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Regional Differences and Sociodemographic Factors Associated with Cesarean Section Delivery in Bangladesh through Multilevel Poisson Regression Model

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ABSTRACT: Cesarean section is the most challenging issue not only in developing countries but also in developed countries because it is increasing at an alarming rate worldwide, where the majority of cesarean sections are unnecessary. Unnecessary cesarean delivery in Bangladesh is widespread and is responsible for long-term and short-term health complications for both mothers and children. This study aimed to assess regional differences and sociodemographic factors associated with cesarean section delivery in Bangladesh. The most recent Bangladesh Demographic and Health Survey 2017-18 data was used in this study. A total of 5,299 ever-married women who gave birth within the three years preceding the survey were analyzed. A multilevel Poisson regression model was used to identify the sociodemographic factors associated with cesarean section deliveries in Bangladesh. The prevalence of cesarean section deliveries was about 33.0%. The result showed that women's aged 30-36 years (IRR = 1.11, 95% CI = 1.01–1.22), women's secondary education (IRR = 1.52, 95% CI = 1.14–2.02), higher secondary education (IRR = 1.82, 95% CI = 1.35–2.47), partner's secondary education (IRR = 1.28, 95% CI = 1.05–1.57), higher secondary education (IRR = 1.54, 95% CI = 1.25–1.91), women living in the Dhaka division (IRR = 1.22, 95% CI = 1.04–1.43), women living in the Khulna division (IRR = 1.36, 95% CI = 1.15–1.60), and women living in the Rajshahi division (IRR = 1.26, 95% CI = 1.06–1.51), middle wealth index (IRR = 1.31, 95% CI = 1.13-1.52), richest wealth index (IRR=1.59, 95% CI=1.37-1.84) and exposure to mass media (IRR = 1.45, 95% CI = 1.27–1.64) were significantly more to deliver by cesarean section. Therefore, attention to women's age, education, partner's education, division, wealth index, and exposure to mass media might help policymakers make appropriate strategies and policies that would contribute to avoiding unnecessary cesarean section deliveries in Bangladesh.

KEYWORDS: Cesarean section, Prevalence, Incidence rate ratio, Multilevel Poisson regression model, Bangladesh.

INTRODUCTION

A cesarean section, often called a C-section or cesarean delivery, is a medical technique used to deliver a baby through a mother's abdominal incisions [1]. It can contribute to saving the lives of the mother and the infant from difficulties caused by pregnancy [2], [3]. Complications associated with pregnancy account for almost 75% of maternal deaths around the world; cesarean birth can reduce this number [4]. Worldwide, almost 287,000 maternal and 2.9 million neonatal deaths occur annually due to pregnancy disturbances, which can be minimized by cesarean delivery [5]. To remove delivery complications for women, the cesarean section is an efficient surgical treatment not only in developing countries but also in developed countries [6]. When an emergency cesarean delivery is necessary for mothers' medical treatment, it can significantly lower maternal and neonatal mortality and morbidity [7]. But unnecessary cesarean sections are negatively associated with the mother's and baby's health [8] and also hamper economic conditions [9]. The global number of deliveries via cesarean section is rising alarmingly day by day [10]. The World Health Organization (WHO) recommended that the acceptable range for cesarean deliveries should be between 10% and 15% and ought not to be lower than five percent [11]. Every year, almost 20 million newborns worldwide are delivered by cesarean section [12]. In 1990, 6.7% of deliveries worldwide were cesarean, but by 2015, that number had risen to 21.1% [13]. In Latin America and the Caribbean, the prevalence of cesarean deliveries was greater than 40%, and it was also common in Northern America (32.3%), Oceania (31.1%), Europe (25%), Asia (20%), and Africa (7.3%) [14]. Unnecessary cesarean delivery is responsible for short-term and long-term maternal and neonatal health complications [15], [16]. One of the most significant emergency obstetric care

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approaches today is a cesarean section delivery; nevertheless, it can bring higher hazards for mothers and babies compared to vaginal delivery [17]. There is about 8 times more maternal mortality and 8–12 times more maternal morbidity because of cesarean sections as opposed to vaginal delivery [18]. Delayed breastfeeding, infection, placentation, uterine rupture, cardiac arrest, abnormal placentation, venous thromboembolism, hysterectomy and injury may be caused by cesarean section delivery. Future pregnancies and long-term pain are also related to it. Cesarean delivery may result in respiratory illness, a greater likelihood of low birth weight, metabolic syndrome, asthma, diabetes, gastrointestinal disease, overweight, obesity, asphyxia, and different complications of the lungs in infants after birth [19]–[21]. In low and middle-income countries (LMIC), it may also be costly and impose a financial burden on families who are already struggling [22].

Cesarean delivery is a concerning issue in developing countries like Bangladesh. It is rising rapidly in Bangladesh [23]. The prevalence of cesarean sections has increased from 3% in 2001 to 33% in Bangladesh [24]. Around thirty days before the anticipated delivery date, the majority of women opt to deliver through caesarean section; however, this is rarely necessary. Around $483 million in 2018 was spent on medically unjustified cesarean sections in Bangladesh. Both the overall national economy and the financial status of families are severely hampered [7]. After cesarean delivery, most mothers experience a variety of health problems, and about 20% of kids are underweight and experience additional health concerns [25]. Despite the risks associated with unnecessary cesarean deliveries, very few studies on regional differences in Bangladesh have been done. The majority of the studies have identified the factors affecting cesarean delivery through binary logistic regression analysis [26], [27], [28]. This paper was to determine the regional variations and sociodemographic determinants of cesarean section delivery in Bangladesh. These results would help policymakers take the appropriate measures to reduce unnecessary cesarean section deliveries in Bangladesh.

MATERIALS AND METHODS

We utilized the most recent nationally representative Bangladesh Demographic and Health Survey (BDHS) 2017–18 data. With assistance from the United States Agency for International Development (USAID), the National Institute of Population Research and Training (NIPORT), the Medical Education and Family Welfare Division, and the Ministry of Health and Family Welfare worked together to carry out this survey. Informed consent was obtained from each participant in the DHS survey, which was authorized by the ICF Institutional Review Board (IRB). The information was obtained from the DHS program website with permission (https://dhsprogram.com/data/available-datasets.cfm). This survey was performed using a two-stage stratified sampling procedure. In the first phase of this investigation, 675 enumeration areas were chosen at random. In the second stage, 30 households were selected at random from each enumeration area. Finally, 672 enumeration areas were selected in this investigation after the removal of three areas due to flooding. A total of 20,127 ever-married women aged 15–49 were interviewed in this survey. For this study's analysis, 5299 women were used as the study sample. The outcome variable was delivery by cesarean section, which was a binary variable. It was coded 1 for cesarean delivery and 0 for non-cesarean delivery. The explanatory variables were selected based on the literature review [24], [29]–[33]. The sociodemographic variables were women's age (15–29, 30-36, 37–43, and 44–49 years), women's education (no, primary, secondary, and higher secondary), partner's education (no, primary, secondary, and higher secondary), women's occupation (agricultural worker, physical worker, service, business, and unemployed), partner's occupation (agricultural worker, physical worker, service, business, and others), division (Barisal, Chittagong, Dhaka, Khulna, Rajshahi, Rangpur, Mymensingh, and Sylhet), place of residence (urban, rural), wealth index (poorest, middle, richest), exposure to media (yes, no), and religion (Muslim, non-muslim). In order to describe the background characteristics of the study participants, descriptive statistics were used. The chi-square test was applied to determine the regional difference with the cesarean delivery. The sociodemographic factors that influence cesarean delivery were identified using a multilevel Poisson regression model. The incidence rate ratio (IRR) of the findings was presented, along with a 95% confidence interval. The STATA 13 version was used for all analyses.

RESULTS

Table 1 illustrates the study population's sociodemographic characteristics. The prevalence of women who delivered their babies via cesarean section was about 33.0%. Around 26.0% of the total respondents were aged 15–29 years, and almost 22.0% were aged 44–49 years at the time of the survey. Nearly 25.0% of total women had no education, and only 6.86% of respondents completed their higher secondary education. Nearly 11.0% of husbands of women had higher secondary education, while around 29.0% had

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none. About 42.0% of women's husbands were physical workers, while approximately 45.0% of women overall were unemployed. The majority of women (74.23%) came from rural areas, and about 24.0% lived in the Dhaka division. The maximum number of respondents (42.78%) belonged to the poorest wealth index, and nearly 37.0% were from the richest wealth index. Almost 60.0% of the total respondents had access to mass media, and nearly 92.0% followed the Muslim religion.

Table 1. Percentage distribution of sociodemographic variables of women aged 15–49 years

Covariates	Percentage	95% CI	
		Lower	Upper
Cesarean delivery			
No	67.23	65.23	69.16
Yes	32.77	30.84	34.77
Women's age			
15-29 years	26.28	25.57	27.01
30-36 years	26.79	25.92	27.68
37-43 years	24.69	23.84	25.57
44-49 years	22.23	21.38	23.1
Women's education			
No education	24.68	23.44	25.97
Primary	36.77	35.74	37.82
Secondary	31.68	30.52	32.87
Higher Secondary	6.86	6.32	7.44
Partner's education			
No education	29.16	27.74	30.61
Primary	34.06	32.95	35.19
Secondary	25.37	24.44	26.32
Higher Secondary	11.42	10.63	12.25
Women's occupation			
Agricultural worker	2.48	1.92	3.19
Physical Worker	13.21	12.18	14.31
Service	1.12	0.96	1.3
Business	38.52	36.5	40.58
Unemployed	44.67	42.61	46.75
Partner's occupation			
Agricultural worker	29.18	27.69	30.72
Physical Worker	41.36	40.06	42.67
Service	3.83	3.42	4.28
Business	22.41	21.35	23.51
Others	3.21	2.82	3.66
Division			
Barisal	5.92	5.54	6.34
Chittagong	19.62	18.72	20.55
Dhaka	23.97	22.88	25.08
Khulna	10.32	9.84	10.83
Mymensingh	8.07	7.55	8.61
Rajshahi	13.03	12.27	13.83
Rangpur	12.0	11.4	12.63
Sylhet	7.07	6.63	7.54

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Place of residence			
Urban	25.77	24.85	26.71
Rural	74.23	73.29	75.15
Wealth index			
Poorest	42.78	40.7	44.88
Middle	20.33	19.22	21.48
Richest	36.89	35.03	38.79
Exposure to media			
No	40.51	38.37	42.69
Yes	59.49	57.31	61.63
Religion			
Muslim	91.56	89.76	93.06
Non-Muslim	8.44	6.94	10.24

CI: Confidence Interval

Figure 1 demonstrates regional differences in the use of cesarean section delivery. Cesarean deliveries were more prevalent in the red area of the map and less widespread in the green area. The prevalence of cesarean delivery in the Dhaka division was higher than in other regions (19.7%). In comparison to other regions, the Barisal division had a lower rate of cesarean deliveries (8.62%).

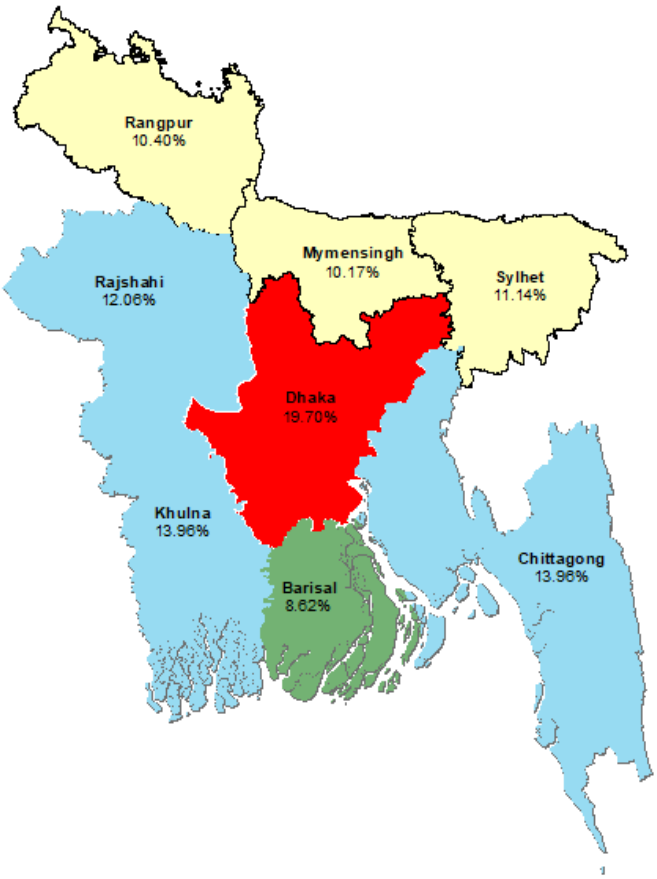

Figure1. Prevalence of cesarean section delivery by division

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The multilevel Poisson regression model's findings showed that women's age, women's education, partner's education, division, wealth index, and exposure to mass media were significantly associated with cesarean section delivery. Women aged 30-36 years were 1.11 times more likely to have cesarean delivery (IRR = 1.11, 95% CI = 1.01–1.22) compared to women aged 15–29 years. Women with higher secondary education were 1.82 times more likely to deliver by cesarean section than uneducated women (IRR = 1.82, 95% CI = 1.35–2.47). Women whose husbands completed higher secondary education were 1.54 times more likely to undergo cesarean than women whose husbands had no education (IRR = 1.54, 95% CI = 1.25–1.91). Women living in the Dhaka division (IRR = 1.22, 95% CI = 1.04–1.43), Khulna division (IRR = 1.36, 95% CI = 1.15–1.60), and Rajshahi division (IRR = 1.26, 95% CI = 1.06–1.51) were more likely to deliver by cesarean section compared to women living in the Barisal division. Women who came from the richest wealth index were 1.59 times more likely to have cesarean delivery (IRR=1.59, 95% CI=1.37-1.84) women who came from the poorest wealth index. Women who had access to mass media were 1.45 times more likely to undergo cesarean delivery (IRR = 1.45, 95% CI = 1.27–1.64) than women who had no access to mass media.

Table 2. Results of Multilevel Poisson regression model on cesarean delivery

Covariates	IRR
Women's age	
15-29 years	1.00
30-36 years	1.11 (1.01-1.22) *
37-43 years	1.12 (0.92-1.36)
44-49 years	1.14 (0.40-3.23)
Women's education	
No education	1.00
Primary	1.05 (0.79-1.40)
Secondary	1.52 (1.14-2.02) **
Higher Secondary	1.82 (1.35-2.47) ***
Partner's education	
No education	1.00
Primary	1.09 (0.90-1.33)
Secondary	1.28 (1.05-1.57) *
Higher Secondary	1.54 (1.25-1.91) ***
Women's occupation	
Agricultural worker	1.00
Physical Worker	0.88 (0.49-1.59)
Service	1.15 (0.63-2.08)
Business	0.84 (0.48-1.50)
Unemployed	1.13 (0.63-2.01)
Partner's occupation	
Agricultural worker	1.00
Physical Worker	1.01 (0.87-1.18)
Service	1.10 (0.92-1.31)
Business	1.03 (0.88-1.20)
Unemployed	0.97 (0.68-1.38)
Division	
Barisal	1.00
Chittagong	0.86 (0.71-1.03)
Dhaka	1.22 (1.04-1.43) *
Khulna	1.36 (1.15-1.60) ***
Mymensingh	1.08 (0.89-1.30)

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Rajshahi	1.26 (1.06-1.51) *
Rangpur	1.14 (0.95-1.37)
Sylhet	0.94 (0.78-1.15)
Place of residence	
Urban	1.00
Rural	0.97 (0.89-1.07)
Wealth index	
Poorest	1.00
Middle	1.31 (1.13-1.52) ***
Richest	1.59 (1.37-1.84) ***
Exposure to media	
No	1.00
Yes	1.45 (1.27-1.64) ***
Religion	
Muslim	1.00
Non-Muslim	1.10 (0.97-1.26)

IRR: Incidence rate ratio
***P<0.001
**P<0.01
*P<0.05

DISCUSSION

This study was to identify regional variations and sociodemographic risk factors of cesarean section delivery based on the recent nationally representative Bangladesh Demographic and Health Survey 2017–18 data. The prevalence of cesarean delivery (32.77%) is increasing alarmingly day by day, and it has already crossed the WHO recommended rate (10% to 15%). In 2000, the rate of cesarean delivery was only 2.37% in Bangladesh; now it is higher than in neighboring countries, e.g., India (14%), Pakistan (14%), and Nepal (4%), and developed countries such as England (9%), Sweden (8.6%), and Norway (17.1%) [23]. This study revealed that women's age was significantly related to cesarean section delivery in Bangladesh. Older women were more likely to have cesarean sections than young women. This result was consistent with another study conducted in Jerusalem [34]. Women who are young face pregnancy-related complications and are not able to deliver a baby easily. Women under 18 years old are more responsible for preterm labor than older women. Young women often suffer from urinary tract infections, which can lead to preterm birth [35]. Also, older women, especially those aged 35 or more, were more likely to die because of obstetric complications than women aged 25–29. Women who are older suffer from severe complications of pregnancy such as gestational diabetes, placenta previa, postpartum hemorrhage, pulmonary embolism, and preeclampsia, which are responsible for caesarean delivery [36]. It is suitable for women to become pregnant between the ages of 20 and 35, which may be vital for vaginal delivery [37]. Women's education was one of the most influential factors in the decision to deliver by cesarean section. Educated women were more likely to deliver by c-section compared to uneducated women. In another investigation, a similar result was discovered [38]. Educated women have sufficient knowledge about pregnancy-related complications and can detect their problems easily. Their improved autonomy and empowerment help them make decisions for cesarean delivery [24]. The majority of educated women want to delay having children, which may account for the rise in cesarean sections [39]. There was a significant association between the partner's education and cesarean section delivery. Women whose husbands were educated were more likely to have cesarean deliveries than women whose husbands had no education. A similar finding was identified in another study [40]. A husband's education is associated with employment and helps him get a better job, which contributes to increasing family income. The better economic condition of the family may be responsible for cesarean delivery because this type of family is able to pay the cost of cesarean delivery and has knowledge of obstetric complications [37]. Bangladesh has eight administrative areas; among these areas, women living in Dhaka, Khulna, and Rajshahi divisions were more likely to have cesarean deliveries than other divisions. Women from Chittagong and Sylhet divisions had lower chances of having cesarean deliveries than women from the Barishal division. The primary factors

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reducing caesarean birth rates in these regions are increased awareness of unnecessary caesarean deliveries and the advantages of vaginal birth [7]. The disparities in economic conditions, inadequate healthcare facilities, education, and a lack of communication facilities were the main reasons for regional differences in cesarean section delivery [25]. Women who belonged to the richest wealth index were more likely to deliver by cesarean section compared to women who belonged to the poorest wealth index. This finding was similar to another investigation [33]. Women who come from the richest wealth index lead comfortable lives and enjoy better facilities to survive. They fear labor pain during vaginal delivery and make the decision to deliver by cesarean section [8]. Women's exposure to mass media was identified as an influential factor in cesarean section delivery. Women who were exposed to mass media had a higher chance of having a C-section than women who were not exposed to mass media. This result was in line with another study [41]. Media exposure can play a crucial role in family planning and pregnancy-related complications, which was identified as a risk factor for cesarean section delivery [42].

The study included advantages and limitations. This study utilized a significant amount of data from the nationally representative survey. We used appropriate statistical modeling to determine risk factors for cesarean section delivery. This method provides the research study with the accurate results that are required to draw conclusions. On the contrary, recall bias was prevalent in this study as cross-sectional data were examined. Due to a lack of data, a few explanatory variables were not taken into account.

CONCLUSION

Cesarean section delivery is a concerning public health issue in developing countries like Bangladesh as it is increasing rapidly and is responsible for short-term and long-term health complications for both mothers and newborn babies when it is conducted without medical needs. Unnecessary cesarean sections cannot decrease maternal and child mortality and morbidity rather it increases maternal mortality and morbidity compared to vaginal delivery, which is widespread in Bangladesh. This study recommends that women's age, women's education, partner's education, division, wealth index, and exposure to mass media might play a crucial role in declining unnecessary cesarean section delivery. This research would also help policymakers make appropriate policies and strategies so that the cesarean delivery rate can be brought to a standard level in Bangladesh.

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