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Determinants and Geographical Distribution of Caesarean Delivery at First Birth in Bangladesh: Evidence from the 2019 Bangladesh Multiple Indicator Cluster Survey

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Abstract

Background

The prevalence of Caesarean section (CS) has increased substantially worldwide, including in Bangladesh. Evidence suggests that women undergoing CS at first birth are more likely to have repeat Caesarean deliveries in subsequent pregnancies, contributing to the continued rise in overall CS rates. This study aimed to identify the determinants of CS at first birth and examine its district-level geographical distribution in Bangladesh.

Methods

This study analyzed data from 3,180 women included in the 2019 Bangladesh Multiple Indicator Cluster Survey (MICS). The outcome variable was the mode of delivery at first birth. Explanatory variables at the individual, household, and community levels were considered. Bivariate analyses were performed to assess associations between CS and the explanatory variables, followed by multilevel logistic regression to identify factors independently associated with CS at first birth.

Results

Overall, 44.66% of first births were delivered by CS. Women aged 30 years or older, those who received four or more antenatal care visits, those delivering larger-than-average infants, and those giving birth in private health facilities had significantly higher odds of CS at first birth. Geographical analysis revealed marked district-level variation, with the highest prevalence concentrated in the Dhaka and Khulna divisions.

Conclusions

Nearly one in two first births in Bangladesh are delivered by CS, with substantial geographical disparities across districts. Advanced maternal age, delivery in private health facilities, frequent antenatal care utilization, and larger birth size were significant determinants of CS at first birth. These findings underscore the need for evidence-based clinical guidelines, strengthened monitoring of CS practices, and targeted interventions to reduce unnecessary Caesarean deliveries while ensuring equitable access to medically indicated obstetric care.

Introduction

Caesarean section (CS) is one of the most common surgical procedures aimed at preventing adverse obstetric outcomes. This surgical intervention is recommended when vaginal birth is likely to pose a risk to either the mother or the baby [1]. In 2020, per day, approximately 800, and annually, 287000 women

lost their lives during and following pregnancy and childbirth [2]. Each year, CS deliveries are estimated to prevent approximately 187,000 maternal deaths and 2.9 million newborn deaths worldwide [1, 3]. Still, in the same breath, the health of the mother and child is also at risk due to needless CS [4]. The CS rates have been increasing worldwide, with significant variations among different countries and regions. Globally, the CS rate was 18.6% in 2014 and increased to 21.1% in 2018 [5]. More than 50 countries have CS rates greater than 27% [6]. Research findings suggest that this number is set to continue increasing over the coming decade, with nearly a third (29%) of all births likely to be delivered through CS by 2030 [7]. This increasing rate is especially seen in low- and middle-income countries (LMICs). In Pakistan, the rate was 15.8% in 2013 [8] and reached 46.7% in 2017 [9]. In Nepal, the rate rose from 5% in 2011 [10] to 18.2% in 2018 [11], and in India from 11% in 2006 [12] to 31.29% in 2018 [13]. In Bangladesh, the rate of CS has increased more than eightfold from 4.5% in 2004 to 33% in 2017 [14]. According to the Bangladesh Demographic and Health Survey (BDHS), CS rates for all deliveries rose from 8% in 2007 to 23% in 2014 and 45% in 2022 [15]. The World Health Organization (WHO) published guidelines regarding CS delivery rates in 1985, revised in 1994, stating that no region should have Caesarean birth rates higher than 5 to 15% [16]. If these guidelines are considered, the global rate can be viewed as an alarming public health issue. Therefore, given several investigations into the reasons for the rising rates of CS, it is now considered an emerging ‘global epidemic.’

The CS poses significant health risks, both in the short term and long term, such as hemorrhage, uterine rupture, abnormal placentation, ectopic pregnancy, stillbirth, preterm birth, and complications in future pregnancies [17]. Emerging evidence suggests that babies born by CS have different physical and hormonal exposures, breathing problems, weaker immune development, and reduced intestinal gut microbiome diversity [17, 18]. The rise in CS deliveries reported in the literature is attributed to pregnant women's social, demographic, cultural, and economic characteristics [19, 20].

Like the overall CS rate, the rising rate of CS at first birth is also alarming worldwide. It is a crucial factor contributing to the overall increase in CS rates. Babies of second or higher birth order are less likely to be delivered by CS than first-order births [21]. In South and Southeast Asian countries, the risk of CS for the first order of birth is 2.80 to 25.56 times higher than that for the fourth order of birth [22]. In India, CS were more common among first births (24%) than higher-order births (ranging from 2% to 16%), rising from 24% to 28% in 2021. In 2001, Robson classification proposed a system that categorized women into ten groups based on their obstetric characteristics, in which he pointed out that a previous CS is an indication of further CS [23]. In this context, undergoing a CS at first birth is associated with an increased likelihood of Caesarean delivery in subsequent births. Again, CS at first birth is associated with an increased risk of adverse maternal and perinatal outcomes in the subsequent pregnancy [24]. Studies indicated that women who delivered their first child by CS may be less likely to conceive a second child in the three years following the first delivery, even 40.2% of women with a Caesarean first birth did not have a subsequent live birth [25, 26]. In Bangladesh, CS rates were also higher for first-order births (40%) than for second or third-order births (31.5%) in 2018. In 2022, the rate exceeded 50%, which is a matter of great concern [15]. Despite these growing concerns, the understanding of factors associated with CS at first birth is still lacking in Bangladesh. Furthermore, methodological issues persist in earlier research.

Most previous studies have examined the determinants of CS at first birth using logistic regression models. However, these models may have limitations in accounting for regional variations when the data exhibit clustering patterns. Moreover, there is limited evidence on spatial variations highlighting regions with relatively high or low rates of CS at first birth, in the context of Bangladesh. The conceptual framework (Fig. 1) illustrating the hypothesized relationships between key explanatory variables and CS at first birth, as well as its subsequent influence on repeat Caesarean deliveries and the overall prevalence of unnecessary Caesarean procedures. Identifying factors associated with CS at first birth may help reduce the likelihood of CS at first birth. That, in turn, lowers repeat CS, reducing the overall prevalence of unnecessary CS. Therefore, this study aims to investigate the determinants of CS at first birth and identify the districts with high and low prevalence of CS.

Methods

Study Design and Sampling Strategy

This cross-sectional study used data from the sixth round of the Bangladesh Multiple Indicator Cluster Survey 2019 (MICS-2019). The Bangladesh Bureau of Statistics (BBS) conducted this nationally representative survey in collaboration with the United Nations Children's Fund (UNICEF) Bangladesh as part of the Global MICS Program. Data collection was held from 19 January to 1 June 2019. A two-stage stratified cluster sampling approach was used to select a nationally representative sample for the whole country. At the first stage of sampling, a total of 3,220 enumeration areas (EAs) (634 in urban areas and 2586 in rural areas) were selected from a list of 293,533 EAs with probability proportional to EA size. The 2011 Bangladesh Population and Housing census frame was used to select EAs from each of the 64 districts, proportionately from rural and urban areas. In the second stage of sampling, a systematic random sampling method was used to select a fixed number of 20 households from each of the selected clusters. Among these selected 64,400 households, 64,378 women (aged 15–49 years) were successfully interviewed, yielding a response rate of 93.7%. The survey sample is representative of ever-married women across the country's eight divisions and all 64 districts. The detailed methodology of this survey has been published elsewhere [27].

Analytical Sample

The data were restricted to ever-married women who were given at least one live birth two years preceding the survey. Based on this restriction, 39,558 women with no live births were excluded. Hence, a total of 9,285 women with at least one live birth remained. Among these women, 3,215 were identified as having given birth to their first child. After adjusting for the missing data, a total of 3,180 data were analyzed. A summary of the sample selection procedure is illustrated in the flowchart shown in Fig. 2.

Outcome Variable

The outcome variable for this study was the mode of delivery at first birth. The data for this variable was collected by asking the respondents 'Was (name) delivered by Caesarean section?'. That is, did they cut your belly open to take the baby out? If respondents answered 'yes,' the variable was categorized as Caesarean delivery, while the answer 'no' indicated normal delivery.

Explanatory variables

A range of explanatory variables at the individual, household, and community levels was considered for this study. These variables were selected based on two criteria: i) Relevant published literature [19, 20, 28–31]. ii) Their availability in the MICS dataset.

Individual-level factors that were included are as follows: mother's education (pre-primary or no education, primary, secondary, and higher secondary and above), maternal age (≤ 19, 20–24, 25–29, ≥ 30), pregnancy intention status (intended, unintended), antenatal care visits (no, 1–3, ≥ 4), size of the baby at birth (larger than average, average, smaller than average). Household-level factors were treated as media exposure (not exposed, exposed) [which was measured by the frequency with which they listened to the radio, read newspapers, and watched television], place of delivery (public facilities, private facilities, and non-government organization), and wealth quintile (poorest, poorer, middle, richer, and richest). Community-level factors were place of residence (urban, rural) and division (Barishal, Chittagong, Dhaka, Khulna, Mymensingh, Rajshahi, Rangpur, and Sylhet).

It is noteworthy to mention that we considered children ever born (CEB) = 1 as a proxy of first birth. Because CEB reflects the total number of children a woman has had. Therefore, CEB = 1 was selected to represent first births, as their only child must be their first.

Statistical Analysis

Descriptive statistics were used to summarize the background characteristics of the study participants. Sampling weights were applied to ensure representativeness and to adjust for the non-proportional allocation across clusters. A bivariate analysis using the Chi-square test was performed to assess the presence of associations between CS delivery and selected explanatory variables. In the MICS data set, respondents were organized at multiple levels: respondents were nested within households, and households were nested within clusters. To adequately handle this hierarchical data structure, we employed a multilevel mixed-effect binary logistic regression model to identify the determinants of CS at first birth

We ran four models: the null model, which was run without incorporating any explanatory variables; Model 1, which incorporated the individual-level factors; Model 2, individual-level and household-level factors; and Model 3, which incorporated all the individual-, household-, and community-level factors. To measure the goodness of fit and model comparison, we further calculate Intra Class Correlation (ICC), Bayesian Information Criterion (BIC), and Akaike Information Criterion (AIC). Before fitting the models,

multicollinearity among the explanatory variables was checked using the variance inflation factor (VIF), and no significant issues were found. Divisional and districts map were created to show the geographical distribution. All analyses were conducted using Stata software version 15 and R version 4.3.3. Sampling weights were applied using the 'svyset' command in Stata.

Results

Socio-demographic and maternal characteristics of the study population are presented in Table 1. Among the 3,180 mothers, 28.68% had completed higher secondary education or above. More than half of the mothers (51.48%) were younger (≤ 19). 47.64% mothers received antenatal care 1–3 times. Mothers claimed that 70.35% babies were within the average size. About two-thirds of the mothers (65.69%) were exposed to media, and 43.33% gave birth in private hospitals. The distribution of socio-economic status was almost the same.

Characteristics	Levels	Frequency (n)	Percentage (%)
Mother's education	Pre-primary or none	115	3.62
	Primary	514	16.16
	Secondary	1,639	51.54
	Higher secondary and above	912	28.68
Maternal age (in years)	≤ 19	1,637	51.48
	20–24	1,179	37.08
	25–29	287	9.03
	≥ 30	77	2.42
Pregnancy intention status	Intended	2,680	84.28
	Unintended	500	15.72
Antenatal care visit	0	362	11.38
	1–3	1515	47.64
	≥ 4	1303	40.97
Size of the baby at birth	Larger than average	381	11.98
	Average	2,237	70.35
	Smaller than average	562	17.67
Media exposure	Not Exposed	1091	34.61
	Exposed	2089	65.69
Place of delivery	Home	1,178	37.04
	Public facility	582	18.30
	Private facility	1378	43.33
	NGO	42	1.32
Wealth index	Poorest	603	18.96
	Poorer	604	18.99
	Middle	670	21.07
	Richer	694	21.82
	Richest	609	19.15

Note: 'NGO, Non-governmental organization'

Characteristics	Levels	Frequency (n)	Percentage (%)
Place of residence	Urban	662	20.82
	Rural	2518	79.18
Division	Barishal	295	9.28
	Chattogram	640	20.72
	Dhaka	659	20.13
	Khulna	457	14.37
	Mymensingh	165	5.19
	Rajshahi	344	10.82
	Rangpur	382	12.01
	Sylhet	238	7.48
Note: 'NGO, Non-governmental organization'			

Table 2 presents the prevalence of CS at first birth by sample characteristics. The prevalence of CS was 44.66%. Mothers with higher education accounted for more than two-thirds (63.2%) of CS deliveries. Three-fourths (74.32%) of mothers aged 30 years or above delivered through CS. Mothers who were exposed to media showed a higher rate of CS delivery (48.29%). The majority of the deliveries that occurred in a private health facility were via CS (84.89%). Mothers who visited antenatal care at least 4 times and had notably high rates (60%). Mothers from the richest families (61.47%) and those residing in urban areas (53.73%) also had a higher prevalence of CS.

Table 2
Weighted prevalence of Caesarean Section delivery at firstborn children, N = 3,155

Characteristics	Levels	CS delivery (%)		*p*-values
		Yes (44.66)	No (55.34)	
Mother's education	Pre-primary or none	25.89	74.11	0.000
	Primary	27.6	72.4	
	Secondary	41	59	
	Higher secondary and above	63.2	36.8	
Maternal age (in years)	≤ 19	37.30	62.70	0.000
	20–24	47.9	51.1	
	25–29	64.77	35.23	
	≥ 30	74.32	25.68	
Media exposure	Not Exposed	29.29	70.71	0.000
	Exposed	48.29	51.71	
Place of delivery	Home	0.00	100	0.000
	Public facility	32.39	67.61	
	Private facility	84.89	15.11	
	NGO	45.43	54.57	
Pregnancy intention status	Intended	45.53	54.47	0.079
	Unintended	59.99	40.01	
Antenatal care visit	0	16.4	83.6	0.000
	1–3	37.15	62.85	
	≥ 4	60.04	39.96	
Size of the baby at birth	Larger than average	59.1	40.9	0.000
	Average	44	56	
	Smaller than average	37.51	62.49	
Wealth index	Poorest	20.09	79.91	0.000
	Poorer	37.1	62.9	
	Middle	42.77	57.23	

Note: 'CS, Caesarean section', 'NGO, Non-governmental organization'

	Richer	52.16	47.84	
	Richest	61.47	38.53	
Place of residence	Urban	53.73	46.27	0.000
	Rural	41.73	58.27	
Division	Barisal	29.34	70.66	0.000
	Chattogram	33.23	66.77	
	Dhaka	54.85	45.15	
	Khulna	61.65	38.35	
	Mymensingh	33.54	66.46	
	Rajshahi	54.15	45.85	
	Rangpur	42.89	57.11	
	Sylhet	24.89	75.11	

Note: 'CS, Caesarean section', 'NGO, Non-governmental organization'

The distribution of CS across divisions and districts is presented in Figs. 3–4, respectively. Showing a regional disparity in the utilization of CS, the exceptionally high rates (60% to 90%), were concentrated in the Khulna division, specifically in districts such as Meherpur, Chuadanga, and Jhenaidah, as well as the Dhaka division (e.g., Dhaka, Rajbari, Manikganj). Districts like Panchaghor, all districts from Sylhet, Mymensingh, and parts of Chattogram showed moderate rates between 15% and 30%, although still elevated compared to international benchmarks. Conversely, the green areas, indicating the lowest Caesarean delivery rates (0% to 15%), were predominantly found in some districts of Chattogram, such as Bandarban, Khagrachhari, Bhola, Cox's Bazar, and Rangamati.

To measure the goodness of fit and model comparison, we considered ICC, AIC, and BIC values. The model with lower AIC, BIC, and ICC values was considered a better fit for the data. In Model 0, the value of ICC was 23.53%, indicating that 23.53% of the variation in CS was attributable to differences between clusters. The ICC values gradually declined, reaching their lowest point of 8.55% in Model 3 after adjusting for all individual-, household-, and community-level factors. Again, Model 3 had the lowest AIC and BIC values. Therefore, Model 3 was selected as the final model (Table 3).

Table 3
Summary statistics of the models used to examine the relationship of CS with individual, household, and community-level factors for firstborn children

Model summary	Null model	Individual-level model	Individual and household-level model	Individual, household, and community-level model
AIC	2479.45	2394.42	1878.35	1853.08
BIC	2490.66	2461.64	1984.79	1979.33
ICC	23.53%	23.83%	13.24%	8.55%
Median Odds Ratio	2.61	2.63	1.96	1.79
Variance of the Random Intercept	1.01	1.03	0.50	0.31

Note: 'AIC, refers to the Akaike Information Criterion', 'BIC, refers to the Bayesian Information Criterion', 'ICC, stands for Intra Class Correlation'

Table 4 delineates the results of the multi-level logistic regression model used to determine the predictors of CS at first birth. According to Model 3, a gradient relationship was found between maternal age and CS, with the odds of CS increasing as maternal age increased. Compared to mothers aged 19 years or younger, those aged 25–29 years were 1.81 times (aOR: 1.81, 95% CI: 1.13–2.90) more likely to have a CS delivery, and those aged 30 years or older showed the highest odds at 3.25 times (aOR: 3.25, 95% CI: 1.43–7.37). The odds were significantly higher for those women who had received at least 4 antenatal care (aOR: 2.20, 95% CI: 1.26–3.85) compared to those with no visits at all. Similarly, first-time mothers whose baby was larger-than-average were 2.36 times more likely to undergo CS (aOR: 2.36, 95% CI: 1.48–3.76). The most important predictor of CS at first birth was the place of delivery, with private facilities showing overwhelmingly higher odds, 14.77 times (aOR: 14.77, 95% CI: 9.75–22.38) higher than the deliveries that took place in the public facilities. Lastly, mothers in the Chattogram (aOR: 0.47, 95% CI: 0.26–0.83) and Sylhet (aOR: 0.50, 95% CI: 0.25–0.99) regions were about 50% less likely to have a CS delivery compared to mothers in the Barishal region.

Table 4
Multilevel logistic regression model at the Individual, household, and community level factors that are correlated with cesarean delivery at first birth (N = 2,002)

Characteristics	Model 1 aOR (95%CI)	Model 2 aOR (95%CI)	Model 3 aOR (95%CI)
Mother's education (ref: Pre-primary or none)			
Primary	1.15(0.50–2.65)	0.68(0.27–1.75)	0.60(.23-1.54)
Secondary	1.6(0.70–3.45)	0.71(0.29–1.74)	0.59(.24-1.47)
Higher secondary+	2.37(1.06–5.32)*	1(0.4–2.50)	0.80(.31-2.01)
Maternal age (ref: ≤19 years)			
20–24 years	1.20(0.93–1.55)	1.16(0.88–1.53)	1.18(0.90–1.55)
25–29 years	2.07(1.32–3.24)**	1.81(1.13–2.91)*	1.81(1.13–2.90)*
≥ 30 years	2.80(1.28–6.10)*	3.41(1.47–7.88)**	3.25(1.43–7.37)**
Antenatal care visit (ref: 0)			
1–3	1.62(0.98–2.67)	1.43(0.82–2.48)	1.41(0.82–2.42)
≥ 4	2.60(1.56–4.35)***	2.31(1.31–4.06)**	2.20(1.26–3.85)**
Size of the baby at birth (ref: Smaller than average)			
Larger than average	2.63(1.69–4.09)***	2.53(1.58–4.07)***	2.36(1.48–3.76)***
Average	1.30(0.95–1.76)	1.18(0.85–1.64)	1.23(0.88–1.71)
Media exposure (ref: Not exposed)			
Exposed		1.36(1.01–1.83)*	1.17(0.87–1.59)
Place of delivery (ref: Public facility)			
Private facility		16.71(10.97–25.43)***	14.77(9.75–22.38)***
NGO		1.78(0.84–3.74)	1.76(0.83–3.71)
Wealth index (ref: Poorest)			
Poorer		1.54(0.96–2.48)	1.49(0.93–2.38)
Middle		1.18(0.74–1.89)	1.39(0.87–2.22)
Richer		1.07(0.67–1.69)	1.25(0.78–1.99)

Note: 'aOR, Adjusted odds ratio', 'CI, Confidence Interval', '*$p < 0.05$, ** $p < 0.01$, ***$p < 0.001$'. Model 0: Null model, Model 1: Adjusted for individual-level factors, Model 2: Adjusted for individual and household-level factors, Model 3: Adjusted for individual-, household-, and community-level factors.

Characteristics	Model 1 aOR (95%CI)	Model 2 aOR (95%CI)	Model 3 aOR (95%CI)
Mother's education (ref: Pre-primary or none)			
Richest		1.01(0.62–1.66)	1.39(0.81–2.39)
Place of residence (ref: Urban)			
Rural			1.01(0.73–1.41)
Division (ref: Barishal)			
Chattogram			0.47(0.26–0.83)*
Dhaka			1.30(0.74–2.31)
Khulna			1.11(0.63–1.98)
Mymensingh			1.68(0.76–3.69)
Rajshahi			1.18(0.64–2.17)
Rangpur			1.16(0.62–2.14)
Sylhet			0.50(0.25–0.99)*

Note: 'aOR, Adjusted odds ratio', 'CI, Confidence Interval', '*$p < 0.05$, ** $p < 0.01$, ***$p < 0.001$'. Model 0: Null model, Model 1: Adjusted for individual-level factors, Model 2: Adjusted for individual and household-level factors, Model 3: Adjusted for individual-, household-, and community-level factors.

Discussion

In this study, we comprehensively assessed the determinants of CS deliveries at first birth and identified the regions with high and low prevalence in Bangladesh, using the most recent MICS data (2019). Our study underscores an alarmingly high prevalence of CS at first birth, accounting for 44.66% of all deliveries. The prevalence we found was nearly three times higher than the WHO-recommended range (10–15%). This study also found that middle-aged (25–29) and advanced-age mothers (≥ 30) who received antenatal care at least 4 times, larger than average-size babies, and gave birth in private facilities were key determinants of utilizing CS at a higher rate. The study also found that the high-prevalence regions were most of the districts of the Khulna, Dhaka, and Rajshahi divisions. In Bangladesh, the prevalence of CS in the case of the first birth was higher (44%) than in other South Asian countries, such as India (32%), Pakistan (26.6%) [28, 32]. The rate also exceeded from developed countries such as Italy (33%) and Australia (36%) [33, 34] as well as from Egypt (33.9%), and Nigeria (3.6%) [35, 36].

As expected, our result supports the hypothesis that CS and maternal age are causally related. In our study, CS continues to rise with increasing age. Several studies also documented similar findings regarding CS at first birth and maternal age, which are completely in line with our results [37, 38]. The

consistency of these outcomes further reinforces the link between advanced maternal age and a higher prevalence of CS at first birth. Various obstetric complications, pre-existing hypertension, placenta praevia, suspected intrauterine growth restriction, and gestational diabetes all constantly increased with advanced age, making spontaneous labor impossible [39]. Actually, primiparous women experienced pregnancy and labor-related complications at all ages. However, without any indications, older mothers still face a 2.5 times increased risk of CS at first birth [40]. Consequently, maternal age alone can influence the decision of CS at the time of the first birth.

Increased surveillance and risk detection during antenatal care visits may contribute to increased CS in first-time pregnancies [41]. Although antenatal care has frequently been cited as a strong predictor of CS globally, some countries, such as Brazil and Georgia, do not support this statement [42, 43]. However, our study supports the trend, indicating that more frequent antenatal visits were associated with higher CS rates. The possible reasons are due to heightened precautionary measures taken by healthcare providers. However, in some cases, healthcare providers may influence women by presenting CS as the safer option and exploiting maternal concerns, such as fear of labor pain, to promote CS [42]. Mothers are more fearful of labor pain and bleeding, fair of vaginal area tears and ruptures at their first delivery [44]. This misleading influence during antenatal care intimidates mothers into opting for CS during their first birth.

Consistent with other studies [37, 43], we found that having a larger baby at the time of first birth is one of the important predictors of CS. The possible reasons are that first-time mothers' bodies have not previously adapted to labor, which can lead to a baby becoming wedged in the birth canal. Another explanation is that since the first-time mother's pelvis hasn't properly dilated, along with tight or tense pelvic floor muscles, it may be sized in a way that makes it more difficult for the baby to pass through, increasing the possibility of Cephalopelvic Disproportion.

As expected, our study showed that occurrences of CS were high in private healthcare facilities. A study from Turkey also found that private hospitals increase the likelihood of CS 11.25 times for primiparous mothers [45]. The increasing trend of CS rates in private hospitals is highly concerning as it raises questions about the potential overuse of medical intervention in the country. The main reason is excessive financial gain for healthcare providers and clinic owners. Clinical agents (brokers) influence patients' decisions by steering them toward private clinics rather than public hospitals. Additionally, obstetricians' lack of critical knowledge regarding the appropriate timing and indications for CS is a leading factor in this increasing trend [46]. The pervasive belief is that private hospitals offer more comprehensive emergency obstetric care and are better equipped for emergencies than public facilities. Again, the shortage of specialized healthcare providers and staff is more pronounced in public hospitals [47]. Since first-time mothers are more likely to experience complications [48], they may prefer private healthcare facilities due to the availability of better management for complications and access to specialized doctors.

Our study indicates that the utilization of CS was not uniformly distributed across regions. Due to regional differences, it is observed that districts in Khulna and Dhaka were utilizing CS more frequently. The robustness of our findings has been supported by additional study [49]. The probability of women undergoing CS increases notably with the availability of nearby health facilities, the management and infrastructure of the health facilities, and the availability and readiness to provide comprehensive care [50]. Healthcare centers in Dhaka and Khulna are better positioned in terms of facility availability, whereas Chittagong and Sylhet lag behind in this regard [51]. Another possible reason is related to the availability of sufficient healthcare providers and staff. The districts in Chittagong, especially the hill tracts, face a critical problem with the retention of specialized doctors, nurses, and staff. Meanwhile, the Khulna and Dhaka divisions are reported to have fewer vacant posts, which contributes to the higher utilization of maternity care services [52]. The lack of qualified personnel, quality services, skilled management, heterogeneous distribution of socioeconomic status, and imbalance of the health workforce are the leading causes of variability in utilizing CS across different administrative regions.

This study has several key strengths and limitations. The first strength is that this study was conducted based on a large, nationally representative dataset, which provides adequate power to investigate the determinants of CS. This study utilized advanced and suitable statistical tools for data analysis. To account for clustering and dependency problems arising due to hierarchical structure, multilevel regression models were performed, which provide the chance to adjust a range of individual, household, and community-level factors that were selected after reviewing the available literature. As a result, the study's findings are robust and should be used to inform evidence-based policy and program development in Bangladesh as well as in other LMICs. Despite these strengths, this study has some limitations, too. The major limitation of this study is that it relied on cross-sectional data. Therefore, the findings reported are correlational in nature rather than causal. Additionally, factors related to the respondents' medical history were not available in this dataset. As a result, the study was based solely on socio-demographic factors. The data were collected based on participants' self-reporting, without any opportunity for validation by interviewers, which introduces the possibility of reporting errors. Data on delivery methods were collected retrospectively, two years before the survey, which could lead to recall bias.

Conclusion

This study found that more than one-third of first births in Bangladesh were delivered by CS. The rate was particularly high in the Khulna region. The growing availability of private hospitals has contributed to a rapid rise in the prevalence of CS in Bangladesh. Middle-aged and advanced-age, receiving more antenatal care visits, and larger than average-sized babies, influence women to opt for CS. Hence, it is important to establish clear, evidence-based guidelines to ensure that decisions are made based on clinical needs rather than the sequence of birth. The government should take necessary steps to create safe and supportive environments for normal deliveries in health facilities by strengthening resources for midwives and maternal health specialists. It is essential to provide guidelines and training to healthcare professionals on when CS are medically necessary, discourage unnecessary procedures, and prioritize

maternal and neonatal health. An awareness-raising campaign about the adverse effects of CS should be implemented throughout the country, regardless of high- or low-prevalence regions.

Abbreviations

AIC
Akaike Information Criterion
aOR
Adjusted Odds Ratio
BBS
Bangladesh Bureau of Statistics
BDHS
Bangladesh Demographic and Health Survey
BIC
Bayesian Information Criterion
CEB
Children Ever Born
CI
Confidence Interval
CS
Caesarean Delivery
EA
Enumeration Area
ICC
Intra Class Correlation
LMICs
low- and middle-income countries
MICS
Multiple Indicator Cluster Survey
UNICEF
United Nations Children's Fund
WHO
World Health Organization

Declarations

Conflict of interest:

The authors declare no conflict of interest.

Ethics, Consent to Participate, and Consent to Publish declarations

not applicable.

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Author Contribution

SP: Conceptualization, methodology, formal analysis, data curation, and writing—original draft. MH: Data curation, formal analysis, and writing-original draft. MMR: Methodology, statistical analysis, and writing-review and editing. MRI: Data analysis, visualization, and writing-review and editing. MNIM: Conceptualization, methodology, supervision, validation, project administration, corresponding author, and writing-review and editing. MAR: Methodology, validation, and writing-review and editing. MRA: Data curation, visualization, and writing-review and editing. MAL: Literature review, data interpretation, and writing-review and editing. All authors contributed to the manuscript, critically revised it for important intellectual content, approved the final version, and agreed to be accountable for all aspects of the work.

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Clinical trial number: not applicable.

Data Availability Statement:

The data used in this study is publicly available from the UNICEF MICS program and can be accessed upon request via https://mics.unicef.org/

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Figures

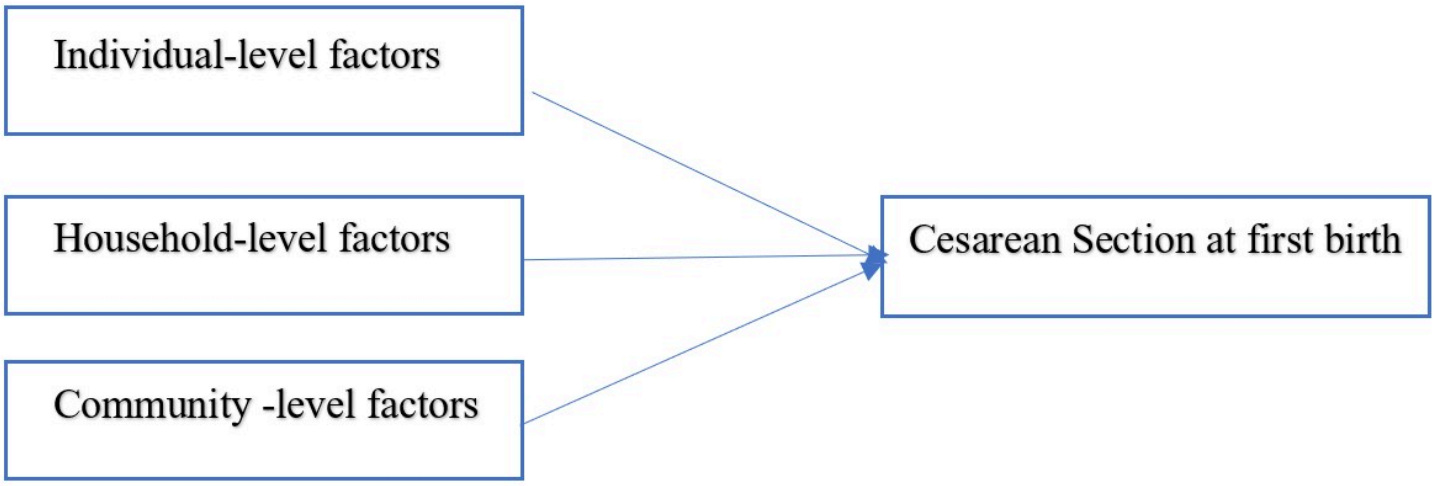


Figure 1

Conceptual framework

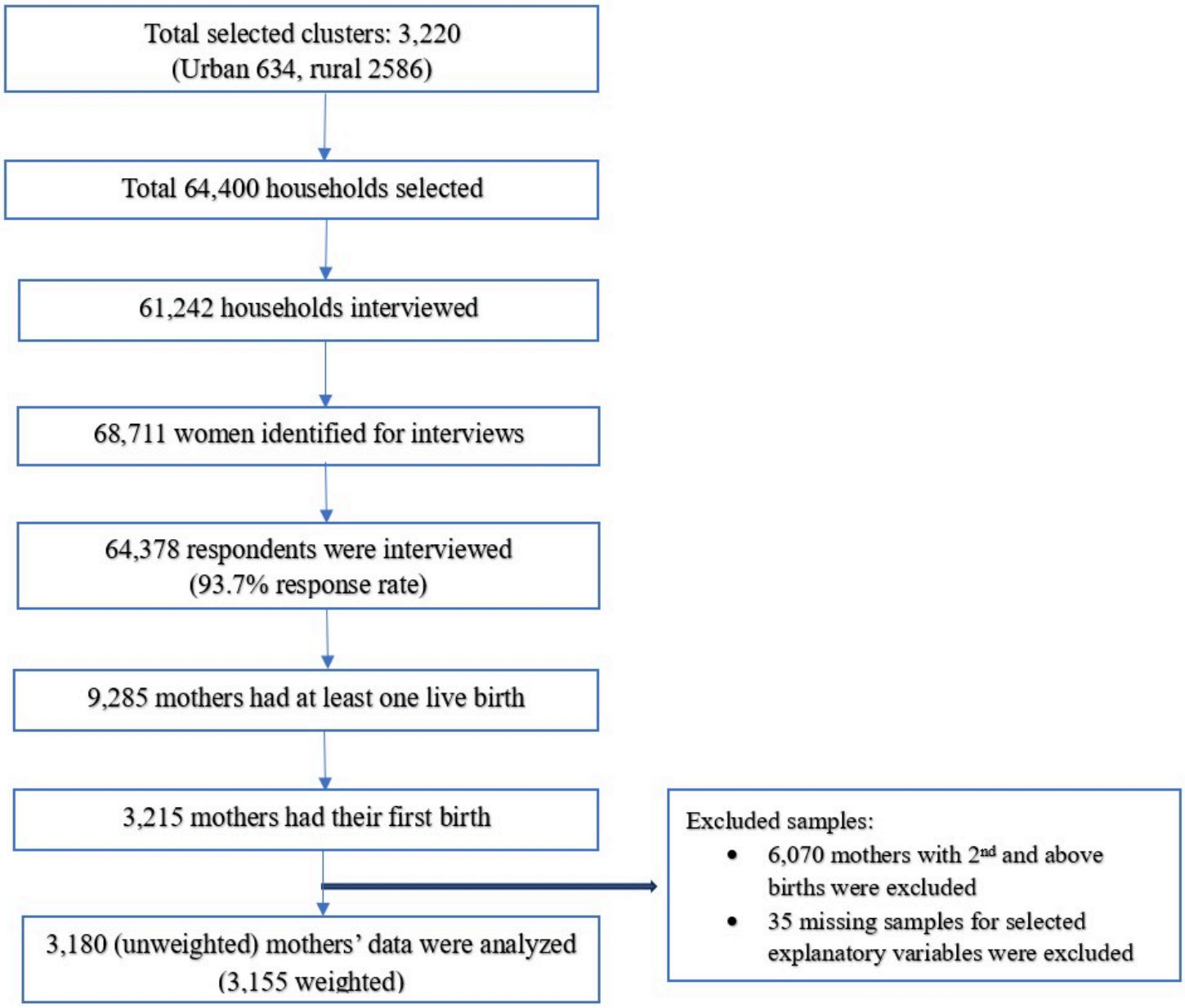


Figure 2

Sampling strategy of the MICS 2019 and sample selection procedure for this study

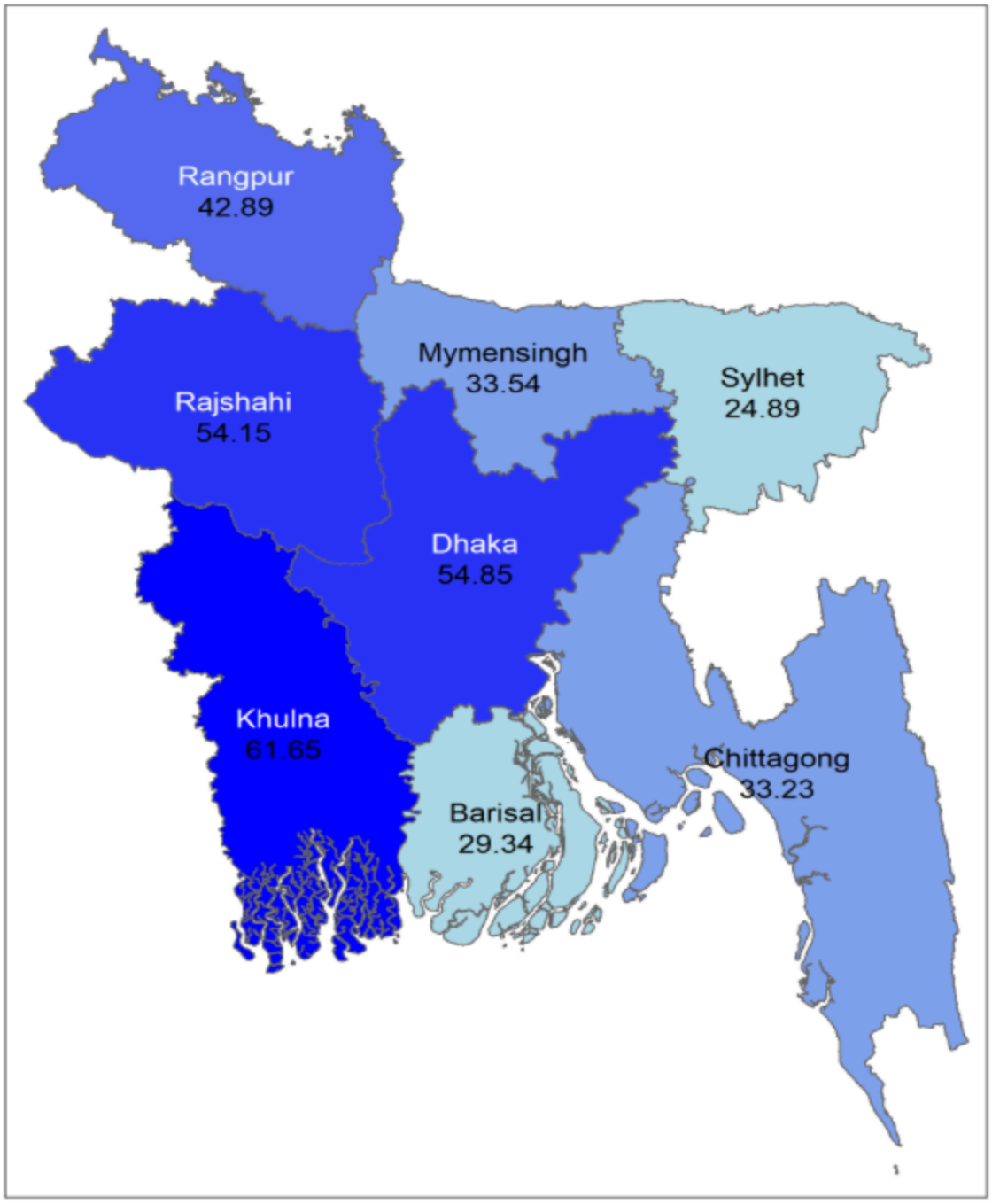


Figure 3

Divisional rate of CS at first birth

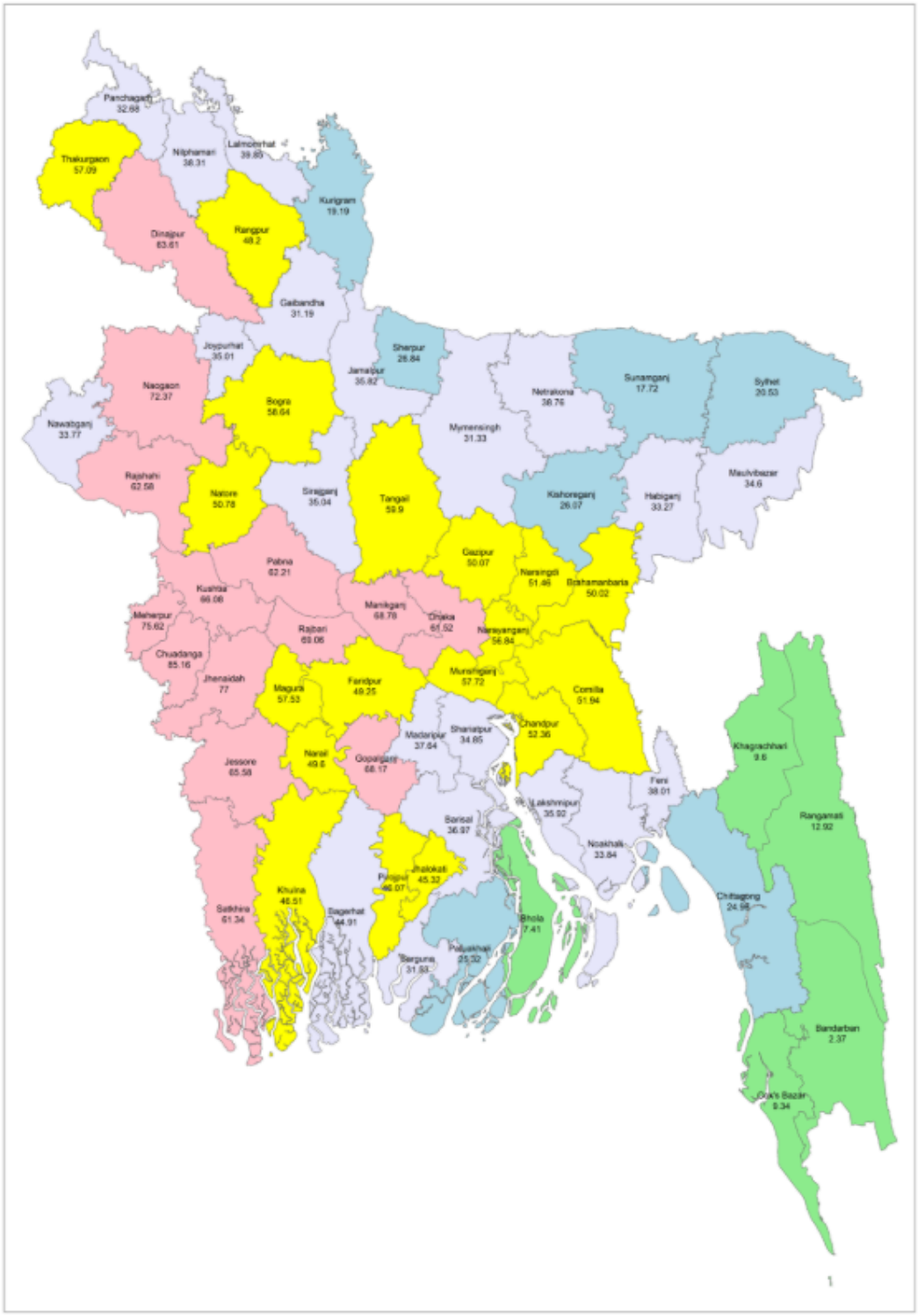


Figure 4

District-wise rate of CS at first birth