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## Trends in Correlates of Cesarean Section in Bangladesh: Insights from BDHS 2007–2017

Jahida Gulshan  
Priom Saha

2024 No. 204

September 2024

This document was produced for review by the United States Agency for International Development.

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DHS Working Papers No. 204

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Insights from BDHS 2007–2017**

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September 2024

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The authors would like to thank the United States Agency for International Development (USAID) for funding this research through the Demographic Health Survey (DHS) Program. Participating in the DHS Fellows Program 2024, which was implemented by ICF, was a great privilege. We extend heartfelt gratitude to the facilitators of the DHS Fellows Program, Drs. Sara Riese, Elma Laguna, and Azaz Bin Sharif, for providing in-depth training and supervision throughout this research process.

This research would not have been shaped as it appears now without the suggestions and comments of the reviewers (Drs. Rose Donohue and Rashida Begum) and the editors and formatters of ICF. We also would like to thank Olsen Hanner for the logistic support. Finally, we offer special appreciation to Institute of Statistical Research and Training, University of Dhaka, which allowed two faculty members from the same department to be released, time to time, from academic responsibilities to participate in the 2024 DHS Fellows Program.

This study was conducted with support from USAID through The DHS Program (#720-OAA-18C-00083). The views expressed are those of the authors and do not necessarily reflect the views of USAID or the United States Government.

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Editors: Diane Stoy and Greg Edmondson

Document Production: Natalie Shattuck, Joan Wardell, and Chris Gramer

Recommended citation:

Gulshan, Jahida, and Priom Saha. 2024. *Trends in Correlates of Cesarean Section in Bangladesh: Insights from BDHS 2007–2017*. DHS Working Papers No. 204. Rockville, Maryland, USA: ICF.

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## ABSTRACT

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Cesarean section (CS) delivery is one of the life-saving medical practices that save the lives of both mothers and newborns. However, non-medically indicated CS may have a long-term effects on both maternal and child health. In Bangladesh over the last three decades, the percentage of CS has increased almost 15-fold. Studies have described sociodemographic, maternal, child, and community factors that may affect CS delivery. In this study, trends in CS in Bangladesh from 2007 to 2017 and the correlates of CS were analyzed with data from Bangladesh Demographic and Health Surveys. The results showed that from 2007 to 2017, the adjusted odds ratio (AOR) for higher education in CS delivery decreased from 4.6 to 1.8, which indicated reduced differences in the odds of CS among women with the highest and lowest education levels. The adjusted odds ratio for the richest wealth quintile peaked at 5.3 in 2011 but fluctuated and showed the richest-poorest gap narrowing to 3.3 by 2017. Unemployed mothers had a 30% lower odds of CS in 2017, but were insignificant in the previous years. In all four surveys, birth order consistently showed lower odds (AOR<1) of CS delivery for the second and third child, as well as obese mothers and mothers who have children at older age being more prone to having CS deliveries. In addition, the AOR for maternal age at first birth over age 25 decreased from 5 in 2007 to 3.1 in 2017. The AOR for 4+ antenatal visits dropped from 3.2 in 2007 to approximately 2 in 2017. A geospatial variation of the CS trends was also observed across eight divisions of Bangladesh over the four surveys, with Dhaka consistently higher until 2014, and Khulna increasing to 1.7 by 2017. Mass awareness, as well as government and nongovernmental interventions, are necessary to reduce the number of CS deliveries in Bangladesh.

**Key Words:** pregnancy, cesarean section, correlates, BDHS, Bangladesh



# 1 INTRODUCTION

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Pregnancy often presents challenges and complications that require careful consideration to ensure the well-being of both the mother and the child. In such situations, cesarean section (CS) delivery has emerged as a crucial medical intervention that offers a lifeline for mothers and infants.<sup>1-3</sup> Although CS has played a pivotal role in reducing maternal mortality over the last few decades around the world, CS without proper indication and justification has adverse consequences that lead to increased maternal and neonatal mortality and morbidity.<sup>4-9</sup> The global rate of CS delivery has risen steadily and reached 21.1% of all births in 2015, with an average annual increase of 3.7% from 2000 to 2015.<sup>10</sup> This increase can be attributed to factors such as the perceived safety of CS by both healthcare providers and patients, medico-legal concerns, and an array of maternal risks that include obesity, mother's age, and pre-existing medical conditions.<sup>11-12</sup> According to the World Health Organization (WHO), a global CS delivery rate of 10 to 15% is deemed acceptable, with rates that surpass 15% considered medically unjustified.<sup>13-14</sup> Despite these guidelines, the rate of CS deliveries has been on a steady rise in Bangladesh from 17.7% in 2012 to 35.4% in 2019.<sup>15-16</sup> Understanding the intricate dynamics that are driving the surge in CS deliveries is paramount to mitigating this increasing prevalence and optimizing maternal and infant health outcomes.

Factors that have contributed significantly to the surge in elective CS deliveries around the world include personal preferences that are influenced by the fear of childbirth pain, perceived inadequacy of care, and women with prior CS deliveries.<sup>17-18</sup> In Bangladesh, the exponential increase in CS rates, from 2.7% in 2000 to 33% in 2017 underscores the urgency of addressing the determinants of this trend.<sup>16-18</sup> Although governmental initiatives aimed at improving maternal health have contributed to a reduction in maternal and infant mortalities, the unintended consequence of the increased access to comprehensive obstetric care been a surge in CS deliveries. It is imperative to discern the underlying factors driving this trend in order to implement targeted interventions that can reduce unnecessary CS deliveries and improve maternal and neonatal health in Bangladesh.

Factors that contribute to the rise in CS rates include not only medical indications, but also socioeconomic status, cultural norms, and healthcare preferences.<sup>14-19</sup> Women from higher socioeconomic backgrounds often delay childbirth, which leads to a higher prevalence of CS deliveries due to complications associated with older maternal age. Moreover, urban populations and those who use private healthcare facilities have higher rates of CS deliveries compared to their rural and public healthcare counterparts.<sup>14-26</sup>

Given the escalating rates of CS deliveries and their associated risks, this study endeavors to explore the prevalence and factors associated with the CS delivery in Bangladesh over the years. The change in CS rates and the associated factors changed over time are also studied.

## 1.1 Research Question

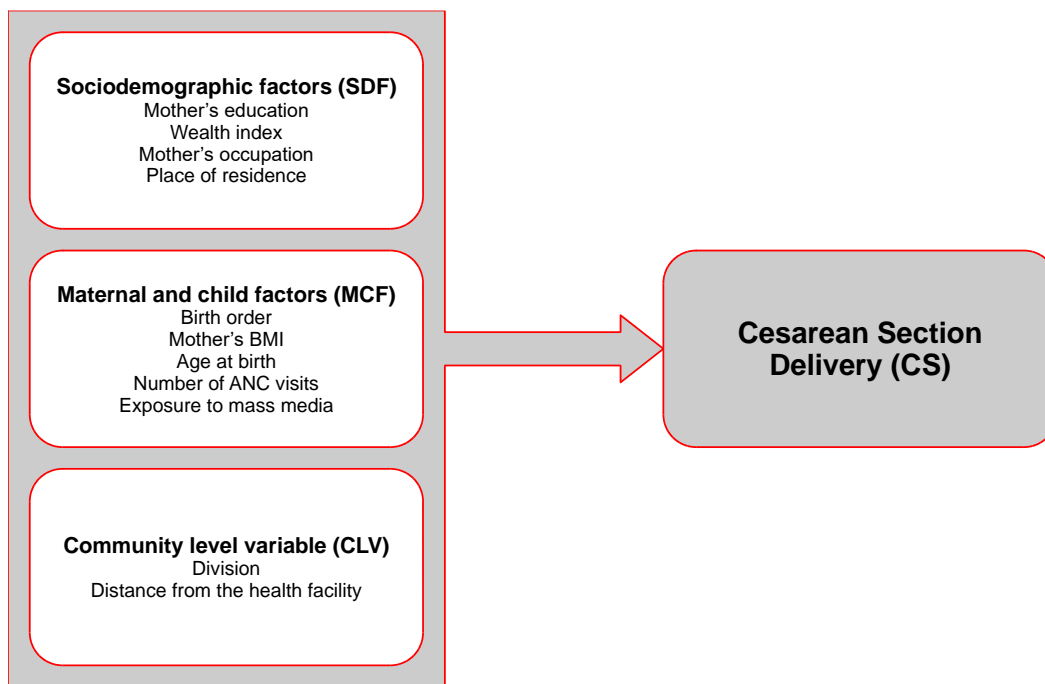
In this study, we aimed to explore the trend in the CS deliveries over the years in Bangladesh and to examine the recognizable forms or patterns in the CS deliveries. The three research questions of this study include:

- What is the trend and pattern of CS delivery in Bangladesh over the years 2007 to 2017?
- What are the associated factors that contribute to CS deliveries in Bangladesh over these years?
- Is there any change in the correlates of CS deliveries in Bangladesh over the years 2007 to 2017?

## 1.2 Conceptual Framework

The conceptual framework for this study is shown in the following diagram:

**Figure 1** Conceptual framework to identify factors that contribute to CS deliveries



## 2 DATA AND METHODS

---

### 2.1 Data

The Bangladesh Demographic and Health Survey (BDHS) datasets for the years 2007, 2011, 2014, and 2017 were used in this study. The BDHS is a national survey that is conducted periodically and designed to be representative of the population. The survey is typically conducted under the auspices of the National Institute of Population Research and Training (NIPORT), Ministry of Health and Family Welfare, in collaboration with Mitra and Associates and with funding from the United States Agency for International Development (USAID). Access to the BDHS dataset is available on the DHS program website, subject to authorization (<https://dhsprogram.com/data/available-datasets.cfm>). The BDHS data are collected with a two-stage stratified cluster sampling that gathers information from the ever-married women age between 15 to 49 de facto residents who were present in the household at the time of the survey.

The BDHS data are available from 1993 in three-year intervals with the most recent dataset available for 2017. We have used the latest four survey datasets (BDHS 2007, BDHS 2011, BDHS 2014, BDHS 2017) in this study to reflect changes over a decade. Our unit of analysis for this study is children born in the past three years with the corresponding datasets used for the analysis.

### 2.2 Variables

#### 2.2.1 Dependent variables

The main outcome variable of this study is delivery by cesarean section. This is a dichotomous variable where 0 denotes normal or vaginal delivery and 1 denotes cesarean delivery.

#### 2.2.2 Independent variables

In this analysis we have used variables that may affect the decision to have a cesarean section based on the previous literature.<sup>16,20</sup> The independent variables are broadly categorized into three groups (i) sociodemographic variables (ii) maternal and child related factors (iii) community level variables.

The sociodemographic factors (SDF) are mother's education, wealth quintile, mother's occupation, and place of residence. Mothers' education has 4 categories which are coded as no education, primary education, secondary education, and higher education. Mother's wealth quintile is coded as poorest, poorer, middle, richer, and richest. We have recoded the mother's occupation as a binary variable to observe the differences between unemployed and employed/housewife mothers. The place of residence is either rural or urban.

The maternal and child factors are birth order, mother's body mass index (BMI), mother's age at first birth, number of antenatal care (ANC) visits, and exposure to mass media.

The birth order is recoded as 1st child, 2nd child, and 3rd or greater child. Based on the World Health Organization's (WHO) definition, the BMI is recoded as underweight (BMI <18.5), normal weight (BMI 18.5–24.9), overweight (BMI ≥25.0), or obese (BMI ≥30.0). Mother's age at first birth in three categories (≥ age 18, age 19–25, or >age 25), while the ANC visit is recoded as a binary variable (<4, ≥4).

Three variables were chosen for capturing the community level variation: division, health facility accessibility, and place of delivery. There are currently eight divisions in Bangladesh, although in 2007 there were six divisions. To ensure comparability, we merged the Mymensingh Division with Dhaka and the Rangpur Division with Rajshahi, and then considered 6 divisions (Barishal, Chittagong, Dhaka, Khulna, Rajshahi, and Sylhet). Health facility accessibility is a dichotomous variable with respondents answering the question if the distance to the health facility was a big problem or not. It should be noted that it is women who report they view distance to the health facility as a serious problem when accessing health care for themselves when they are sick, and it may not be limited only to reproductive health care. To observe the differences in a public facility versus a private facility, the type of health facility was relabeled as place of delivery and then recoded as a binary variable with categories of public facility = 1 and private facility = 0. Among the community level variables, the two important variables of (i) health facility accessibility and (ii) type of health facility were dropped from our analysis to ensure comparability because the health facility accessibility data are only available in the 2017 dataset and the place of delivery was recorded for very few children in the 2007 survey.

## **2.3 Statistical Analysis**

The statistical analysis was conducted in three stages. First, weighted percentages of the background characteristics were calculated to observe the frequencies in each group (Table 1). We then conducted a bivariate analysis to identify associations between the background variables and the outcome variable (CS). We used a chi-square test of association. To determine the magnitude of the association, a multivariable logistic regression analysis was performed.

All the analyses were performed using STATA version 18.0 (StataCorp, College Station, TX, USA). STATA *svyset* command was used to address the complex survey design used to collect the BDHS data. Candidate variables for multivariable regression analysis were obtained after checking multicollinearity between independent variables with the variance inflation factor (VIF). No significant correlation was observed among the independent variables.

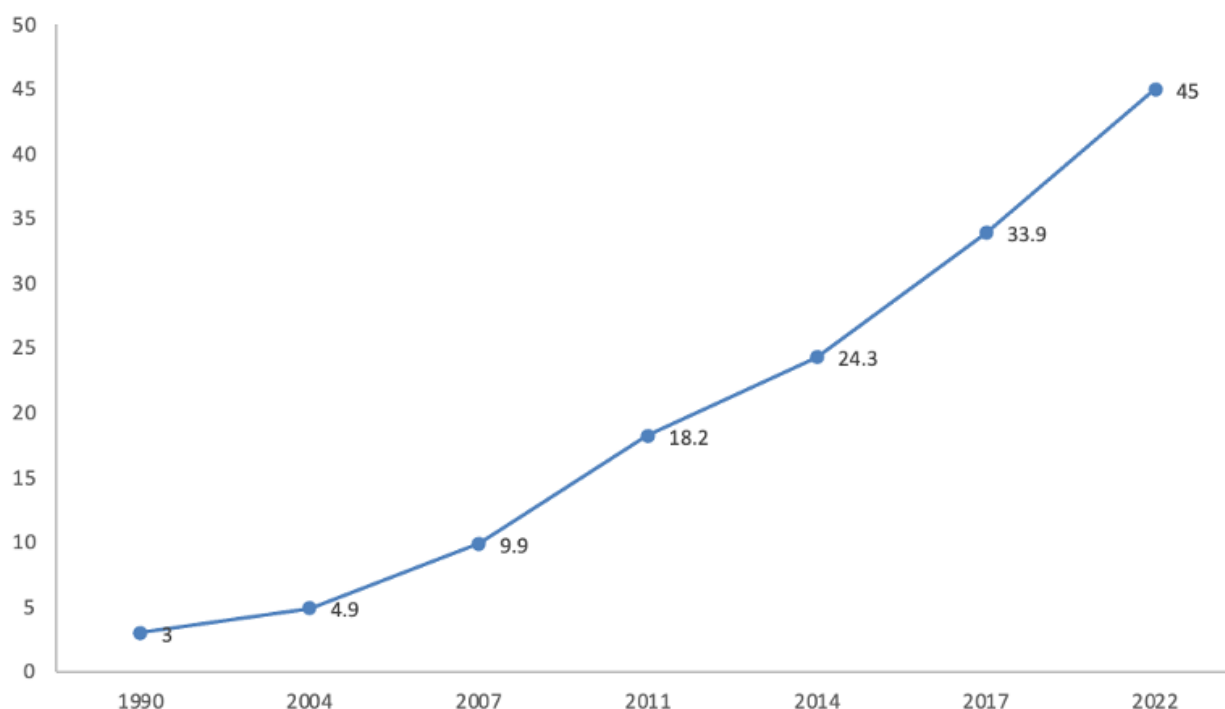


### 3 RESULTS

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The unit of analysis for this research is the children born in the three years prior to the survey date. The mothers of that child are married (BDHS only collects data from married women) and have at least one child. In this section, and throughout the paper the term “women” refers to married women with a live birth.

**Figure 2** Cesarean section trends (percentages) in Bangladesh over time in 2 years before the survey



The percentage of women having CS delivery is increasing over time in Bangladesh (Figure 2). In 1990, there were only 3% CS deliveries. This percentage has increased 15 times in three decades and was 45% in 2022, which indicates that almost 50% of the deliveries were performed by CS.

Throughout this section we provide the changes in CS trends and the corresponding changes in the covariates. The results section is divided into three sub-sections: the percentage distribution (Section 3.1), the bivariate association (Section 3.2), and the logistic regression (Section 3.3).

#### 3.1 Background Characteristics of the Analytical Sample

The percentage distribution of the background characteristics of the women with one or more live births is shown in Table 1. Results shows that the percentage of highly educated women has increased over the years. In 2007, only 43% of the women had secondary or higher education, which increased to 66% in 2017. In 2017, most respondents were rural residents (around 75%) and the employment rate was as low as 39%. The proportion of overweight and obese mothers has increased over time (9.5% in 2007, 14.6% in 2011, 17.1% in 2014, and 23% in 2017).

The percentage of ANC visits has also increased with only 20% of the mothers having 4+ ANC visits in 2007, and almost 50% in 2017. In 2007, almost half (54%) of the deliveries were performed by CS. Over the years, an increase in CS deliveries was observed in private health facilities. In 2017, almost 85% of the CS deliveries were performed in a private health facility. Accessing the health facility remains a problem in Bangladesh. Earlier surveys did not ask this question, although in 2017, almost 40% of women reported that accessing the health facility remained a problem.

**Table 1** Percent distribution of the married women with at least one birth by sociodemographic, maternal, child, and community level variables

Variables	2007		2011		2014		2017	
	Percent	Number	Percent	Number	Percent	Number	Percent	Number
<b>Sociodemographic characteristics</b>								
<b>Highest educational level</b>								
No education	26.1	1,278	19.2	1,414	14.2	649	6.3	318
Primary	30.9	1,511	30.2	2,216	28.1	1,285	27.6	1,395
Secondary	36.3	1,776	43.1	3,165	47.7	2,183	49.0	2,473
Higher	6.7	327	7.5	554	10.0	458	17.1	863
<b>Wealth quintile</b>								
Poorest	21.8	1,067	22.0	1,614	21.7	994	20.6	1,042
Poorer	21.3	1,041	20.0	1,472	18.9	866	20.5	1,035
Middle	19.0	929	19.8	1,452	19.2	877	19.2	969
Richer	19.5	956	19.7	1,450	20.6	944	20.2	1,018
Richest	18.4	899	18.5	1,362	19.5	893	19.5	985
<b>Place of residence</b>								
Urban	21.2	1,038	23.4	1,718	26.0	1,188	26.9	1,356
Rural	78.8	3,854	76.6	5,632	74.0	3,386	73.1	3,693
<b>Occupation</b>								
Unemployed	69.8	3,417		NA	74.8	3,419	60.7	3,067
Employed	30.2	1,476			25.2	1,155	39.3	1,982
<b>Maternal and child factors</b>								
<b>Birth order</b>								
1st child	32.0	1,565	33.4	2,456	39.9	1,824	38.2	1,931
2nd child	26.7	1,307	29.8	2,188	30.1	1,376	32.8	1,656
3rd child and above	41.3	2,020	36.8	2,704	30.0	1,373	29.0	1,463
<b>Mother's BMI (WHO)</b>								
Underweight	31.4	1,537	26.0	1,912	24.1	1,102	15.4	766
Normal weight	59.1	2,891	59.4	4,367	58.8	2,688	61.6	3,056
Overweight	7.5	365	10.7	783	14.7	673	18.6	924
Obese	2.0	99	3.9	288	2.4	110	4.4	218
<b>Age of respondent at first birth (years)</b>								
≤ 18	65.9	3,222	63.8	4,692	59.4	2,715	57.1	2,882
19–25	31.7	1,553	33.0	2,428	37.2	1,702	39.3	1,987
>25	2.4	118	3.1	230	3.4	158	3.6	180
<b>Number of antenatal care visits</b>								
0 to 3 visits	79.3	3,882	76.1	5,591	68.7	3,142	51.9	2,598
4+ visits	20.7	1,011	23.9	1,759	31.3	1,433	48.1	2,411
<b>Mass media exposure</b>								
Not exposed	36.8	1,801	35.2	2,587	38.3	1,752	35.7	1,788
Exposed	63.2	3,092	64.8	4,764	61.7	2,822	64.3	3,221

Continued...

**Table 1—Continued**

Variables	2007		2011		2014		2017	
	Percent	Number	Percent	Number	Percent	Number	Percent	Number
<b>Community level variable</b>								
<b>Division</b>								
Barishal	6.4	313	5.8	429	5.8	266	10.7	526
Chittagong	21.0	1,026	21.6	1,589	21.9	1,001	16.4	811
Dhaka	31.7	1,551	31.5	2,312	35.2	1,612	26.7	1,316
Khulna	10.3	502	9.7	712	8.1	369	10.4	517
Rajshahi	22.8	1,118	24.5	1,801	19.7	903	21.9	1,000
Sylhet	7.8	383	6.9	505	9.3	423	13.9	684
<b>Distance to health facility</b>								
Big problem	Not collected		Not collected		Not collected		41.1	2,078
Not a big problem	Not collected		Not collected		Not collected		58.9	2,972
<b>Place of delivery</b>								
Public facility	45.9	368	41.3	805	34.0	600	15.4	722
Private facility	54.1	434	58.7	1,143	66.0	1,168	86.6	1,812
<b>Total</b>	<b>100.0</b>	<b>4,892</b>	<b>100.0</b>	<b>7,350</b>	<b>100.0</b>	<b>4,574</b>	<b>100.0</b>	<b>5,009</b>

### **3.2 Association between CS Delivery and Women’s Sociodemographic, Maternal, Child, and Community Levels**

The bivariate association of the background characteristics with CS delivery is shown in Table 2. Chi-square test shows a significant association of the background factors with CS delivery. Cesarean section (CS) rates have been consistently increasing among higher educated women, from 38% in 2007 to nearing 60% in recent years (51% in 2011, 57% in 2014, and 60% in 2017). Similarly, the CS rates among the lower-educated women have risen from 4.1% in 2011 to 17.3% in 2017. Wealth status also reflects this trend, with rates among the richest quintile increasing from 27% in 2007 to 61.5% in 2017, and rising rates in the lower wealth quintiles as well. In addition, urban areas have higher CS rates, and unemployed women have a higher rate of CS deliveries than employed women. In 2017, nearly 40% of unemployed women had CS deliveries compared to 25% of employed women.

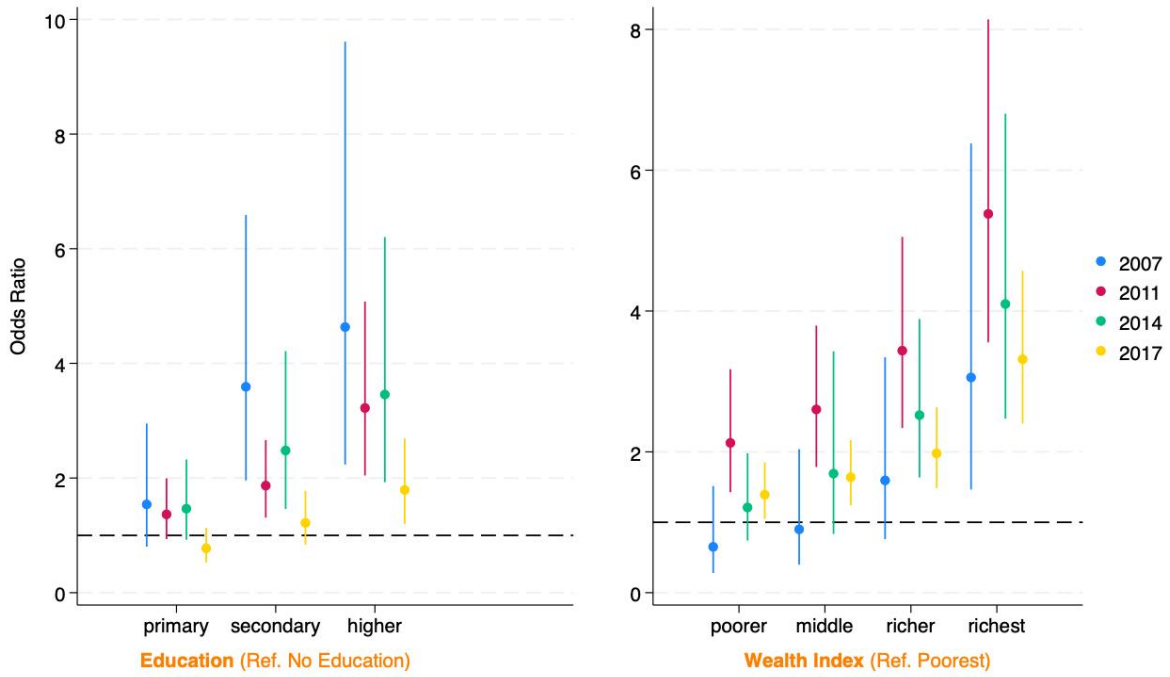
Among the maternal and child related factors, higher CS rates were found in the 1st order children (41% in 2017). The prevalence is high among obese mothers with almost 63% of obese mothers having a CS delivery in 2017. Mothers having babies at older ages are more prone to having a CS delivery. The results show that almost 70% of women age greater than 25 at first birth had CS deliveries in 2017. Significantly higher CS rates were also observed among the women with 4 or more ANC visits.

Differences in the CS rates by different divisions show the geospatial variation. The highest rates are observed in Dhaka, Khulna, and Rajshahi with almost 80% of all CS performed in private health facilities in 2017.

**Table 2 Association between women's CS delivery and sociodemographic, maternal, child, and community level characteristics**

	2007			2011			2014			2017		
	%	CI	p value	%	CI	p value	%	CI	p value	%	CI	p value
<b>Sociodemographic characteristics</b>												
<b>Highest educational level</b>												
No education	1.5	0.9,2.4		4.1	3.1,5.6		7.5	5.3,10.6		17.0	12.9,22.7	
Primary	3.0	2.2,4.0		7.8	6.5,9.4		12.6	10.2,15.3		18.0	15.7,20.8	
Secondary	13.1	11.1,15.3		18.6	17.0,20.4		29.0	26.3,31.9		35.0	32.1,36.9	
Higher	38.4	32.2,45.0	<.001	51.7	46.9,56.4	<.001	56.8	51.3,62.0	<.001	60.0	56.1,63.8	<.001
<b>Wealth quintile</b>												
Poorest	2.1	1.2,3.7		2.7	2.0,3.6		7.3	4.8,10.8		13.1	10.8,15.9	
Poorer	2.1	1.2,3.6		7.1	5.7,8.9		10.8	8.5,13.6		22.6	19.5,26.0	
Middle	3.8	2.5,5.6		12.0	10.1,14.1		19.8	16.3,23.9		31.4	27.9,35.1	
Richer	10.1	7.8,13.0		19.0	16.6,21.6		30.4	26.5,34.7		38.9	35.4,42.6	
Richest	27.2	23.9,30.8	<.001	37.5	34.0,41.0	<.001	53.3	49.2,57.4	<.001	61.5	57.9,65.0	<.001
<b>Place of residence</b>												
Urban	17.8	14.9,21.0		26.6	23.5,29.8		39.5	35.4,43.8		44.2	41.2,47.3	
Rural	6.2	5.0,7.5	<.001	11.6	10.4,12.8	<.001	18.7	16.5,21.1	<.001	29.2	26.9,31.6	<.001
<b>Occupation</b>												
Unemployed	9.6	8.2,11.2					26.1	23.6,28.6		38.2	35.8,40.7	
Employed	6.3	5.0,7.9	<.001	NA		<.001	18.4	15.4,21.7	<.001	25.4	23.1,27.9	<.001
<b>Maternal and child factors</b>												
<b>Birth order</b>												
1st child	14.9	12.8,17.3		22.3	20.4,24.3		31.8	28.4,35.5		40.9	38.1,43.9	
2nd child	9.0	7.3,11.0		15.8	13.9,17.8		24.3	21.6,27.3		34.8	32.2,37.6	
3rd child and above	3.5	2.6,4.8	<.001	8.0	6.7,9.4	<.001	13.7	11.2,16.6	<.001	21.1	18.6,23.9	<.001
<b>Mother's BMI (WHO)</b>												
Underweight	3.5	2.6,4.7		7.6	6.3,9.2		14.3	11.4,17.9		22.7	19.5,26.3	
Normal weight	8.5	7.3,9.8		13.6	12.4,14.9		22.3	20.0,24.8		29.1	27.0,31.3	
Overweight	27.2	22.4,32.6		33.2	29.1,37.5		41.5	35.6,47.7		47.3	43.6,51.0	
Obese	24.1	17.2,32.6	<.001	37.4	31.2,43.9	<.001	59.2	48.6,69.0	<.001	62.9	55.2,69.9	<.001
<b>Age of respondent at first birth (years)</b>												
≤ 18	4.6	3.9,5.6		9.5	8.5,10.7		17.2	15.0,19.6		25.5	23.5,27.7	
19–25	14.0	11.8,16.5		22.2	20.1,24.4		31.9	28.9,35.1		40.9	38.3,43.7	
>25	46.8	37.4,56.4	<.001	53.1	45.4,60.8	<.001	59.6	50.0,68.5	<.001	70.7	63.3,77.2	<.001
<b>Number of antenatal care visits</b>												
0 to 3 visits	3.9	3.2,4.6		9.5	8.5,10.5		16.5	14.5,18.8		41.0	38.3,43.7	
4+ visits	26.9	23.5,30.5		32.9	30.1,35.9		40.8	37.1,44.5		71.0	63.3,77.2	
<b>Mass media exposure</b>												
Not exposed	2.8	2.0,3.9		5.3	4.3,6.4		11.0	9.1,13.3		17.4	15.1,19.9	
Exposed	12.0	10.5,13.6	<.001	20.4	18.9,22.0	<.001	32.2	29.6,35.0	<.001	41.5	39.4,43.6	<.001
<b>Community level variable</b>												
<b>Division</b>												
Barishal	4.7	2.8,7.9		10.3	7.6,13.9		18.6	13.3,25.4		24.8	20.2,30.0	
Chittagong	7.3	5.6,9.6		12.5	10.4,15.0		19.5	15.7,23.9		26.5	22.2,31.3	
Dhaka	11.8	9.4,14.7		17.7	15.1,20.6		30.6	25.8,35.9		38.4	34.8,42.2	
Khulna	10.0	7.4,13.4		23.3	20.0,27.1		34.4	29.7,39.4		43.1	37.8,48.6	
Rajshahi	7.0	4.9,9.8		12.5	10.7,14.5		20.7	17.8,24.1		32.0	28.2,36.1	
Sylhet	5.5	4.0,7.5	<.001	12.7	9.7,16.4	<.001	11.9	9.0,15.6	<.001	23.3	18.6,28.8	<.001
<b>Distance to health facility</b>												
Big problem										28.7	26.0,31.6	
Not a big problem				NA						36.4	34.2,38.6	<.001
<b>Place of delivery</b>												
Public facility	37.4	31.6,43.7		40.9	36.9,45.0		38.4	33.4,43.6		X	32.3,40.1	
Private facility	65.4	59.5,70.9	<.001	68.1	64.7,71.2	<.001	74.6	71.4,77.5	<.001	78.3	75.8,80.7	<.001
<b>Total</b>	<b>8.6</b>	<b>7.5, 9.8</b>		<b>15.0</b>	<b>13.9, 16.3</b>		<b>24.0</b>	<b>22.0, 26.3</b>		<b>33.0</b>	<b>31.3,35.2</b>	

**Figure 3 Trends of the association of CS with education and wealth index**



**Figure 4 Trends of the association of CS with BMI and age group**

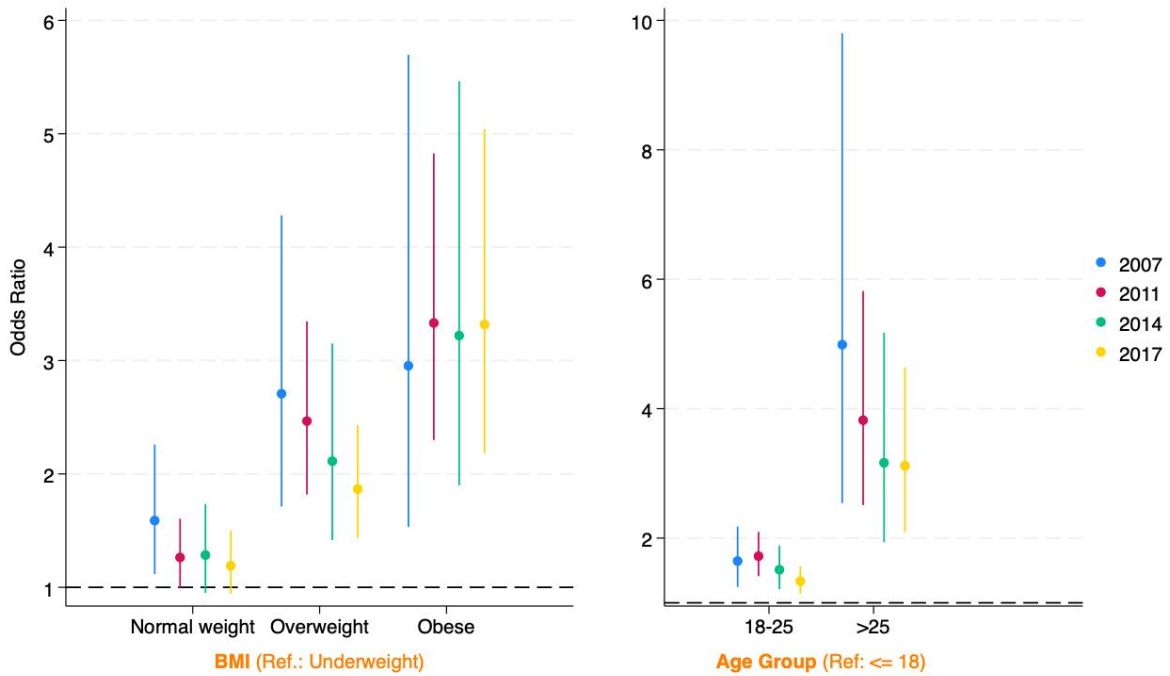
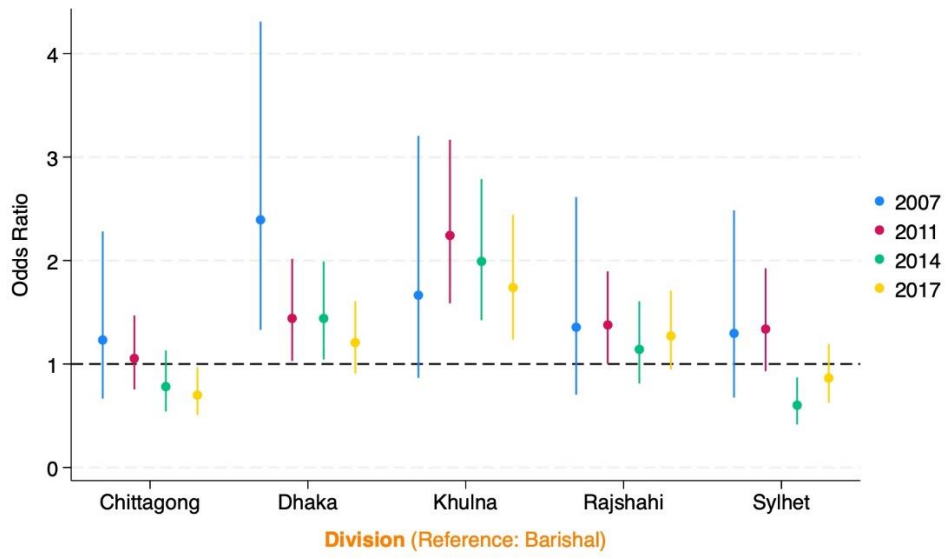


Figure 5 Trends of the association of CS with division



## 4 DISCUSSION

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The evolution of CS rates in Bangladesh reveals significant shifts in influencing factors and a narrowing gap between different socioeconomic and demographic groups. This analysis examines the trends and patterns of CS delivery in Bangladesh from 2007 to 2017, identifies factors associated with CS, and explores changes in these correlates over the years.

### **What is the trend and pattern of CS delivery in Bangladesh over the years 2007–2017?**

Over the past decade in Bangladesh, there has been a significant increase in higher education among women, with rates rising from 42% in 2007 to 66% in 2017. This period also saw an increase in antenatal care (ANC) visits, with the percentage of mothers having 4 or more ANC visits increasing from 20% in 2007 to nearly 50% in 2017 (Table 1). Unfortunately, these improvements have been accompanied by a surge in CS deliveries, particularly in private health facilities, with urban areas experiencing higher rates of CS compared to rural areas.

For example, the CS rate among women with no education rose dramatically from 1.5% in 2007 to 17.3% in 2017, while those with higher education also saw an increase from 38.4% to 60% (Table 2). Disparity in the percentage of CS based on the women's educational level was also observed in earlier studies at different survey waves, with a higher concentration among those having higher education.<sup>16</sup> The bivariable analysis indicates a significant correlation between background characteristics and CS delivery, with notable increases in CS rates among higher-educated and wealthier women over the years. Urban areas exhibit higher rates of CS deliveries compared to rural areas, with unemployed women having a disproportionately higher rates of CS deliveries compared to employed women. The increases were larger in the lower wealth/education groups, although there were lower numbers of women than in the wealthier/higher educated group.

### **What are the factors associated with CS in Bangladesh?**

Multivariable logistic regression highlighted the significant impact of higher education, wealth, and maternal factors on CS delivery. Higher education and wealth were strong predictors of increased odds of CS in 2007. Maternal factors such as obesity, older maternal age (above age 25), and having 4 or more ANC visits were also associated with higher odds of CS. For example, Kundu et al.<sup>16</sup> and Khan et al.<sup>20</sup> showed a significant disparity between the higher odds of CS among the richest group compared to the poorest group through all survey points, with a downward trend over time from 2004 to 2017.<sup>16,18</sup> Maternal and child-related factors such as being the first child, maternal obesity, older maternal age (above age 25), and having 4 or more ANC visits are associated with higher odds of CS. These findings agree with previous studies.<sup>16, 19, 20–23</sup>

Earlier studies discussed geospatial differences that reveal higher odds of CS deliveries in certain divisions such as Dhaka, Khulna, and Rajshahi, with the majority of CS procedures being performed in private health facilities. This indicated potential disparities in access to maternal healthcare services across regions.<sup>27</sup> These findings, however, were not consistent across all survey years. There was variations in which regions were significant over the years, with no region having significantly lower or higher odds than Barishal in each survey.

One study based on BDHS 2014 showed that 74% of mothers decided on CS delivery as doctors or physicians had suggested in response to complications in pregnancies such as malpresentation of the fetus (28.29%), failure to progress in labor (14.38%), and other complications (24.31%). However, analysis of the timing of the decision showed that 40.7% of CS decisions were made two or more days before the delivery date. This indicated that many CS decisions were made well before complications arose.<sup>27</sup> Another study in Bangladesh indicated that some CS deliveries were medically induced and sometimes imposed unnecessarily by medical professionals who justified the medical rationale.<sup>28</sup>

The type of place of residence was not significant in any of the regression models, although it was found significant in the bivariable analysis.

### **Is there any change in the correlates of CS in Bangladesh over the years 2007–17?**

Over the past decade, there has been a notable increase in education among women. The CS rates were higher among those with higher education in 2007. However, by 2017, the increase in education among women persisted, although the odds ratios (ORs) for higher education gradually decreased, which indicated a convergence of CS rates across different education levels. Wealth was a strong predictor of increased CS rates in 2007, but by 2017, the ORs for wealth status decreased. This dynamic suggests a complex interplay of socioeconomic factors that influence CS delivery preferences over time, with wealth initially playing a significant role in driving disparities. However, as CS rates across different wealth levels converged over the years, the ORs decreased, which reflected a diminishing difference in CS rates among wealth segments.

This period also showed a concerning escalation in the prevalence of overweight and obesity in mothers that potentially contributed to a surge in CS deliveries, which soared from around half to the majority of the deliveries between 2007 and 2017, particularly in the private health facilities. Maternal factors such as obesity and older age (> age 25) were associated with substantially higher odds of CS delivery. Across the years, maternal BMI and higher age (age 25+) at first birth were consistently correlated with higher CS rates. Although the ORs decreased over time, which suggested a diminishing impact, the gap between underweight and overweight/obese categories and age groups remained.

The significance of ANC visits in predicting CS rates diminished over time, but remained noteworthy in 2017. Geographical disparities also persisted, with Dhaka and Khulna consistently reporting higher CS rates compared to Barisal, although the gap appeared to narrow by 2017. The odds of CS in Sylhet decreased sharply to 0.6 by 2014, while Chattogram had the lowest odds of CS delivery (0.7) in 2017, compared to Barisal.

Our study adds a new dimension to the existing literature by highlighting the narrowing gap in CS delivery rates across different socioeconomic, demographic, and maternal factors in Bangladesh over the past decade. Initially, education and wealth were strong predictors of CS rates, but their impact has decreased over time, which indicated improved equity in access to healthcare services. While maternal factors such as obesity and older age consistently predicted higher CS rates, the significance of ANC visits diminished over time but remained relevant. Despite persistent geographical disparities, with some regions consistently reporting higher CS rates, the differences appeared to narrow by 2017. This suggests a trend towards more equitable healthcare access and delivery practices across diverse population groups.



## **Strengths and Limitations**

This study utilized nationally representative survey data with a large sample size to examine a unique outcome variable. The study findings are representative and can be useful for the government and the policymakers to promote policies that discourage unnecessary CS deliveries.

The limitations of this study include the data that come from previously collected secondary data, and the study's reliance on the available explanatory variables provided by the surveys. Thus, some important sociodemographic variables were not available for different waves and could not be included in the analysis.

The biggest challenge is determining if a CS delivery is warranted. For example, the increase in CS delivery among the uneducated over time might be related to improving access, while the increase among the more highly educated might be evidence of an increase in unwarranted CS. Without medical records, we cannot determine which CS deliveries were warranted.



## 5 CONCLUSION

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To address the escalating trend of unnecessary CS deliveries in Bangladesh, targeted policy interventions are crucial. These may include implementing strict guidelines for CS indications, enhancing education and awareness among healthcare providers and expectant mothers about the risks and benefits of CS versus vaginal delivery, and promoting evidence-based decision-making processes during childbirth to reduce unwarranted CS rates. In addition, ensuring equitable access to quality maternal healthcare services, particularly in underserved areas, and strengthening monitoring and oversight mechanisms can help to mitigate the rise of unnecessary CS deliveries and improve maternal and neonatal health outcomes in Bangladesh.



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