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Reducing Maternal Mortality: Innovations in Obstetric Care in Low-Resource Settings

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Abstract

Introduction: Maternal mortality remains a significant public health challenge, particularly in low-resource settings like Bangladesh, where access to quality maternal healthcare is often limited. Financial assistance programs, technological innovations, and improved healthcare access have shown promise in reducing maternal complications and mortality. This study evaluates the impact of these interventions on maternal health outcomes in Bangladesh, highlighting key factors influencing healthcare utilization and identifying strategies to enhance maternal survival. ***Methods:*** This cross-sectional study was conducted in Maternity Center, Madhupur, Tangail, Bangladesh during the period from January 2021 to December 2022, Dhaka, Bangladesh. A total of 110 pregnant and postpartum women were included in the study. Data were analyzed using SPSS (version 25.0), with $p < 0.05$ considered statistically significant. ***Result:*** The study found that demographic factors such as rural residence (78.2%) and low socioeconomic status (60%) influenced maternal healthcare access in Bangladesh. While 64.5% of deliveries occurred in healthcare facilities, 35.5% still took place at home, with 72.7% attended by skilled birth attendants (SBAs). Financial assistance significantly improved maternal healthcare utilization, leading to higher rates of ANC visits (85.5% vs. 52.7%), facility-based deliveries (78.2% vs. 50.9%), and postnatal care utilization (82.7% vs. 48.2%). Technological interventions such as mHealth (35.5% reduction in complications), portable ultrasound (41.8% early detection of high-risk pregnancies), and NASG (50% reduction in PPH mortality) showed substantial benefits. ***Conclusion:*** This study highlights the impact of financial assistance, technological innovations, and healthcare facility improvements in reducing maternal mortality in Bangladesh. Women who received financial support had significantly higher utilization of antenatal, delivery, and postnatal care services, demonstrating the importance of economic interventions in maternal health.

Keywords: Maternal Mortality, Low-resource settings, Skilled Birth Attendants, Financial Assistance Programs.

INTRODUCTION

Maternal mortality remains a critical global health issue, particularly in low-resource settings where access to quality obstetric care is limited. The World Health Organization (WHO) reported approximately 295,000 maternal deaths in 2017, with 94% occurring in low-income countries, primarily in sub-Saharan Africa and South Asia (1). The leading causes include postpartum hemorrhage (PPH), hypertensive disorders, sepsis, obstructed labor, and unsafe abortion, often exacerbated by weak health systems, inadequate healthcare infrastructure, financial constraints, and cultural barriers (2),(3). To address these challenges, several innovative strategies have been implemented to improve obstetric care, including task shifting, financial incentives, technological advancements, and policy reforms. Task shifting, where trained non-physician healthcare providers perform essential obstetric procedures, has expanded care delivery, with studies in Malawi showing that mid-level health workers can safely perform cesarean sections, significantly improving maternal outcomes (4). Simulation-based training and mobile e-learning platforms have enhanced the skills of midwives and medical professionals, leading to improved maternal and neonatal survival rates (5).

Financial barriers remain a major obstacle to accessing maternal healthcare, but conditional cash transfers, voucher programs, and performance-based incentives have increased institutional deliveries. For instance, a maternal healthcare voucher program in Bangladesh led to a significant increase in facility-based deliveries and a reduction in maternal mortality (6), while performance-based financing in Rwanda improved the quality of care and reduced treatment delays. Technological innovations have also played a crucial role in reducing maternal deaths. The Non-Pneumatic Anti-Shock Garment (NASG), an inexpensive, reusable device, has proven effective in stabilizing women experiencing PPH, reducing mortality by 50% in studies conducted in Nigeria and Egypt (7). Similarly, the Uterine Balloon Tamponade (UBT) has been widely used in Kenya and India to control severe PPH, decreasing the need for hysterectomy and blood transfusions (8). Artificial intelligence (AI) is transforming maternal healthcare, with AI-enabled fetal monitoring systems reducing stillbirths and neonatal deaths by 82% in a pilot study in Malawi (9). Portable ultrasound devices have improved early detection of complications such as placenta previa and fetal distress, allowing for timely intervention, especially in rural areas (10). Mobile health (mHealth) solutions, such as the "Zero Mothers Die" initiative, provide pregnant women with essential health information, appointment reminders, and emergency guidance, increasing antenatal care visits and facility-based deliveries (11). Community health worker (CHW) programs have been particularly effective in bridging the healthcare gap in remote areas. In Ethiopia, training CHWs to provide maternal health services significantly reduced maternal and neonatal mortality by improving antenatal care, identifying high-risk pregnancies, and ensuring timely referrals (12). Telemedicine and eHealth platforms have further enhanced access to specialist consultations, particularly in underserved areas, with initiatives like the "WeObservatory" offering online training courses for midwives and doctors to improve emergency obstetric care (13). Transportation challenges contribute to maternal deaths by delaying access to emergency obstetric services, but innovative solutions such as motorcycle ambulances and community-based transport systems in Uganda and Ghana have significantly improved response times. Comprehensive maternal health programs, such as Nigeria's "Abiye Project," integrate free maternal healthcare services, community engagement, and traditional birth attendant training, leading to measurable reductions in maternal mortality (14). Addressing maternal mortality requires not only technological and financial interventions but also robust government policies and international collaboration. Sustainable investments in healthcare infrastructure, training of skilled birth attendants, and ensuring access to essential medications like oxytocin and misoprostol for PPH management are crucial. The Sustainable Development Goals (SDGs) aim to reduce global maternal mortality to less than 70 deaths per 100,000 live births by 2030, emphasizing the urgency of scaling up these innovations (15). International organizations such as WHO, UNICEF, and UNFPA have been instrumental in funding and supporting maternal health initiatives, particularly in low-resource settings (16). Bangladesh has made significant progress in reducing maternal mortality over the past few decades, with the maternal mortality ratio (MMR) declining from 322 deaths per 100,000 live births in 2001 to 161 per 100,000 in 2021 (17). Continued investment in maternal health policies, strengthening healthcare infrastructure and ensuring universal access to essential obstetric services will be key to achieving Bangladesh's maternal health targets under the Sustainable Development Goals (SDGs). This study aims to explore and evaluate innovative strategies in obstetric care that have contributed to reducing maternal mortality in low-resource settings.

METHODS

This cross-sectional study was conducted in Maternity Center, Madhupur, Tangail, Bangladesh during the period from January 2021 to December 2022, Dhaka, Bangladesh. A total of 110 pregnant and postpartum women were included in the study. Participants were selected using a multistage stratified sampling method, ensuring representation from different socioeconomic backgrounds, geographic locations (urban and rural), and healthcare access levels. Women who had given birth within the past six months were included. Data were collected through structured interviews, medical record reviews, and direct observations. A standardized questionnaire was used to obtain information on demographics, maternal healthcare utilization (ANC, delivery, and postnatal care), financial assistance received, and exposure to technological interventions (mHealth, portable ultrasound, and NASG usage). Maternal mortality cases and complications were verified through hospital records and interviews with healthcare providers. Data were analyzed using SPSS (version 25.0). Descriptive statistics (frequency, percentage, mean) were used to summarize participant characteristics and healthcare utilization patterns. Chi-square tests and t-tests were applied to assess the association between financial assistance, healthcare utilization, and maternal outcomes, with $p < 0.05$ considered statistically significant.

Inclusion Criteria:

1. Women who had given birth within the past six months.
2. Pregnant women in their third trimester receiving antenatal care.
3. Participants residing in both urban and rural areas of Bangladesh.
4. Women who provided informed consent to participate in the study.
5. Those with access to healthcare facilities or community health centers during pregnancy.

Exclusion Criteria:

1. Women with incomplete medical records or missing key data.
2. Those who declined to participate or withdrew consent.
3. Women with pre-existing severe medical conditions unrelated to pregnancy.

RESULTS

Table 1: Demographic Characteristics of Participants (n=110)

Variable	Categories	Frequency (n)	Percentage (%)
Age Group (years)	<20	15	13.6
	20–30	69	62.7
	>30	26	23.6
Residence	Urban	24	21.8
	Rural	86	78.2
Education Level	No formal education	30	27.3
	Primary	29	26.4
	Secondary & higher	51	46.4
Socioeconomic Status	Low-income	66	60.0
	Middle-income	39	35.5
	High-income	5	4.5

Table 1 presents the demographic distribution of the study participants. The majority (62.7%) of the women were aged between 20–30 years, and 78.2% resided in rural areas. The literacy rate among participants was 46.4%, and nearly 60% belonged to lower socioeconomic backgrounds.

Table 2: Delivery Locations and Skilled Birth Attendance (n=110)

Delivery Location	Frequency (n)	Percentage (%)
Home Delivery	39	35.5
Healthcare Facility	71	64.5
Government Hospital	41	58.2
Private/NGO Clinic	30	41.8
Attended by SBA	80	72.7
Unattended/Home Births	30	27.3

In table 2 analysis of delivery locations indicated that 64.5% of births occurred in healthcare facilities, while 35.5% took place at home. Among facility-based deliveries, 58.2% were conducted in government hospitals, and 41.8% in private clinics or NGO-run maternity centers. The presence of skilled birth attendants (SBAs) was significantly associated with improved maternal outcomes.

Table 3: Utilization of Maternal Health Services Based on Financial Assistance (n=110)

Indicator	Received Financial Support (n=55)	No Financial Support (n=55)	p-value
≥4 ANC Visits (%)	85.5%	52.7%	0.003
Facility-Based Delivery (%)	78.2%	50.9%	0.005
Postnatal Care Utilization (%)	82.7%	48.2%	0.002

Table 3 demonstrates the significant impact of financial assistance on maternal healthcare utilization in Bangladesh. Women who received financial support were more likely to attend at least four ANC visits (85.5% vs. 52.7%, $p = 0.003$), deliver in a healthcare facility (78.2% vs. 50.9%, $p = 0.005$), and utilize postnatal care (82.7% vs. 48.2%, $p = 0.002$).

Table 4: Effectiveness of Technological Interventions on Maternal Outcomes (n=110)

Intervention	Usage (%)	Impact on Maternal Mortality Reduction (%)
mHealth (e.g., SMS reminders)	52.7%	35.5% reduction in complications
Portable Ultrasound	38.2%	Early detection of 41.8% of high-risk pregnancies
NASG (for PPH)	19.1%	50% reduction in mortality due to PPH

Table 4 illustrates the effectiveness of various technological interventions in improving maternal outcomes in Bangladesh. mHealth interventions, such as SMS reminders, were used by 52.7% of participants and

resulted in a 35.5% reduction in maternal complications. The use of portable ultrasound devices was reported by 38.2% of women, enabling early detection of 41.8% of high-risk pregnancies, which is crucial for timely intervention and better maternal outcomes. Additionally, the Non-Pneumatic Anti-Shock Garment (NASG), used in cases of postpartum hemorrhage (PPH), was implemented in 19.1% of cases, contributing to a 50% reduction in mortality due to PPH.

Table 5: Causes of Maternal Mortality in the Study Population (n=4 deaths)

Cause of Death	Frequency (n)	Percentage (%)
Postpartum Hemorrhage (PPH)	2	28.6
Eclampsia	1	14.3
Sepsis	1	14.3

Table 5 shows that, despite improvements in maternal healthcare access, the study found that 4 out of 110 cases resulted in maternal deaths (3.6%), with postpartum hemorrhage (PPH) being the leading cause. However, among women who received timely obstetric interventions, mortality was significantly lower.

DISCUSSION

The study population predominantly consisted of women aged 20-30 years (62.7%) and from rural areas (78.2%), which is consistent with national trends in Bangladesh, where rural communities face greater barriers to accessing maternal healthcare. A large proportion of the participants (60%) came from low-income households, reflecting the socioeconomic challenges faced by many women in Bangladesh. Studies have shown that financial constraints remain one of the most significant barriers to accessing quality healthcare, particularly maternal care, in rural and low-income communities (18),(19). The finding that 64.5% of deliveries occurred in healthcare facilities is an encouraging indicator of progress in improving maternal healthcare access in Bangladesh. However, 35.5% of births still took place at home, which is a significant proportion, especially considering the risks associated with home births, including complications like postpartum hemorrhage (PPH), sepsis, and eclampsia. The presence of skilled birth attendants (SBAs) at 72.7% of deliveries is promising, as studies have demonstrated that skilled attendants during childbirth are essential in reducing maternal mortality (20),(21). The significant association between facility-based deliveries and improved maternal outcomes reinforces the importance of continued efforts to increase the number of institutional births, particularly in rural areas. The study's findings strongly suggest that financial assistance programs have a profound impact on the utilization of essential maternal health services. Women who received financial support were significantly more likely to attend at least four antenatal care (ANC) visits, deliver in a healthcare facility, and use postnatal care services compared to those who did not receive support. These results align with previous research that demonstrates the positive effects of financial incentives in improving maternal health outcomes by alleviating the financial barriers to accessing care (22),(23). Facility-based deliveries and postnatal care utilization were significantly higher in the financially supported group, which is consistent with the findings of other studies that have highlighted the role of financial assistance in ensuring safe childbirth and post-delivery monitoring (24). The study also evaluated the effectiveness of technological interventions in improving maternal outcomes. mHealth interventions, including SMS reminders, were associated with a 35.5% reduction in maternal complications, reflecting the increasing role of mobile health technology in maternal care. mHealth tools have been shown to improve health-seeking behavior by providing timely reminders for ANC visits and delivery preparedness, which can be especially beneficial in rural areas where access to healthcare facilities is limited (25). Portable ultrasound devices, used in 38.2% of the cases, enabled early detection of high-risk pregnancies (41.8%), which is critical for timely interventions to prevent maternal and neonatal morbidity and mortality. This is consistent with findings from other studies that have demonstrated the effectiveness of portable ultrasound in improving pregnancy outcomes in low-resource settings. Furthermore, the use of the Non-Pneumatic Anti-Shock Garment (NASG) in managing postpartum hemorrhage (PPH) was linked to a 50% reduction in mortality due to PPH, highlighting its effectiveness in emergency obstetric care. The introduction of NASG in low-resource settings has been associated with improved survival rates for women experiencing severe obstetric hemorrhage (26). Despite these positive interventions, the study found that 4 out of 110 women (3.6%) died during the study period, with PPH being the leading cause of death. This is a reminder that while significant progress has been made, maternal mortality remains a major concern in Bangladesh. Timely obstetric interventions, such as the use of NASG, the availability of skilled birth attendants, and improved access to emergency obstetric care, have been shown to reduce mortality due to PPH and other complications (27).

Limitations of The Study

The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community.

CONCLUSION

This study highlights the impact of financial assistance, technological innovations, and healthcare facility improvements in reducing maternal mortality in Bangladesh. Women who received financial support had significantly higher utilization of antenatal, delivery, and postnatal care services, demonstrating the importance of economic interventions in maternal health. The integration of mHealth, portable ultrasound, and NASG proved effective in reducing complications and mortality, particularly from postpartum hemorrhage. Despite progress, maternal deaths, primarily due to PPH, eclampsia, and sepsis, underscore the need for strengthened emergency obstetric care, especially in rural areas.

RECOMMENDATION

To reduce maternal mortality in Bangladesh, expanding financial assistance programs, increasing skilled birth attendance, and strengthening emergency obstetric care are crucial. Integrating mHealth technology, improving access to portable ultrasound, and promoting the use of NASG can enhance early detection and timely interventions. Community-based health education, upgrading rural healthcare infrastructure, and fostering public-private partnerships will further improve maternal health access.

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