LITERATURE REVIEW

Comparative Investigation of the Reasons Propagating Maternal Mortality in Sweden, India and Rwanda

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Abstract

Background: Haemorrhage, sepsis, and hypertensive disorders have been identified as the leading causes of maternal mortality worldwide. The majority of maternal deaths occur in developing countries and the majority are preventable. Despite the advent of technologies and scientific progress that have significantly reduced maternal mortality globally, developing countries disproportionately represent the majority of maternal deaths. Identifying and comparing countries with different maternal mortality rates is important because it provides an opportunity to reduce maternal death by understanding *why* and *how* we can learn from countries that perform well to inform and prioritize health policies, programmes and funding.

Objectives: First, to identify the leading causes of maternal mortality in Sweden, India and Rwanda. Second, to identify the factors contributing to maternal death and the strategies used by said countries to address and/or decrease maternal mortality. Third, to identify strategies that could be adopted to reduce maternal death.

Methods: International databases such as the World Health Organisation, World Bank, Population Reference Bureau, World Poverty Clock and the National Eclampsia Registry were used to identify key metrics. A scoping review was conducted in databases (PubMed Medline, Embase, Pubmed, Cochrane Library and Scopus) on quantitative and qualitative studies conducted in Sweden, Rwanda and India after 2000. We also searched for articles in search engines (Google Scholar and Google).

Results: The research highlights that socioeconomic and demographic barriers contribute to the higher rates of maternal mortality seen in developing countries. The implementation of standardised guidelines for the use of drugs, investment in community-led care and the implementation of a midwifery model could play a key role in addressing maternal mortality in developing countries.

Conclusion: It is understood that a multitude of factors contribute to maternal mortality. These perpetuating reasons are often closely interlinked in a complex relationship with the country's socioeconomic and political conditions. Therefore, in order to decrease maternal mortality rates in developing countries especially, the focus needs to be diverted towards bridging the gap between the urban and rural populations, and equipping mothers with accessible, affordable, and high-quality healthcare.

Keywords: Maternal Mortality, Sweden, India, Rwanda

Introduction

Maternal mortality is defined by the World Health Organisation (WHO) as the "annual number of female deaths from any cause related to or aggravated by pregnancy or its management (excluding accidental or incidental causes) during pregnancy and childbirth or within 42 days of termination of pregnancy" [1]. The three major causes of maternal mortality are 1) haemorrhage, such as from postpartum haemorrhage (PPH), 2) sepsis and 3) hypertensive disorders, such as gestational hypertension, preeclampsia (PEC), and eclampsia (EC). PPH refers to excessive bleeding after giving birth while maternal sepsis can develop during pregnancy or after labour due to an infection. Eclampsia refers to one or more seizures and/or an unexplained coma before, during and after birth, and is considered to be a complication of severe preeclampsia[2].

Sweden

According to the 2013 State of World Population report, Sweden has a maternal mortality rate (MMR) of 4 per 100,000, making it one of the lowest in the world[3]. The Swedish National Board of Health and Welfare's statistical database indicates that from 2010–2019, there were only an average of 0.075 deaths related to pregnancy, childbirth, or puerperium per 100,000 women per year, equivalent to an average of 3.7 total deaths per year[4]. While the 2019 data reported only 4 deaths related to

pregnancy, childbirth, and puerperium, there were still 54 deaths that year related to perinatal conditions, and these numbers could be higher as cases may have been underreported by hospitals or unaccounted for if they did not occur under obstetric care[5]. The large decline in Sweden's maternal mortality rates since the early 1900s has been largely attributed to the introduction of midwives and changes in reproductive health policy[6].

An external review conducted between 2007–2017 found that the leading causes of maternal death in Sweden were PEC, sepsis, and PPH[7]. Over the 11 year span, 10 women died from PEC and 8 died from infections. 7 of the 10 women that died from PEC died from intracranial haemorrhage (a severe and life-threatening complication of PEC). The review found that most maternal deaths due to PEC were preventable if diagnosed and treated earlier with antihypertensive medications[7]. The report recommended that Swedish healthcare providers closely monitor patients' blood pressure and immediately treat a systolic blood pressure greater than 160 mmHg with antihypertensives[7]. It is important to note that obstetric bleeding contributes to approximately 15% of the direct causes of maternal mortality in Sweden[7].

Antenatal Care

Created in 2013, the Swedish Pregnancy Register—formed through merging other maternal health registers—tracks and assesses the population, and is used to inform recommendations for perinatal care[8]. Sweden recommends that antenatal visits begin at 9 weeks gestation and receive a minimum of 8 antenatal visits throughout the course of their pregnancy[8]. All pregnant women are offered a second trimester ultrasound scan and a follow-up visit 8–12 weeks postpartum[8]. The second trimester ultrasound scan is significant because it can identify conditions such as placenta previa and vasa previa, which can lead to torrential obstetric haemorrhage, a major cause of maternal mortality in developing nations that lack healthcare resources[9].

Midwife Care

The role of midwives in women's care grew in Sweden in the 19th century, drastically reducing its maternal mortality rate[6]. The midwife licensure in Sweden is highly regulated and a practitioner must first graduate from a midwife educational program that requires 90 advanced-level credits[10]. Upon successful completion of this program, the Swedish National Board of Health and Welfare grants a license to practice[10]. A midwife must show competency in the field of reproductive, perinatal, and sexual health by demonstrating knowledge and skills within several competency areas[10]. The competency skills listed by the Swedish Association of Midwives include tending to the patient's "psychological, physical, and emotional needs of the patient seeking healthcare" by coordinating patient care with other members of the healthcare team; handling healthcare-technical activities/equipment; participating in research to enhance healthcare quality; promoting healthy choices from a lifestyle perspective and a reproductive and sexual health perspective; and managing normal and complicated pregnancy, labour, childbirth, and the postnatal period independently, including vacuum-assisted or forceps-assisted birth[10]. A midwife is also licensed to prescribe contraception and provide care for spontaneous or induced abortions regardless of circumstances[10]. This is important because it reduces maternal death due to unsafe abortions and improves accessibility and acceptability of healthcare services.

Sexual and Reproductive Rights

Sweden's welfare model and national response to sexual reproductive and health rights aims to address the societal and social inequities underpinning poor public health outcomes[11]. This open, non-judgemental approach improves healthcare outcomes by focusing on the rights of individuals to make decisions regarding their own sexual and reproductive health and to access services that support that[11]. Portugal implemented a similar strategy in 1970 when its maternal mortality rate was around 47.7 per 100,000 live births[12]. The policy reforms that were implemented improved the quality and accessibility of antenatal and obstetric care, and included sexual health education, access to safe abortion, and free contraception[12]. The implementation contributed to a subsequent decrease in maternal mortality to 6.9 per 100,000 live births by 2016[12]. Improving access to sexual and reproductive health services is integral to improving maternal mortality rates.

The Swedish government announced in 2005 that women's sexual and reproductive rights would be prioritized as a means of addressing maternal mortality, neonatal care, gender equality, sex education, right to contraception, safe abortion practices and HIV/AIDS initiatives[6]. Protection of women's sexual and reproductive rights in Sweden has contributed to overall maternal well-being. The country has built antenatal, paediatric, and school health services that have displayed positive health outcomes in young individuals[6]. The efforts of these programs have generated notable improvement in the health of both new mothers and their babies in Sweden, significantly contributing to the low maternal mortality rates seen in the country[6].

India

India's mortality rate is 113 per 100,000—on the spectrum of maternal mortality rates, India is considered to have a moderate MMR and its reduction remains a challenge[13]. Although India has made considerable progress in enhancing its reproductive care, the MMR does not yet satisfy the United Nations Millennium Development Goal threshold of 109 deaths per 100,000 live births[13]. Although conditions are improving and rates of haemorrhage, sepsis, and preeclampsia are decreasing, a wide range of unaddressed socioeconomic and cultural factors remain large contributors to the country's MMR.

Sepsis

The high rates of maternal death due to sepsis highlight the socioeconomic framework that maternal mortality operates within. A by-product of poverty is the lack of safe and hygienic settings and practices to carry

out deliveries and abortions which contributes to the precipitation of life-threatening sepsis. A study carried out at Vardhman Mahavir Medical College and Safdarjung Hospital, New Delhi from January to June 2016 observed 33 women with severe maternal sepsis[14]. During the study period, there were 14,550 admissions to the Obstetrics and Gynaecology Department, 366 (2.5%) of which were due to puerperal sepsis. Although this would seem relatively manageable in a high-resource setting, ultimately only 73% of these women were admitted into an intensive care unit (ICU) while 18% did not receive ICU care due to a lack of resources[14]. As a result, 85% of the 336 women with puerperal sepsis died[14]. The study identified that the considerable delay in diagnosis by the physician was the main contributing factor associated with severe sepsis[14]. On further observation by the research team, it was discovered that most of the women were admitted with no prior supervision, having delivered at home or in outside hospitals, hailing mostly from lower socioeconomic backgrounds[14]. Given that many of these women came from underprivileged backgrounds, this study highlights the impact of poverty on maternal mortality. As reported by the Population Reference Bureau, the lack of knowledge about obstetric complications, the lack of adequate transport connecting rural areas to urban centres, and the lack of access to adequate healthcare in rural settings perpetuates the high maternal mortality rates highlighted by the study above[15].

Poverty

A statement published by the WHO in 2016 highlighted the dire reality of women living in poverty in India, reporting that nearly 5 women die every hour in India from complications related to childbirth[16, 17]. It was reported that PPH accounts for 19.9% of maternal deaths, estimated to represent 78,000 to 117,000 maternal deaths in India[16, 17]. In the North-East state of Manipur, it has been reported that out of the 94 maternal deaths per 102,525 live births during the years 2000–2010, 53.19% died due to haemorrhage, accounting for about 21.27% of total deaths[18]. Rates of maternal mortality throughout the country are unequally distributed, ranging from as high as 300 per 100,000 live births in the state of Assam to as low as 61 per 100,000 live births in Kerala, a comparatively more affluent state[16, 17]. Assam has the highest MMR of all India's states, with three-quarters of these deaths occurring amongst tea plantation workers[19]. These workers lack access to basic services such as schools, healthcare, safe drinking water, and latrines[19]. Additionally, many of these tea gardens are far from hospitals making maternal healthcare inaccessible, a factor which drives unsafe home deliveries[19]. Therefore, in order to reduce the MMR and treat easily preventable causes of death such as PPH, the country needs to bridge internal socioeconomic gaps present within regions of India.

Eclampsia

Eclampsia is estimated to contribute to 5% of maternal deaths in India, with an average incidence of 1.9%[20]. The rates of maternal mortality have been declining for several reasons, such as the administration of magnesium sulphate postnatally to women who are at risk of developing eclamptic seizures and the improved management of their care in ICU and tertiary health care facilities[21]. However, there has been no decrease in the incidence of eclampsia over the decades and studies strongly suggest this is due to lost opportunities for prevention[21,20]. A cross-sectional study on the prevalence of eclampsia in India has shown a 20-fold difference in eclampsia rates between the states with the lowest and highest prevalence[22].

Antenatal care has been identified as the single most important factor for reducing maternal mortality in India[20], yet studies reviewing cases of maternal mortality in tertiary hospitals show that a majority of women (57.6–92.3%) have not attended an antenatal visit[23–25]. According to the Federation of Obstetric and Gynaecological Societies of India's National Eclampsia Registry (NER), of those that do register for antenatal care, a majority do so late in the course of pregnancy, with only 12.54% booking in the first trimester. Since 76.78% of eclampsia occurs antenatally[20], early identification and management of women at high risk of eclampsia is necessary for its prevention. Two other major factors contributing to high mortality rates secondary to eclampsia are 1) limited access to healthcare services and 2) magnesium sulphate scarcity. A majority of rural patients take 1–4 hours to access hospital care from the first convulsive episode and 40.5% of patients present after having 1–4 convulsions[20]. This highlights the need for better healthcare access and improved primary care management of eclampsia, including the administration of magnesium sulphate. Although the WHO recommends that magnesium sulphate "should be available in all health-care facilities throughout the healthcare system"[26], NER data shows that only 44% of women with eclampsia received magnesium sulphate prior to hospital admission and this can in part be explained by poor supply; some states have reported up to 61% of secondary and tertiary facilities with no magnesium sulphate stock[27]. In addition, there is a lack of standardized guidelines and training on magnesium sulphate administration resulting in variable and inadequate eclampsia treatment[28,29]. In order to tackle the persistently high incidence of eclampsia in India, there is a need for standardization of pre-eclampsia and eclampsia care as well as improvement in care access, training and focus on reducing socioeconomic inequalities that predispose to maternal mortality.

A considerable amount of the Indian population is below the poverty line with 90% of the population living in rural and semi-urban communities where health facilities are not accessible[30]. It is important to note that most health services in India are concentrated in urban medical centres and it is difficult for the rural population to utilize urban health care due to financial barriers. Therefore, the majority of abortions are performed by unqualified, untrained practitioners and home deliveries without medical support are also common, factors which significantly increase the risk of maternal

mortality[30]. Additionally, many women at the grassroots level remain uninformed about the use of contraception and safe reproductive practices. The lack of awareness of safe medical practices therefore plays a prominent role in propagating maternal mortality rates.

Reduction in Maternal Mortality

Despite all obstacles, India has nonetheless managed to achieve success in reducing maternal mortality. In a statement for the WHO, Dr Poonam Khetrapal Singh, WHO Regional Director for South-East Asia, commended India's effort to increase access to quality maternal health services, stating that since 2005, essential maternal health services have doubled[31]. Furthermore, Dr Singh stated: "State-subsidized demand-side financing like the Janani Shishu Suraksha Karyakram [which organizes free transport and no-expense delivery for women delivering in public health institutions] … has largely closed the urban-rural divide traditionally seen in institutional births"[31]. Additionally, India has placed emphasis on addressing social determinants of maternal health—such as education—with now more than 68% of women being able to read and write[31]. All these steps have enabled women to take control of their reproductive rights and make decisions in favour of their health while bridging the gap between urban and rural areas, enabling equality and better access to healthcare.

Rwanda

In comparison to Sweden and India, Rwanda has been recognized to have one of the highest maternal death rates in the world. About 70% of recorded deaths are due to direct causes[32]. The majority of studies in Rwanda report data from the University Teaching Hospital of Kigali (CHUK), Rwanda's largest healthcare centre.

Sepsis

Sepsis and severe systemic infection are commonly reported as the leading cause of maternal death in Rwandan hospitals, and over one-quarter of these deaths are considered preventable[33]. Between 2012–2013, 77% of patients with postpartum infection suffered severe morbidity and mortality[34]. Inconsistent prophylactic antibiotic use prior to operative obstetric procedures likely contributes to these findings. In a rural hospital in Rwanda, it was found that less than half of all women who became septic following caesarean section received prophylactic antibiotics intraoperatively[34]. Facility-specific factors are also likely to play a role in the development of sepsis in these women. For instance, healthcare workers providing care in Rwandan hospitals may lack sufficient education to provide quality care. A 2011 survey of obstetric care providers in the Bugesera District demonstrated that a majority of providers felt they lacked appropriate knowledge, skills, and confidence in safe motherhood practices, and many failed knowledge assessments of general obstetric knowledge[35]. The lack of infrastructure and resources in healthcare facilities in Rwanda may also prevent safe obstetric practices in Rwandan hospitals as well. It has been found that less than one-third of healthcare facilities had year-round water access, and only 58% had functioning latrines[36]. This lack of access to water and sanitation has significant implications for infection control and infection-related mortality.

Postpartum Haemorrhage

Between 20–39% of maternal mortality cases in Rwanda are due to postpartum bleeding[37,38]. While the cause is multifactorial, both the recent genocide—which greatly limited resources—and an increasing population play a large role[39]. A significant proportion of the population deliver in tertiary care centres with rural skilled birth attendants. In postpartum simulations, these workers scored poorly, thereby reflecting gaps in their capabilities[40,41]. This likely perpetuates the high postpartum mortality rate. The WHO recommends that uterotonic drugs should be used in the third stage of labour by skilled birth attendants[42]. However, current guidelines in Rwanda only allow for oxytocin to be used in district hospitals rather than in rural health centres because of the specific storage and administration requirements[43]. When surveyed, most community health care workers felt that the lack of care and resources, such as lack of prenatal care and access to ambulances to district hospitals, were compounded by poverty, and that these factors played a part in the high rates of postpartum haemorrhage[32].

Pre-eclampsia and Eclampsia

PEC is one of the leading causes of maternal mortality in Rwanda, although the exact rates of PEC and EC are unknown[44,45]. There are several causes that contribute to the high rates of PEC such as undiagnosed chronic hypertension, lack of education, obesity, and complications associated with transport to a referral hospital. Three solutions highlighted in the literature to address PEC include the administration of antiplatelet agents (e.g. low-dose aspirin), addressing food security, and screening for chronic hypertension. A systematic review of 16 reviews found that antiplatelet therapy is associated with a 17% reduction in PEC, an 8% decrease in preterm (<34 weeks) births and a 14% reduction for all types of perinatal deaths (foetal, neonatal, and infant death)[46]. Antiplatelet agents should be given to pregnant women at a high risk of PEC[47]. Calcium plays a key role in reducing the risk of gestational hypertension and PEC, and as such, the WHO recommends daily calcium supplementation in pregnant women[48]. A systematic review found that the daily administration of 1–2 grams of calcium significantly reduced the risk of pre-eclampsia by 55% and 64% in women with an adequate and low dietary intake of calcium respectively[46]. In addition, addressing chronic hypertension is also important. A systematic review and meta-analysis of 55 studies from the United States found that pregnant women with chronic hypertension had a 25.9% higher incidence of superimposed preeclampsia[49]. Several studies in Rwanda have found a high prevalence of undiagnosed chronic hypertension in women of reproductive age[45,50]. Blood pressure (BP) screening is the cornerstone of a preeclampsia diagnosis. A cost-effective device that

can be used by minimally-trained members of the community could ensure that pregnant women get regular BP monitoring for the detection of hypertensive disorders of pregnancy. The semi-automated Microlife BP 3AS1-2 sphygmomanometer is one such device that has been validated to be accurate for use in pregnancy and pre-eclampsia in a low-resource setting[51].

Reduction in Maternal Mortaltiy

Rwanda has maintained the 7.5% reduction in MMR per year required to meet the Sustainable Development Goal introduced by the United Nations in 2015, which aims for the reduction of MMR to 70 or less by the year 2030[39,52]. This could be attributed to the collaborative efforts of the Rwandan government as well as international and local non-government organizations. For example, the United Nations Population Fund (UNFPA) has instituted a maternal mortality reduction programme in Rwanda to increase high-quality training and enhance local mobilization resources[53]. The Rwandan Ministry of Health has also partnered with UNICEF to generate a mobile health tool (mHealth) to track and monitor pregnant women for the early detection of complications[54]. A local organization has designed and implemented an emergency obstetric care package in district hospitals, which has reduced case fatality rates by 30-50%[55]. The Rwandan government has also instituted policies promoting safe obstetric practices nationwide, including incentives for larger proportions of women delivering within healthcare facilities[56]. Importantly, community participation is encouraged through the election of three community health workers per village, insurance for maternal healthcare services has become more financially accessible for mothers, and a national monitoring campaign has also been implemented to allow the country to better allocate healthcare resources in each community[56].

Rwanda's maternal mortality rates have been excessive for years, and although there has been some improvement, there are still relatively high rates of maternal mortality. Identifying the barriers to reducing maternal mortality rates is the first step in improvement. Potential barriers identified that can be addressed include education provided to rural health care professionals, provision of essential medications, training for the use and storage of these medications, improvements in hospital infrastructure, and a recognition of socioeconomic factors that prevent women from accessing the appropriate care in a timely manner.

Comparison

Globalization has enabled the rapid spread of technology and science; human civilization has advanced more in the past hundred years than in all the preceding years combined[57]. Globalization has many advantages but the absence of protective global measures has led to massive inequalities between nations[58]. The disparity in maternal deaths between developed and developing countries is one of the most significant divides of our time. The majority of maternal deaths occur in the developing world and are preventable in part due to the advent of technologies such as ultrasound sonography[57].

The most recent information from the World Bank estimates that 38.2% of the population in Rwanda lives under the poverty line, and—according to the World Poverty Clock—5% of India's population lives below the poverty line[59,60]. There is an unequivocal two-way link between health and poverty; illness impairs learning ability and quality of life which has a negative impact on productivity which perpetuates the cycle of poverty. Poor people are exposed to more environmental risks such as pollution, natural disasters, violence and poor sanitation which compounds over time[58]. Poor people are less informed about healthy lifestyles and have limited access to healthcare.

Maternal mortality and perinatal mortality are sensitive indicators and reflect the strength of the healthcare system. In 2020, Sweden spent $6,028 US dollars (USD) per capita on healthcare compared to $56.6 and $57.5 USD per capita spent by India and Rwanda respectively[61]. Sweden's healthcare model offers publicly funded antenatal and postnatal care by qualified midwives at a community-based level to ensure equal access and prevent unnecessary deaths[6]. In India, antenatal care is provided free of cost at public health centres, but with the caveat that private health care providers play a central role in delivering antenatal care which leaves many living in poverty disenfranchised. In rural India and Rwanda there is a lack of access to healthcare, so incorporating and/or expanding the midwifery model and investing in community-led care would be practical and beneficial.

Access to healthcare in rural areas is another key factor contributing to high maternal mortality rates in Rwanda and the implementation of community-led care could play a role in addressing the gap in accessibility. Community-level interventions such as educational programs play a key role in under-resourced settings as they are cost-effective and require minimal training[62]. Local groups for women who are not healthcare workers could coordinate several meetings per month after receiving basic training in maternal health, including—but not limited to—PEC and EC prevention, danger signs, and regular blood pressure monitoring using semi-automated blood pressure devices[62]. A systematic review of similar educational programs implemented in other under-resourced countries such as India, Bangladesh, Malawi and Nepal found that educational programs are associated with a 37% reduction in maternal mortality and a 23% reduction in neonatal mortality[62].

Limitations

The authors acknowledge that this study is subject to limitations. Firstly, our account is only as reliable as the primary investigations included, which varied in methods, data quality, and definitions used. We are also limited by publication bias, although every effort was made to minimize this. There was a relative scarcity of Rwandan quantitative peer-reviewed literature that met our inclusion criteria, and usable studies were mainly conducted at a single tertiary hospital, which may limit

the generalisability of our findings. The inclusionary criteria used were broad and non-specific.

Conclusion

It is understood that a multitude of factors contribute to regional differences in maternal mortality. These perpetuating reasons are often closely interlinked in a complex relationship with the country's socioeconomic and political conditions. Therefore, to decrease maternal mortality rates in developing countries especially, the focus needs to be diverted towards bridging the gap between the urban and rural populations and equipping mothers with accessible, affordable and high-quality healthcare. ◄

Declarations

The authors declare that this research was conducted in the absence of any relationships—commercial, financial, or otherwise—that could be construed as a potential conflict of interest.

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