current research are mostly in line with the available literature which supports the idea that late referrals, inadequate antenatal care coverage, rural status, and low socioeconomic status of the mother play a crucial role in maternal mortality in tertiary care hospitals. Although the country still has efforts to encourage institutional deliveries and to enhance the quality of maternal health services, preventable causes still predominate maternal deaths. Enhancement of peripheral health service, upgrading of referral processes and maintenance of prompt care in cases of obstetric and medical complications is still a central factor in making a further reduction in maternal mortality.

Conclusion

This retrospective study demonstrates that maternal death in the tertiary care facility was highly linked with women in their early replicative years, multiparty, rural abode, bad socioeconomic and educational status and unavailability of proper ante birth help, which serves to uncover the role of the social determinants and accessibility to healthcare in maternal outcomes. Most of the deaths were directly due to obstetric causes, but hemorrhage, hypertensive disorders, and sepsis became the most important conditions, with indirect causes like anemia and other medical comorbidities also being a significant cause. These results highlight that in the majority of cases, maternal mortality could be greatly reduced by promptly identifying the high-risk pregnancies, increasing the antenatal coverage, efficient referral systems, competent intrapartum care, and effective obstetric emergency management. Enhancement of primary healthcare services, community awareness and better tertiary-level emergency obstetric care are critical measures to control the number of maternal deaths and reduce the general outcomes of maternal health status.

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