Investigation on maternal mortality in Southeast Asia, Europe and Africa using three delays model approach

Humna Baig1, Usama Javed2, Dua Noor Baig3

1Department of Pharmacy, Al Rehaab Pharmacy, Capital Territory Islamabad 46000, Pakistan. 2Health Services Academy, National Institute of Health, Department of Public Health, Capital Territory Islamabad 46000, Pakistan. 3Department of Biological Sciences, Quaid e Azam University, Capital Territory Islamabad 46000, Pakistan.

*Corresponding to: Humna Baig, Department of Pharmacy, Al Rehaab Pharmacy, Sector F-6, Capital Territory Islamabad 46000, Pakistan. E-mail: humnabg@gmail.com.

Abstract

**Background:** Maternal mortality is a prevalent issue in healthcare provision worldwide. It is particularly common in developing and underdeveloped countries, where maternal deaths during childbirth or pregnancy occur frequently. Various internal and external factors contribute to the high maternal mortality rate in specific regions. One model, known as the three delays model approach, examines three distinct causes that contribute to this problem. The first delay is the lack of awareness in seeking timely healthcare, the second delay involves obstacles in reaching healthcare facilities on time, and the third delay relates to poor or inadequate healthcare provision in tertiary care facilities. These delays are responsible for the elevated maternal mortality rates, with the prevalence of each delay varying across regions. **Objective:** The objective of this literature review is to examine and critically evaluate existing literature on perceptions and investigations regarding maternal mortality in Southeast Asia, Europe, and Africa, utilizing the three delays model approach as a categorization framework. **Method:** This literature review followed BEME guide No. 3. A total of 18 articles were included in the sample after conducting a thorough search of various databases and search engines. A Prisma flowchart was created, and the articles were critically appraised. **Results:** A total of 18 articles focusing on different regions were analyzed. The findings revealed that in countries of Southeast Asia, the primary cause of maternal mortality is the first delay, which refers to the lack of awareness in seeking medical care. On the other hand, in Africa and other European countries, the second and third delays are more prominently associated with maternal mortality. **Conclusion:** Inadequate care is one of the major causes of maternal mortality in majority of regions across the globe. Multiple factors can hinder access to appropriate healthcare. The three delays model plays a significant role in the higher maternal mortality rate. By raising awareness among women and their families about the importance of seeking healthcare, the risk of fatality can be reduced. Similarly, in developing regions, it is crucial to ensure that healthcare facilities are easily accessible and provide high-quality emergency obstetric care to meet the needs of pregnant women in critical situations.

**Keywords:** maternal mortality; three delays model; childbirth; developing countries
Background

Annually, there are approximately 4 million deaths that occur within the first month of life worldwide. The majority of these deaths, accounting for 99%, happen at home and in low- and middle-income countries. However, the exact causes of these newborn deaths remain unknown [1].

Maternal Mortality is defined as the number of female deaths per year resulting from any cause related to or aggravated by pregnancy or its management, excluding accidental or incidental causes. This includes deaths during pregnancy, childbirth, or within 42 days of pregnancy termination, regardless of the duration or site of the pregnancy [2]. More than 90% of maternal deaths are preventable and commonly occur in low-resource settings such as Sub-Saharan Africa and Southern Asia [3].

The maternal mortality ratio (MMR) serves as an indicator of the quality of healthcare services and the social well-being of a nation. The three delays model, developed by Thadeus and Maine in 1994, has been widely utilized to investigate and understand maternal deaths [4].

The three delays conceptual framework is a comprehensive approach in connecting the "pieces", i.e. the events and stories. Thaddeus and Maine argue that in most cases, timely and appropriate medical treatment can prevent adverse outcomes [5]. Moreover, they propose that pregnancy-related mortality is overwhelmingly contributed to delays in three phases.

Firstly, delay in deciding to seek appropriate medical help for an obstetric emergency. This delay is influenced by multiple factors, including the individuals involved in decision-making, sociocultural factors, the distance from the health facility, and the financial and opportunity costs associated with seeking care [6].

Secondly, delay in reaching an appropriate obstetric facility. The time and distance required to reach the nearest healthcare facility play a crucial role in this delay. Factors such as the availability and cost of transportation and the condition of roads impact a woman's ability to access timely care [5].

Thirdly, delay in receiving adequate care upon reaching a healthcare facility. This delay encompasses various factors that affect the provision and receipt of care. It includes the adequacy of the referral system, shortages of supplies, equipment, and trained personnel, the competence of available healthcare providers, ineffective communication, and poor patient management [7].

The objective of this literature review was to conduct a thorough assessment and critical analysis of the existing literature concerning the perceptions and investigations of maternal mortality in Southeast Asia, Europe, and Africa, using the three delays model approach as a framework for categorization.

Method

Review period

The review period for this literature review encompassed articles published in the databases over the past thirty years.

Protocol for literature search

In order to identify and organize articles into categories relevant to the topic of research, and for extensive literature comparison of the said topic, a systematic literature search was carried out following BEME guide No. 3.

Conducting the literature search

The literature search was conducted using various search engines and databases, including PubMed, Eric, Medline, Psych INFO and Google Scholar. To enhance the sensitivity of the results, a combination of search terms (keywords and synonyms) with and without Boolean operators was utilized.

In addition to the initial search, a snowballing approach was employed to identify further relevant articles. This involved examining the reference lists of the initially identified articles to find additional sources that met the inclusion criteria. The aim of these systematic literature search methods was to ensure a comprehensive and thorough analysis of the existing literature on the research topic.

PRISMA


![Figure 1 Flow chart of PRISMA](https://doi.org/10.53388/IN2023020)
**Prevalence of Maternal Mortality**

MMR vary across different regions of the world. In this literature review, we specifically focused on areas in Southeast Asia, Africa and Europe. It has been found that maternal mortality rates are significantly higher in rural regions of Southeast Asia and Africa [8]. These countries, characterized as low-income developing nations, face multiple contributing factors that lead to a high maternal mortality rate [9]. Although there has been a global reduction in maternal mortality rates due to effective policy-making and increased awareness, poverty-stricken regions still struggle to overcome this prevailing health issue, affecting approximately 67% of the population directly and 34% indirectly [2].

Through an extensive literature search exploring the prevalence of maternal mortality worldwide, the results revealed that from 2000 to 2017, the global MMR declined by 38%. South Asia achieved the greatest overall percentage reduction in maternal mortality, with a reduction of 59% [10]. Sub-Saharan Africa also made substantial progress, with a 39% reduction in maternal mortality during the same period [11].

**MMR across the globe**
The table below displays the estimated MMRs in different regions of the world in 2017 (Table 1).

**Three delays model and its distribution across different regions worldwide**

In this comprehensive literature review, we conducted a thorough investigation into the relationship between the three delays model and its impact on the maternal mortality rate in regions across Southeast Asia, Africa and Europe [7].

In the majority of developing low- and middle-income countries in Africa and Southeast Asia, studies suggest that people have sufficient awareness to reach a healthcare facility in case of an emergency. However, the delay in receiving health services occurs due to inadequate infrastructure, workforce, and healthcare facilities. Consequently, the third delay emerges as the primary cause of maternal mortality in these areas [3].

On the other hand, in developed countries, the causes of maternal mortality may not align perfectly with the three delays framework. For instance, in Florida, it was observed that racial disparities between white and black mothers contributed to a significant portion of maternal mortalities [12]. In Mexico, some indirect causes were identified, such as pregnancies occurring either too early or too late.

In Pakistan, specifically, the three delays contribute to maternal mortalities: the first delay, related to delayed care-seeking, is more likely to occur in Pakistan due to social and cultural circumstances and lack of awareness [2]. The second delay is characterized by obstacles in accessing care, such as low socioeconomic status and financial limitations among rural residents [2]. While few studies from different areas of Karachi suggest a delay in the provision of health services once patients reach the facility (third delay), it is important to note that these findings cannot be generalized to the entire country, as there are limited studies investigating the third delay in other cities of Pakistan [13]. Given that Pakistan is a country with a significant poverty rate, it cannot be assumed that its health system is without a third delay. This highlights the need to fill the gap in studying the specific role of the third delay in maternal mortalities so that policymakers can intervene accordingly [14]. More studies on the third delay are required to prioritize the issues and inform national policies.

According to a report by the World Health Organization, the correlation between the three delays model and maternal mortality rates worldwide revealed significant figures [6].

Sub-Saharan Africa and South Asia are two regions that account for 86% of maternal deaths globally. Sub-Saharan Africa has the highest MMR, with 533 maternal deaths per 100,000 live births, resulting in 200,000 maternal deaths annually. This represents over two-thirds (68%) of all maternal deaths worldwide. South Asia follows closely, with a MMR of 163, resulting in 57,000 maternal deaths annually, accounting for 19% of the global total [15].

Furthermore, regional and global averages tend to conceal significant disparities both within and between countries.

Progress has been made in every region, although the levels of maternal mortality in sub-Saharan Africa remain alarmingly high. It is crucial to note that almost all maternal deaths are preventable, as evident from the significant disparities observed across regions and between the richest and poorest countries. The lifetime risk of maternal death in high-income countries is approximately 1 in 5,400, whereas in low-income countries, it is as high as 1 in 45 [16].

![Figure 2 The number of maternal deaths in the region of South Asia.](image)

**Table 1 Estimate of MMR & Maternal deaths in 2017**

<table>
<thead>
<tr>
<th>Regions</th>
<th>MMR</th>
<th>Maternal deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>East Asia and Pacific</td>
<td>69</td>
<td>21,000</td>
</tr>
<tr>
<td>Europe and Central Asia</td>
<td>13</td>
<td>1,400</td>
</tr>
<tr>
<td>Eastern Europe and Central Asia</td>
<td>19</td>
<td>1,200</td>
</tr>
<tr>
<td>Western Europe</td>
<td>5</td>
<td>260</td>
</tr>
<tr>
<td>Middle East and North Africa</td>
<td>57</td>
<td>5,800</td>
</tr>
<tr>
<td>South Asia</td>
<td>163</td>
<td>57,000</td>
</tr>
<tr>
<td>Sub-Saharan Africa</td>
<td>533</td>
<td>200,000</td>
</tr>
<tr>
<td>Eastern and Southern Africa</td>
<td>384</td>
<td>70,000</td>
</tr>
<tr>
<td>West and Central Africa</td>
<td>674</td>
<td>131,000</td>
</tr>
<tr>
<td>Least developed countries</td>
<td>415</td>
<td>130,000</td>
</tr>
<tr>
<td>World</td>
<td>211</td>
<td>295,000</td>
</tr>
</tbody>
</table>

MMR, maternal mortality ratio.
Encouragingly, the global lifetime risk of maternal death has nearly halved between 2000 and 2017, decreasing from 1 in 100 to 1 in 190. This indicates progress in reducing maternal mortality worldwide. However, it is important to continue efforts to further reduce these risks and ensure equitable access to quality maternal healthcare for all women.

**Literature review**

In a study conducted by Upadhyay et al. in 2013, the social factors contributing to neonatal deaths in rural Haryana, India were investigated using the three delays model. The study employed a social audit approach, covering various aspects related to the three delay levels. At the family level, factors such as the awareness of mothers and care-takers regarding neonatal danger signs, gender-based differences in treatment preferences, the type of care provided at home, and reasons for delaying seeking care outside the home were examined. Socio-economic and geographical factors, including the cost of hospitalization and transportation, accessibility of transportation options, distance from the hospital, and travel time, were also considered. Additionally, factors related to hepatitis were included in the analysis, as they align with the three delay levels of the three delays model. Delay 1 pertains to the delay in recognizing the presence of a disease or condition and the need for medical attention. Delay 2 includes newborn babies whose care-takers reported difficulties getting to a health facility; and delay 3 refers to the delay in receiving quality care once at a health facility (as judged by the person conducting the audit). While delay 2 might involve a referral from a lower to higher health facility, delay 1 included seeking care both “outside home” and from a lower to higher health facility. Each fatality might have been caused by one or more delays. As a result of the study, there were 56 newborn fatalities in the study area. Out of these, an audit of 50 deaths was conducted. However, three families had relocated, and in the remaining three cases, none of the trips made by the families were accompanied by a trustworthy informant [17].

Mgwadere et al. 2017 investigated maternal mortality in Malawi using three delays model. The study involved a 12-month reproductive age mortality survey in which 151 maternal deaths were identified. To gather detailed information about the circumstances surrounding each death, verbal autopsy and facility-based medical record reviews were conducted. Using the three delays framework, the data were analyzed for women who had: 1. died at a healthcare facility. 2. Died at home but had previously accessed care. 3. Died at home and had not accessed care. The results revealed that 62.2% (94 out of 151) of maternal deaths occurred at a healthcare facility. Additionally, 21.2% (32 out of 151) of mothers died at home after having accessed care at a healthcare facility. Notably, more than half of the women who died at a healthcare facility (52.1%) experienced more than one type of delay. Type 3 delays were the most significant delay for women who died at a healthcare facility or women who died at home after they had accessed care, accounting for 96.8% of cases. Type 2 delays were experienced by 59.6% of women, while type 1 delays were experienced by 39.7% of all women. Type 3 delays, identified as the most prominent delay, were attributed to various factors such as long waiting hours before receiving treatment at a healthcare facility, multiple delays during the admission process, shortages of drugs, non-availability of necessary resources, and incompetence of skilled staff. Distance to a healthcare facility was the main problem resulting in type 2 delays [6]. These findings highlight the specific challenges faced by women in accessing timely and quality healthcare, including issues related to the availability of resources, competent healthcare providers, and geographical barriers. Addressing these delays is crucial to improving maternal healthcare and reducing maternal mortality rates.

Using a three delays model, Rodriguez-Aguilar (2018) looked at maternal mortality in Mexico. The study focused on two fundamental theories that aim to explain the causes of maternal mortality: 1. social determinants; 2. flaws in the healthcare system. The findings revealed that maternal deaths in Mexico are more common in urban areas, with 60% of these deaths occurring among younger women aged 20 to 34. For preventable conditions linked to poor treatment, more than 90% of dying women received prenatal care. The top causes of maternal death in Mexico have undergone changes in recent years. Previously, they were primarily linked to pregnancy-related hypertensive disease, hemorrhage, puerperal infection, abortion and other factors. In recent years, there has been an increase in the percentage of maternal deaths caused by indirect obstetric causes, which are not directly attributable to slow access or poor care. In 2014, 27% of all maternal deaths were attributed to women who experienced high or very high levels of marginalization. Furthermore, the study found that only 8.5% of women did not receive medical care during childbirth, indicating a decrease from 13.8% in 2002. Interestingly, despite 24% of the 25 municipalities having a lower human development index, they accounted for a smaller proportion of maternal deaths. In these municipalities, the primary causes of death were indirect obstetric reasons (32%), hypertensive disease (21%), various pregnancy and childbirth difficulties (15%), and bleeding during childbirth and the puerperium (14%). In contrast, in the 50 municipalities with a higher HDI, these causes accounted for only 4% of maternal deaths. Together, these causes of death represented 82% of all maternal deaths [18].

In the study conducted by Naz et al. (2022) in the four districts of Khyber Pakhtunkhwa Province, Pakistan (Peshawar, Mardan, Charsadda, and Nowshera), and maternal mortality was investigated. The research utilized a purposive sampling technique, involving 50 key informants (gynecologists from principal hospitals in the four districts), four focus group discussions with lady health workers, and eight case studies involving family members of deceased women. The findings indicated that the majority of the lady health workers were in the young age group of 30–39 years, comprising 58% of the sample. Most of them (87.5%) were married and had an intermediate level of education, along with significant work experience. Thematic analysis was conducted, revealing several social and cultural factors that influence maternal mortality in the context of the Three Delayed Model approach. These factors include low socioeconomic status of women, low nutritional status, lack of awareness regarding maternal health care, limited decision-making power in seeking health care and family planning, and the presence of traditional birth attendants. Additionally, early marriages were identified as a contributing factor. [10]. These findings shed light on the specific social and cultural determinants that play a role in maternal mortality in the studied districts of Khyber Pakhtunkhwa Province, Pakistan. Understanding these factors is crucial for designing targeted interventions and policies to address the underlying causes of maternal mortality and improve maternal health outcomes in the region.

**Conclusion**

This extensive literature review aimed to identify and analyze the prevalence and relevance of the three delays model approach in different regions of the world, specifically Southeast Asia, Africa and Europe. By thoroughly examining the literature, the following conclusions can be drawn: in Southeast Asia, a higher maternal mortality rate is observed, primarily due to all three delays. However, the first delay, which involves a lack of awareness and timely healthcare seeking, emerges as the primary contributing factor. To address the maternal mortality rate in Southeast Asia, efforts should focus on raising awareness among the population regarding the importance of timely healthcare. In Africa, delay in reaching the facility and improper health care facilities which are the 2nd and 3rd delays were the most prevalent contributing factors for higher maternal mortality rates. However in a comparatively developed region of Europe, the third delay can be avoided for reducing prevalent MMR.

Efforts at the national and global levels are necessary to improve obstetric healthcare services and reduce maternal mortality rates in these regions. It requires inclusive efforts from individuals, healthcare providers, and national and international organizations to effectively
address the multifaceted challenges associated with maternal mortality.

**Recommendations**

Public health programs play a significant role in addressing maternal mortality rates and tackling racial inequalities. It is crucial to implement cost-effective interventions that directly target this issue through healthcare system interventions. The following five interventions have been identified as effective in reducing maternal mortality: 1. family planning; 2. health Education; 3. delivery care by professional staff; 4. timely access to emergency obstetric care; 5. access to safe abortion. Implementing these interventions and strengthening healthcare systems can contribute to significant reductions in maternal mortality rates and improve maternal health outcomes globally.

**References**