

# A Statistical Comparative Analysis of Changes in Selected Determinants of Maternal Mortality in Bangladesh: A Road Map for Nigeria

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## ABSTRACT

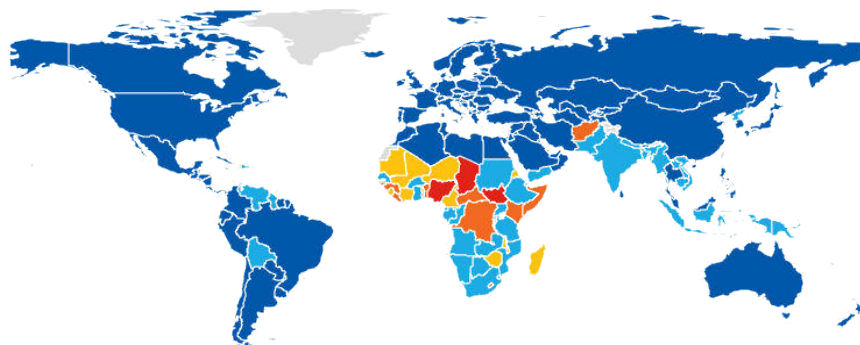
Nigeria failed to achieve the Millennium Development Goal (MDG) 5 and is currently on track to miss the Sustainable Development Goal (SDG) 3 of reducing the maternal mortality rate in the country to under 70 death per 100,000 live births. This study aims to examine trends of maternal mortality in Nigeria and Bangladesh and analyse the impact of changes in selected determinants on maternal mortality in both countries between 1985 and 2020. Pearson correlation and linear regression tests were used to identify the strength and impact of the association between these determinants and maternal mortality. The results from this study reveal that Bangladesh witnessed a significant rise in female literacy rates and female secondary school enrolment which were strongly negatively associated with maternal mortality. The increase in female literacy and female secondary school enrolment was approximately twice that experience in Nigeria, in the same period. In Bangladesh, every unit decline in adolescent fertility rate averted 7.16 deaths per 100,000 live births. The percentage of government total expenditure on health in Nigeria shows a moderate negative Pearson correlation when compared to the maternal mortality ratio. The opposite was however the case in Bangladesh. This may suggest that health expenditure alone is incapable of reducing maternal mortality. From the empirical result of this study, policymakers in Nigeria will need to pay close attention to the sociocultural determinants of maternal mortality in a multi-sectoral approach.

**Keywords:** Nigeria; Bangladesh; Maternal Mortality; Sociocultural Determinants

## INTRODUCTION

Maternal mortality is such a core and important metric to measure the quality of maternal health care delivery trends in a country [1]. According to the World Health Organization, maternal mortality is the annual number of 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, irrespective of the duration and site of the pregnancy [2]. The most common indicator used to calculate maternal mortality is the number of maternal deaths in 100,000 live births.

This is also known as the maternal mortality ratio or MMR [3]. The global set target by Millennium Development Goal 5 was to reduce global maternal mortality by 75%. While this target was not achieved, there was a global reduction of maternal mortality by 43% as of 2013 [4]. The 17 Sustainable Development Goals (SDGs) were formulated to succeed the Millennium Development Goal, with a new target date of 2030. One of the targets contained in SDG 3 was to reduce the global maternal mortality ratio to less than 70 maternal deaths per 100,000 live births [5]. Nigeria as of 2020 was nowhere close to achieving this target.



● Very Low (<100) ● Low (100-299) ● High (300-499) ● Very High (500-999) ● Extremely High (>1000)

**FIGURE 1:** Global prevalence of maternal mortality.

*Source:* UNICEF 2023.

This study will examine trends of maternal mortality in Nigeria and Bangladesh, and statistically analyse the impact of changes in selected determinants on maternal mortality in both countries to understand why the trends in maternal mortality are the way they are. The endgame is to identify recommendations for policymakers in Nigeria.

**General Trend of Maternal Mortality in Nigeria**

Nigeria is a West African country located in the sub-Saharan. As of 2022, it had a population of 218,541,212 and a GDP per capita of \$2,184 [6].

Nigeria has a high maternal mortality ratio that has witnessed quite little improvement in the past 40 years.

With a maternal mortality ratio of 1,283 maternal deaths per 100,000 live births in 1985, and 1,047 maternal deaths per 100,000 live births in 2020 [7], Nigeria's maternal mortality ratio has only improved by about 18.4% in the past 40 years. As of 2020, Nigeria was one of the only 3 countries with more than 1,000 maternal deaths per 100,000 live births. The other two are Chad and South Sudan.

Ogbonna et al [8] and Igwegbe et al [9] identified eclampsia, haemorrhage, and sepsis as the most frequently occurring direct obstetric causes of maternal mortality and acute renal failure as the most common indirect obstetric causes of maternal mortality in Nigeria. They also highlighted that maternal age, primigravida, education, and occupation were major risk factors.

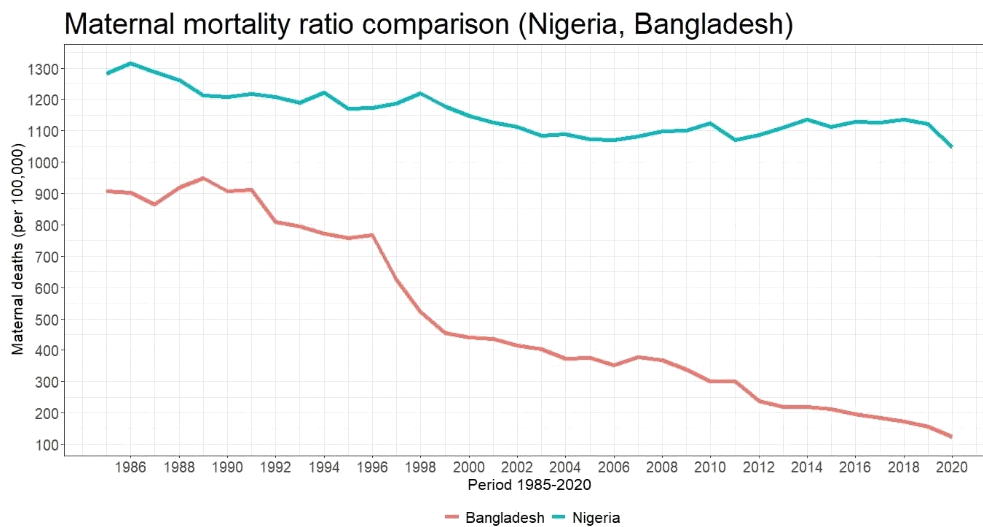


FIGURE 2: Changes in maternal mortality ratio in Nigeria and Bangladesh between 1985 and 2020.

**General Trend of Maternal Mortality in Bangladesh**

Bangladesh is a South-East Asian country located in the sub-continent. As of 2022, it had a population of 171,186,372 and a GDP per capita of \$2,688 [6].

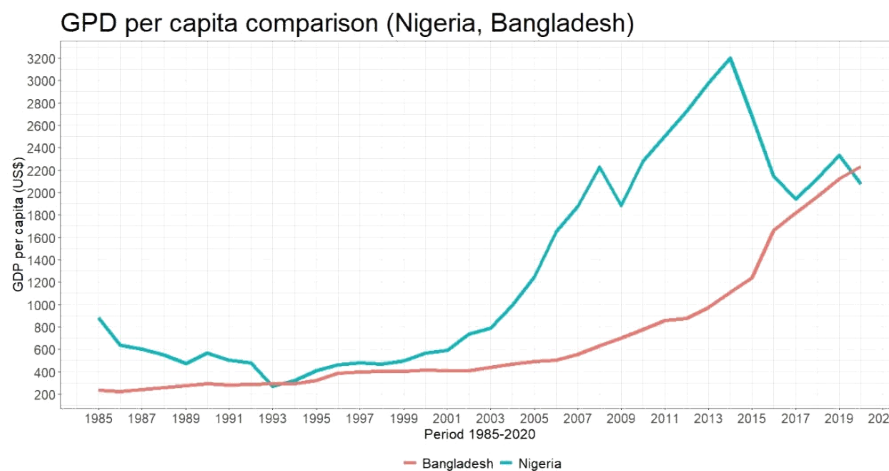


FIGURE 3: Changes in GDP per capita in Nigeria and Bangladesh between 1985 and 2020.

Bangladesh has made significant progress in reducing its maternal mortality ratio since 1985. In 1985, the maternal mortality ratio in the country stood at 907 maternal deaths in 100,000 live births, however, the country has recorded an 86.4% decline in maternal mortality with a ratio of 123 maternal deaths per 100,000 live births in 2020 [7]. According to a study conducted by El Arifeen et al [10], Bangladesh was able to achieve similar levels of reduction in maternal mortality in both rural (39% decrease) and urban settlements (41% decrease).

They also succeed in significantly cutting the direct causes of maternal mortality (eclampsia by 50%, haemorrhage by 35%, obstructed labour by 26%, and abortions by up to 80%).

**Determinants of Maternal Mortality in Nigeria**

Some of the major avoidable factors identified by Ozumba and Nwogu-Ikojo [11] were delay in seeking care, financial constraints, delay in recognizing a problem, lack of blood for transfusion, lack of drugs, and industrial strike action by health workers.

Onwuhafu et al [12] studying the determinants of maternal mortality in Ahmadu Bello University Teaching Hospital between 1990 to 1997, pointed out that nulliparity carried the greatest risk of maternal death which was almost double the average. They also added that being unbooked (having not been to any antenatal clinic session with a trained professional before being presented in labour) was a major predictor of maternal mortality. Complications from unsafe abortions were also implicated as a predictor of maternal mortality in the study. Umeora et al [13] in their analysis of maternal mortality in rural Nigeria, reported that an overwhelming majority 81.2% of maternal deaths were recorded in women of lower socioeconomic status. This is a worrying statistic because, in 2022, the Nigerian National Bureau of Statistics reported that 40% of the total population is classified as being poor according to the 2018/2019 national monetary poverty line, and 63% of the population is multidimensionally poor according to the National Multidimensional Poverty Index 2022 [14]. Poverty in Nigeria is disproportionately distributed with a significantly higher percentage in rural settlements.

The sociocultural determinants listed above can be categorized into three overarching themes, that indirectly affect maternal mortality rates, such as:

Government expenditure on health affects access to health care services, health commodities and availability of skilled health workers.

Adolescent fertility rate which reduces the age of first pregnancy, constituting a great risk of maternal death.

Female literacy and female school enrolment which affects the healthcare-seeking behaviour of pregnant women. It also has an impact on the socioeconomic status of the women which is another risk for maternal mothers.

**METHODS**

This study contains an ecological examination of both countries, with a focus on comparing trends in government

health expenditure on health, adolescent fertility rates, female secondary school enrolment rates, and female literacy rate, and their impact on the maternal mortality ratio in both countries between 1985 and 2020. Both countries, Nigeria and Bangladesh, are comparable as they are both lower-middle-income countries with similar GDP per capita. The data for this study is sourced from the Global Health Observatory data repository and the World Bank Open Data. The datasets have been assessed to be valid and comparable for both countries. A linear regression examination was performed on the data to define the impact of changes in the independent variable (determinants) on the dependent variable (maternal mortality ratio).

The statistical analysis is performed using R programming language on R studio and the regression model adopted is presented in the equation below:

$$MMR = \alpha + \beta x$$

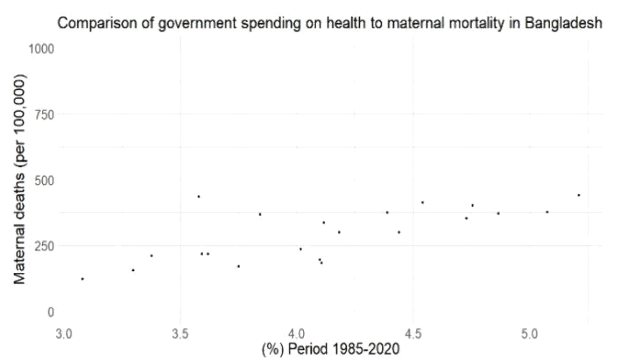
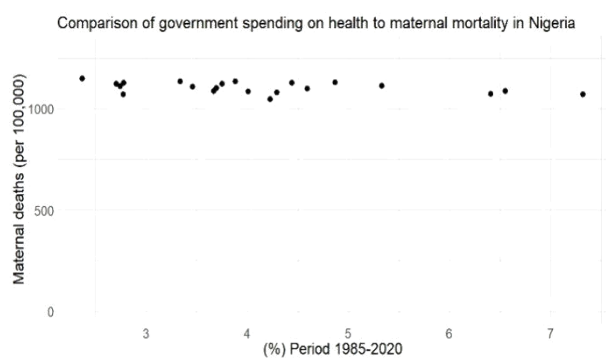
Where  $\alpha$  is the intercept on the y-axis and  $\beta$  is the slope of the correlation line.  $x$  is the independent variable being compared with the maternal mortality ratio. Therefore, when  $x = 0$ , it is expected that MMR is equal to where the trend line intercepts the y-axis.

**RESULTS**

**Percentage of Government Health Expenditure**

The percentage of government total expenditure on health in Nigeria shows a moderate negative Pearson correlation with a wide 95% confidence interval (Pearson correlation = -0.45, p-value = 0.04, 95% CI= -0.74 - -0.02), when compared to maternal mortality ratio.

An interpretation of the wide confidence interval may be that government expenditure alone may not be an appropriate predictor of maternal mortality ratio in a country. This assertion is backed up by the experience from Bangladesh where it appears as though an increase in government expenditure on health causes the maternal mortality ratio to increase (Pearson correlation = 0.71, p-value = 0.00028, 95% CI= 0.41 - 0.88).

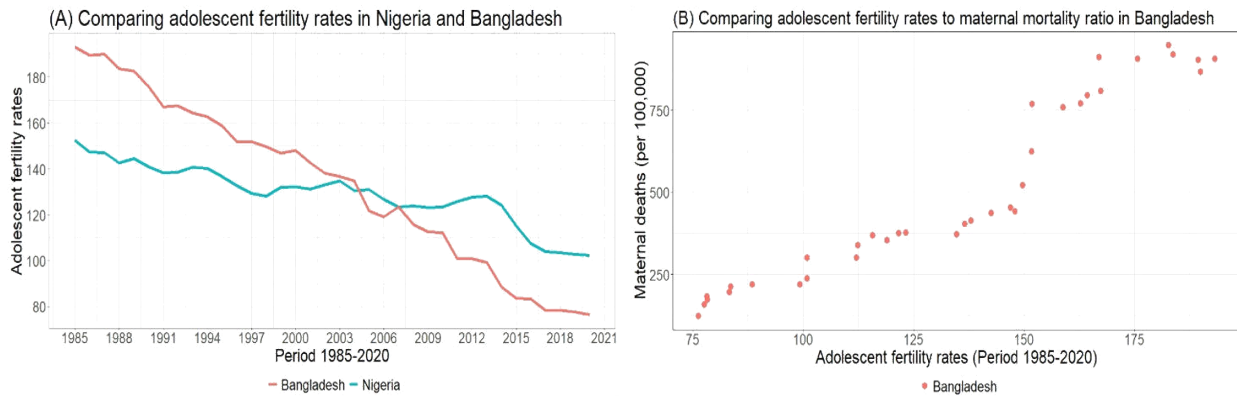


**FIGURE 4:** Comparing government spending on health (percentage of total spending) to maternal mortality in Nigeria and Bangladesh between 1985 and 2020.

**Adolescent Fertility Rates**

A Pearson correlation analysis showed a very strong positive correlation between the decline in adolescent fertility rates (births per 1,000 women aged 15-19) and maternal mortality (Pearson correlation = 0.95, p-value = 2.2e-16, 95% CI = 0.91 - 0.98).

Running a linear regression analysis to compare adolescent fertility rate to mortality rates in Bangladesh showed that for every unit decline in adolescent fertility rate, there was a commensurate decline in maternal mortality rates of 7.16 deaths per 100,000 live births.

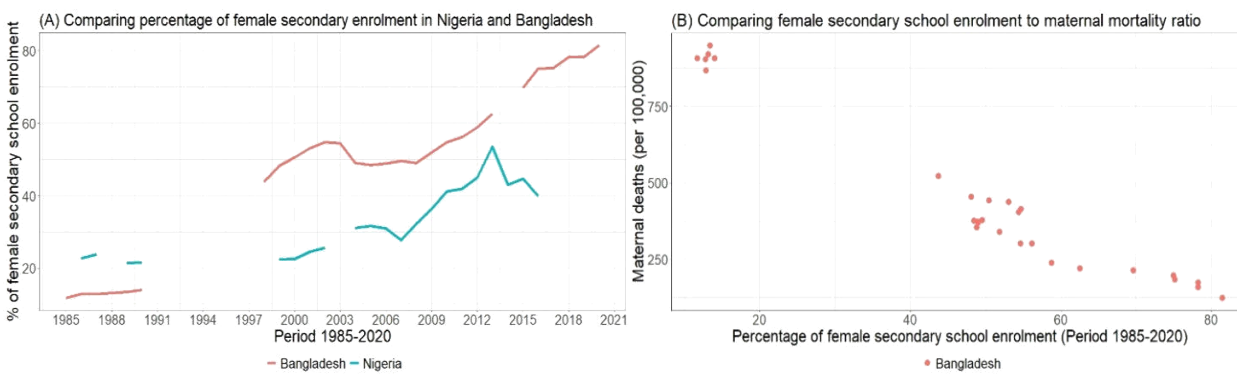


**FIGURE 5:** Adolescent fertility rates (births per 1,000 women aged 15-19).  
 (A) Comparing changes in adolescent fertility rates in Nigeria and Bangladesh between 1985 and 2020.  
 (B) Comparing adolescent fertility rates to maternal mortality ratio in Bangladesh between 1985 and 2020.

**Female Secondary School Enrolment**

From the data reported from Bangladesh, there was a very strong negative correlation between female secondary school enrolment and maternal mortality ratio (Pearson correlation = -0.98, p-value = 2.2e-5, 95% CI = -0.99 – -0.95).

A linear regression analysis suggests that for every unit increase in female secondary school enrolment, there was an 11.95 decline in the maternal mortality ratio (p-value = 2.2e-16, 95% CI = -13.03 – -10.87).

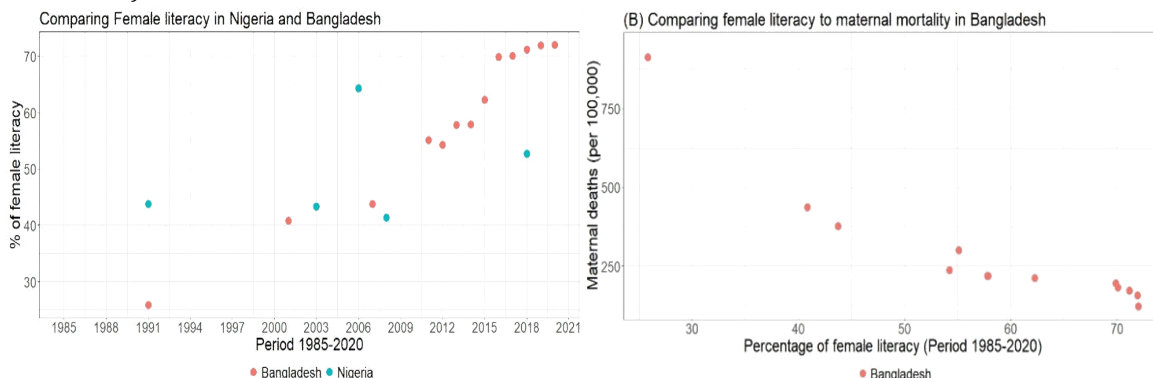


**FIGURE 6:** Percentage of female secondary school enrolment.  
 (A) Comparing changes in percentages of female secondary school enrolment in Nigeria and Bangladesh between 1985 and 2020.  
 (B) Comparing female secondary school enrolment to maternal mortality ratio in Bangladesh between 1985 and 2020.

**Female Literacy**

A similar negative correlation was observed for female literacy and maternal mortality (Pearson correlation = -0.91, p-value = 1.8e-16, 95% CI = -0.97 – -0.71). And a 13.211 decline in the maternal mortality ratio for every unit increase in female literacy (p-value = 1.8e-16, 95% CI = -17.26 – -9.16).

As of 2018, the female literacy rate in Nigeria stood at 52.66% compared to 70% in Bangladesh and school enrolment in Nigeria was 42% compared to 78% in Bangladesh.



**FIGURE 7:** Percentage of female literacy.  
 (A) Comparing changes in percentages of female literacy in Nigeria and Bangladesh between 1985 and 2020.  
 (B) Comparing female literacy to maternal mortality ratio in Bangladesh between 1985 and 2020.

**DISCUSSION**

From the data presented above, it can be empirically argued that increasing government expenditure on health alone is an unreliable predictor for a decline in maternal mortality in a country. This is because there appears to be other sociocultural determinants that stop mothers from seeking quality care during pregnancy, delivery, and following delivery.

It can also be deduced that the Bangladeshi government has been able to significantly cause a decline in maternal mortality with fewer resources (or reallocated resources). It also highlights the need to adopt a multi-sectoral approach and a big-picture way of thinking to address maternal mortality.



There is also the ever-present possibility that there are other confounding variables that played a crucial role in securing this victory that are yet to be identified. This study however will focus on examining the impact of changes in some selected determinants of maternal mortality on the maternal mortality ratio in Bangladesh.

Reduction in fertility in adolescents had a very significant correlation with a decrease in the maternal mortality ratio. This is unsurprising as nulliparity and age of first pregnancy are known predictors of maternal mortality, especially in the absence of quality maternal health care.

Access to education and an increase in female literacy rates was closely associated with a decline in maternal mortality. This can be explained by the phenomenon where educated women are more likely to recognize medical complications and seek medical attention earlier than uneducated women. School enrolment also has the indirect effect of delaying the age of first pregnancy. Increasing literacy rates among women increases knowledge and awareness of modern and safe reproduction practices that contribute to an improvement in maternal health such as contraceptive use and ideas of gender equality, and abortions. These result in a reduction in fertility rates which also reduces the risks associated with pregnancy.

There is also the long-term benefit of improvement in female fertility rates as it results in the improvement of the economic conditions of households and a reduction of poverty rates which also reduces the maternal mortality rates.

#### CONCLUSION

For Nigeria to meet the 2030 SDG 3 target of reducing the maternal mortality ratio in the country to 70 maternal deaths per 100,000 live births, from a staggering 1,047 death per 100,000 live birth, the country will need to avert 98 maternal deaths per 100,000 live births every year. This amounts to an annual reduction of 9.3%. Nigeria is currently not on track to meet this target and the current efforts employed to address this challenge are being diluted by a plethora of sociocultural challenges that must be addressed for any significant progress to be observed.

Bangladeshi stakeholders appear to have understood the dynamics between the usually forgotten sociocultural determinant of maternal mortality and how they amplify the proximal determinants of maternal mortality. This led to efforts to address the underlying causes of maternal mortality such as adolescent pregnancy, female secondary school enrolment and female literacy rates. The impact of these improvements is strongly associated with the almost miraculous decline in the maternal mortality rate in the country.

It is, therefore, the recommendation of the author that policymakers in Nigeria shift focus and adopt a broader view of the sociocultural determinants of maternal mortality.

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