Volume 21
Number 2
Year 2019
ISSN 1529-0905

Journal of BANGLADESH STUDIES

BDI
Bangladesh Development Initiative

Cesarean Section Delivery in Bangladesh

Mohammad Mainul Islam*
Md. Zakiul Alam*
Sayema Haque Bidisha†
S. M. Abdullah†

*Department of Population Sciences, University of Dhaka, Bangladesh
Email: *mainul@du.ac.bd*
Email: *zakiul.alam@du.ac.*bd

†Department of Economics, University of Dhaka, Bangladesh
Email: *sayemabidisha@gmail.com*
Email: *abdullahsonnet@gmail.com*

Abstract

Cesarean deliveries (C-section) have continued to rise at an alarming rate in Bangladesh, a trend which may increase maternal health risks. The prevalence of C-section deliveries in an institutional setting has increased from 2.4% in 1999-2000, to 7.5% in 2007 and to 23% in 2014. This study finds that 15.3% of the C-section performed in 2014 were in the avoidable category. The bivariate analysis shows that the rate varied according to the age at first birth, division (region), place of residence, educational level, access to any media, household wealth quintile of the respondent, birth order, frequency of antenatal care visits, body mass index, and place of delivery. The analysis reveals that the rate of C-section delivery is substantially higher at private hospitals than at public facilities. Our results show that women with higher income households and higher education have a greater probability of a C-section childbirth. However, it is not only the demand side, but also the supply side issues such as the doctor's ethics or lack thereof, which may influence these trends and increase health risks for both the mother and child. These also result in an increased economic burden on the existing medical infrastructure of the country. The paper recommends creating a database for greater transparency, and other guidelines to regulate C-section deliveries in the country.

1 Introduction

Cesarean delivery (C-section) is a major surgical procedure which needs sound medical justification based on the maternal and child health. According to the World Health Organization (WHO), there is no logical justification for any country to have C-section deliveries exceeding 10% to 15% of total child births (Gibbons et al., 2010; WHO, 1985). However, less than 5% of deliveries by C-section in any population indicates a low antenatal and maternal care (WHO, UNFPA, UNICEF, Mailman School of Public Health, & AMDD, 2009). Anecdotal and empirical findings reveal that C-sections have become increasingly common in developing countries like Bangladesh. While 18.6% of all deliveries are currently performed by C-sections (Betrán et al., 2016), according to the BDHS 2014 data, the rate is as high as 23% (National Institute of Population Research and Training (NIPORT), Mitra and Associates & ICF International, 2016). The 2016 data from the Bangladesh Maternal Mortality Survey (BMMS) reported the C-section delivery rate to be 31% (National Institute of Population Research and Training, MEASURE Evaluation & icddrb, 2017). Although, C-section deliveries are rising in Bangladesh at a rapid level, not enough research is available to examine the factors, especially, demographic, socio-economic, and institutional causes that may explain this rise in the C-section procedures. There are gaps in the current literature as most studies are old and have generally ignored various aspects of the demand side of the equation. For example, trends and inequality aspects of C-section have not been explored in these studies. The high rates of C-section deliveries have at least two notable implications—an

increase in the pressure on hospital infrastructure (equipment and human resources), and high physical and psychological cost on the mother (increased risk of postnatal depression). Therefore, it is important to improve our understanding of these trends with the most recent data (Belizán, Althabe, & Cafferata, 2007; Torkan, Parsay, Lamyian, Kazemnejad, & Montazeri, 2009).

Historically, C-section delivery was associated with an improvement in maternal and prenatal health outcomes as a clinical practice to ensure safety of mother and child under conditions of obstetric risks (Roberts & Nippita, 2015). The prevalence of C-section follows the health care inequity pattern as underuse is found in low-income settings, and overuse in middle and high-income settings (Althabe et al., 2006; Betrán et al., 2007; Ronsmans, Holtz & Stanton, 2006). This is widely believed that, medical factors, and clinic managers' and physicians' financial interests also play an important role in determining the choice of C-section, although obstetricians deny this charge (Hasib, 2015). Concerns about high rates of C-section in private obstetric care settings exist in Bangladesh (Neuman et al., 2014; Rahman, Shariff, & Shafie, 2012). However, these factors also influence a provider's decision to perform both elective and emergency C-section in public hospitals in Bangladesh (Aminu, Utz, Halim, & van den Broek, 2014).

A 2015 study in northern Bangladesh showed that, having a previous C-section, higher educational level, prolonged labor, mother's age, a lower order of birth, height of the baby, and lack of a balanced diet are among the significant factors behind increased C-section delivery (M. Rahman, Shariff, Shafie, Saaid, & Tahir, 2015). Another study revealed the importance of residence, religion, birth order, frequent pregnancy, antenatal care-seeking and wealth as important predictors of medical facilities and C-sections in childbirth (Kamal, 2013). Thus the literature suggests that the main determinants of performing and utilizing C-section deliveries are: (a) medical condition -- *repeated Cesarean, presumed fetal distress, failure to progress, breech births, hypertensive disorders, antepartum hemorrhage, near birth complications,* and *postdate pregnancy* (Jabeen, Mansoor & Mansoor, 2013; Parliamentary Office of Science and Technology, 2002); (b) Non-medical factors, such as economic and socio-cultural factors, and (c) institutional factors for Cesarean deliveries.

In a developing country like Bangladesh, the determining factors for the increasing rate of C-section deliveries remain unclear. The existing studies suffer from a number of limitations too (Aminu et al., 2014; Kamal, 2013; Rahman et al., 2015; Rahman et al., 2018). For example, past studies have not considered income and wealth inequality aspects and have not used the most recent data, and have not considered multiple factors responsible for C-section delivery (Aminu et al., 2014; Kamal, 2013; Rahman et al., 2015; Rahman et al., 2018). This paper explores the role played by education and wealth in the rising numbers of C-section deliveries in Bangladesh. Also, the paper explores the avoidable or non-emergency C-section rate in Bangladesh. Given the alarming increase of C-section deliveries in recent years, this study investigates this trend to identify factors associated with C-section delivery. Specific research questions are: (A) what are the trends in C-section delivery in Bangladesh over the last 10 years (2004-2014)? (B) Are demographic, socio-economic, and institutional factors largely responsible for the increasing rate of C-section delivery in Bangladesh? In addition, (C) How much of the rise in the Cesarean section rate can be explained by inequality and changes in household wealth index and educational attainment of mothers aged 15-49?

2 Data and methods

This study used data from the national cross-sectional survey of Bangladesh Demographic and Health Surveys from 1999-2000 to 2014 (National Institute of Population Research and Training - NIPORT), Mitra and Associates (MA), ICF International, & ORCM, 2001, 2005, 2009, 2013, 2016). For trend analysis, three data sets (1999-2000, 2007, and 2014) were used, whereas the BDHS 2014 data was used for multivariable analysis. The study analyzed 17,863 ever-married women aged 15-49 years, of which 4,904 had given birth at institutional settings in the three years preceding the survey.

Variables of the study

The key dependent variable in the study is the "mode of delivery" (normal deliveries and Cesarean delivery) during the last three years preceding the survey. Based on the literature, the "reasons for C-section" is also used as a dependent variable to address the unnecessary C-section delivery (Chen et al., 2018; Kingdon, Downe, & Betran, 2018a, 2018b; World Health Organization, 2018). We labelled two reasons given for C-section as unnecessary; one, surgery justified as convenience reasons, and, second, surgery to avoid the labor pain. The independent variables are: mother's age at marriage, mother's age at delivery, order of birth (primipara, multipara), place of antenatal care, place of delivery, body mass index (BMI) of women (current, if not available for delivery time), wealth index of household, educational attainment of women, husband's educational attainment, number of antenatal visits, number of visits by family planning workers for last six months, size of child at birth, number of living children, gender of all living children, mother's working status, region (division), place of residence,

access to media (TV, radio, newspaper or magazines), and religion of the mother.

Analytical Approach and Framework

Both bivariate and multivariate analysis were carried out to understand the factors behind C-section delivery. First, based on chi-square test we have selected variables for the multivariable analysis. Since the dependent variable is of dichotomous nature, multivariable logistic regression models are fitted to identify the socio-economic, demographic, institutional, and spatial determinants of C-section with the findings have been presented as odds ratios (OR) with 95% confidence intervals. A general formula of logistic regression is:

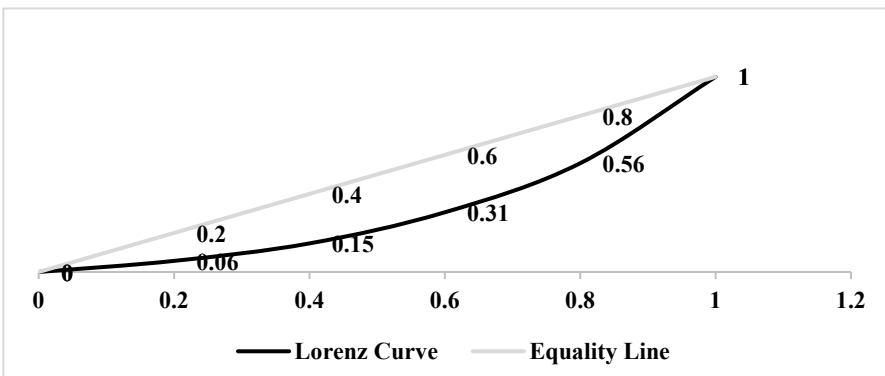
$$log\left[\frac{y}{1-y}\right] = b_0 + b_1X_1 + b_2X_2 + b_3X_3 \ldots + b_nX_n \qquad (1)$$

Here, $\frac{y}{1-y}$ is the log-likelihood, b_0 is the constant, b_1 to b_n are the coefficients, and X_1 to X_n are the independent variables. In the first model, we used the socio-economic variables as independent variables. In the second model, we employed all demographic and institutional variables as independent variables. We combined both socio-economic and demographic and institutional variables as independent variables.

For assessing inequality, four methods of measurement are used; two of the methods were simply the ratio and the difference of C-section between two groups (e.g., C-section of educated women minus/divide C-section of non-educated), whereas the third is the Gini coefficient. If G is the Gini coefficient, A is the area between the diagonal and the Lorenz curve, and A+B is the whole area under the diagonal of equality (see Figure 1 below):

$$G = \frac{A}{A+B} \qquad (2)$$

Figure 1: Lorenz Curve of C-section by Wealth Quintile



Source: Lorenz curve was made using BDHS 2014 data

The final measure of inequality is the Concentration Index. If CI is the Concentration Index, *d* is the variable of concern (C-section), μ is average of C-section, and *r* is the fractional rank of C-section by income distribution (or other variable, e.g. education), then the Concentration Index can be defined as:

$$CI = \frac{2}{\mu} cov(dr) \qquad (3)$$

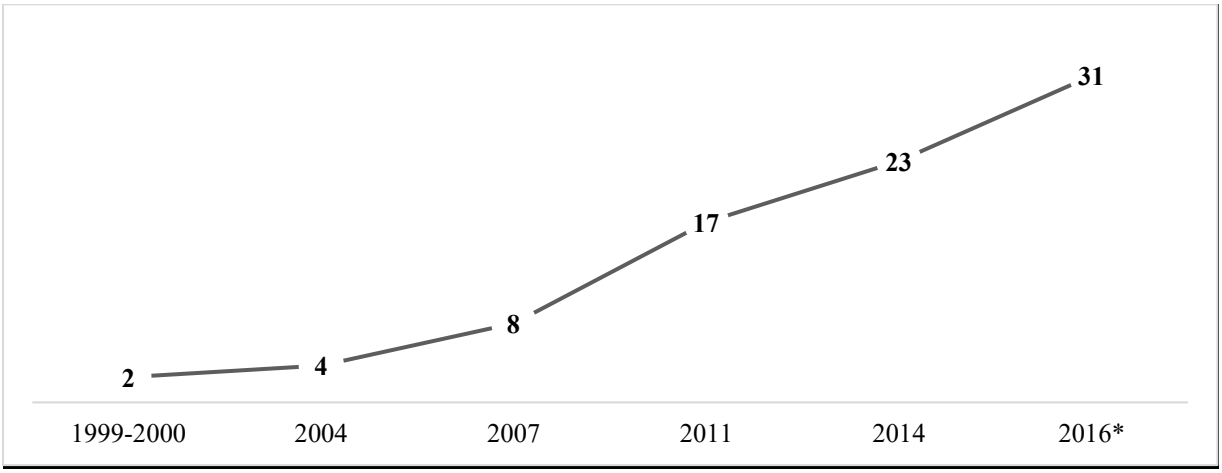
Ethical statements

The Demographic and Health Survey (DHS) of Bangladesh was carried out under the provision of the National Institute of Population Research and Training (NIPORT) of the Ministry of Health and Family Welfare of Bangladesh. Mitra and Associates (a Bangladeshi research firm) implemented the survey with technical assistance provided by ICF International of Calverton, Maryland, USA, as part of its international DHS Program (MEASURE DHS). An interview was conducted only if the respondent provided their consent (verbal). The permission for using the BDHS data set was received and is available from https://dhsprogram.com/data. The user instruction guidelines were strictly followed.

3 Trends of C-section delivery by demographic/socio-economic/ institutional characteristics

The results from the latest *2014 Bangladesh Demographic and Health Survey* (BDHS) show a dramatic increase in the number of C-section births in Bangladesh. C-section accounted for 2% of the childbirths in 1999-2000, 4% in 2004, 8% in 2007, and 17% in 2011, and 23% in 2014. These numbers imply that roughly five in twenty births were delivered by C-section. According to the preliminary report of Bangladesh Maternal Mortality and Health Care Survey 2016, the rate now stands at 31%, which implies almost one in every three births in a health facility are delivered by C-section (see Figure 2).

Figure 2: Trends of the Rate of C-section in Bangladesh (1999-2000 to 2016)



Source: Analysis of BDHS 1999-2000 to 2014
* 2016 data was taken from the preliminary report of Bangladesh Maternal Mortality and Health Care Survey 2016.

According to descriptive statistics based on bivariate analysis in Table 1, Caesarian delivery is more common among relatively educated women. More than half of women with higher education had C-section in 2014, while only 8.3% of women with education delivered a child by this procedure. Husband's education level also plays a similar role. In terms of employment of the women, 24.6% of those who experienced C-section are unemployed, while the figure is relatively lower (17.4%) for women employed. The prevalence of Cesarean delivery is the highest in Khulna division (33.1%), followed by Dhaka (29.1%), with Sylhet division is in the middle (11%). It is not surprising to find that C-section is more prevalent in urban areas (38.1%) than in rural areas (17.6%) according to the recent numbers. Women who have access to media such as radio and television are three times more likely to experience this medical procedure compared to women who have little or no access to media outlets (30.7% vs. 10.5%).

These findings also reveal that C-section procedure is positively associated with a women's weight as measured by the Body Mass Index (BMI). Among women who are underweight, the rate of occurrence of this procedure was only 13.4%. However, for obese women, the rate was much higher at 56%. Similarly, C-section rate was high for the first child's birth (29.7%), followed by the birth of the second and third child. For later children, beyond three, the rate for this procedure falls to below 8%.

Table 1: Trends in C-section delivery by demographic and socio-economic characteristics

C-section by Background Characteristics	Attributes	Absolute percentage (%)			Changes in percentages point (%)	
		1999-2000	2007	2014	2014-1999	2014-2007
Demographic and institutional variables						
Age of women (year)	15-24	1.8	7.3	22.1	20.3	14.8
	25-34	3.2	8.1	23.9	20.7	15.8
	35-49	1.7	6.3	23.1	21.4	16.8
Age at first birth (year)	Adolescent (11-19)	1.4	4.7	17.3	15.9	12.6
	Others (20 +)	6.0	17.0	37.9	31.9	20.9
Number of living children	0	5.2	6.7	23.5	18.3	16.9
	1	4.5	13.7	30.6	26.1	16.9
	2	2.7	7.9	22.6	19.9	14.6
	3	1.2	3.6	15.8	14.6	12.2
	3+	0.6	1.8	6.0	5.4	4.2
Gender of living children	Male	4.2	12.0	26.9	22.7	14.9
	Female	1.8	6.0	20.9	19.1	14.9
Birth order number	1	4.4	12.7	29.7	25.3	17.0
	2	2.7	7.8	23.4	20.7	15.6
	3	1.5	4.2	17.6	16.1	13.5
	3+	0.7	2.2	7.8	7.1	5.6
Size of child at birth	Very large	5.7		19.8	14.1	19.8
	Larger than average	2.8		31.8	29.0	31.8
	Average	2.2		22.3	20.1	22.3
	Smaller than average	2.1		19.3	17.2	19.3
	Very small	2.6		23.3	20.7	23.3
Body Mass Index	Underweight	0.9	2.9	13.4	12.5	10.5
	Normal	2.8	7.5	21.2	18.4	13.8
	Overweight	14.0	26.7	40.0	26.0	13.4
	Obese	9.4	37.5	56.0	46.6	18.5
Visits by family planning worker for last six months	No	2.6	7.7	23.9	21.3	16.2
	Yes	1.9	7.0	19.7	17.8	12.8
Number of ANC visits	0	0.5	1.9	4.5	4.0	2.7
	1	1.5	3.4	13.3	11.8	9.9
	2	4.4	6.9	24.5	20.1	17.6
	3	3.6	10.7	31.2	27.6	20.4
	4	9.6	18.3	34.2	24.6	15.9
	4+	21.1	30.0	44.5	23.4	14.5
Place of delivery	Public Hospital	22.5	34.6	37.2	14.7	2.6
	Private Hospital	46.9	71.8	78.1	31.2	6.3
	Others	0.2	0.7	1.0	0.8	0.3

Socio-economic variables						**(Table continued from the last page)**
Residence (Division) of the respondent	Barisal	0.5	3.9	17.7	17.1	13.6
	Chittagong	1.8	6.4	18.3	16.5	11.9
	Dhaka	3.4	10.1	29.1	25.7	19.1
	Khulna	4.1	9.7	33.0	29.0	23.4
	Rajshahi	1.5	6.4	22.3	20.8	15.9
	Rangpur			17.5	17.5	17.5
	Sylhet	1.8	4.4	10.9	9.2	6.6
Place of residence (urban/rural)	Urban	8.0	15.9	38.1	30.1	22.2
	Rural	1.3	5.4	17.6	16.3	12.2
Educational level	No education	0.6	1.1	7.0	6.4	5.8
	Primary	1.0	2.6	11.7	10.7	9.1
	Secondary	5.4	12.1	27.6	22.2	15.5
	Higher	20.9	36.3	54.8	33.9	18.5
Religion	Islam	2.3	7.2	22.8	20.5	15.5
	Others	3.1	11.0	24.3	21.2	13.3
Access to media (radio, TV, other)	No	0.6	3.3	10.5	9.9	7.1
	Yes	4.9	10.3	30.7	25.8	20.4
Wealth index of the household	Poorest	0.3	1.8	6.7	6.3	4.8
	Poorer	0.5	1.9	10.4	9.9	8.5
	Middle	0.8	3.3	18.5	17.7	15.1
	Richer	3.1	8.4	29.2	26.1	20.8
	Richest	11.9	25.7	51.4	39.5	25.7
Husband's education	No education	0.8	1.8	8.3	7.5	6.5
	Primary	0.7	3.3	14.8	14.1	11.5
	Secondary	3.8	11.3	28.2	24.4	16.9
	Higher	12.0	29.4	52.9	40.9	23.6
Employment status	No	2.5	8.3	24.6	22.1	16.3
	Yes	1.8	5.5	17.4	15.6	11.9
Total		2.4	7.5	22.9	20.5	15.3

Source: Analysis of BDHS 2014 data

C-section is more prevalent among relatively older women than younger. Roughly 38% of women who experienced C-section are 20 years or older. Caesarian delivery is more prevalent among women belonging to higher income households and less common among the poor households. According to the survey, 51.4% of women who underwent this procedure came from rich households, compared to only 6.3% with C-section from the poorest households in 2014. The highest change (31.9%) between BDHS 1999-2000 to 2014 was for mothers who gave birth to their first child at age 20 and older (Table 1).

According to Table 1, C-section birth is higher (44.5%) for those who reported making four or more visits to ANC. But for weight of the mother, there is no difference between those with normal delivery and those with C-section.

4 Determinants of C-section

Socio-economic factors:

The results of regression analysis based on the 2014 BDHS data are presented in Table 1. The results for Model 1 (socio-economic variables) and Model 3 (combination of socio-economic, demographic, and

institutional variables) show that C-section procedure is more prevalent among relatively richer households. The odds of C-section procedure for women who belong to the richest households is 4.6 times greater than women belonging to the poorest households. Similarly, educated women have a 2.77 times higher probability of C-section deliveries than uneducated women. The wives of uneducated husbands are 2 times more likely to have this procedure than the wives of educated husbands.

Although, not found significant in our final model, column 4 of Table 2 also reveals that compared to rural households, C-section delivery is more prevalent among urban households (Adjusted Odds Ratio - 1.14), although this finding is not statistically significant. C-section delivery is 35% more likely for women who are unemployed compared to working women.

Both descriptive and econometric analysis suggest that the likelihood of caesarian delivery varies significantly across different parts of the country. The rate of C-section was lowest in Sylhet division, and significantly higher in Khulna, Rajshahi, and Rangpur division.

Demographic factors and Institutional factors:

Our estimates of Model 2 and Model 3 reveal that C-section delivery is higher among women who have given birth at a relatively old age compared to those between 11 to 19 years (adolescent); women who had their first child at age 20 or older have higher odds for a Cesarean procedure.

Although not found as significant in the final specification, in column 4 of Table 2, the dummy variable for capturing the death of a child has a significantly positive coefficient. A similar finding was also revealed by several living children. Our result reflects that compared to a mother with no living child, a mother with three or more living children is more likely to undergo a C-section delivery.

Given these results, the size of the child at birth appears to have no effect on C-section delivery; this is reflected in the descriptive statistics (Table 1). C-section delivery is more likely among women with higher Body Mass Index (BMI). It is plausible to expect that with an increased number of ANC visits, the likelihood of C-section delivery increases. However, visits by family planning workers is negatively associated with C-section delivery. The odds ratio of most variables decreased in the final model. For example, compared to the poorest women, the richest women are 3.7 times more likely to have C-section in Model 1, which declined to 3.1 times in the final model. It is likely an adjusted model will provide a more accurate relationship.

Table 2: Determinants/factors affecting C-section delivery in Bangladesh

Variables	**Model 1: Socio-economic**	**Model 2: Demographic and Institutional**	**Model 3: Combined**
	Odds Ratio (95% C.I.)	**Odds Ratio (95% C.I.)**	**Odds Ratio (95% C.I.)**
Wealth index (Ref: Poorest)			
Poorer	1.263 (0.909-1.756)		1.121 (0.795-1.579)
Middle	1.832*** (1.327-2.582)		1.521* (1.088-2.127)
Richer	2.774*** (2.004-3.838)		2.026*** (1.441-2.847)
Richest	4.690*** (3.307-6.652)		3.125*** (2.162-4.517)
Education of respondent (Ref: No)			
Primary	1.484* (1.040-2.117)		1.210 (0.831-1.762)
Secondary	2.344*** (1.656-3.318)		1.666** (1.152-2.410)
Higher	2.767*** (1.823-4.202)		1.743** (1.113-2.728)
Division (Ref: Sylhet)			
Chittagong	1.512 (0.944-2.422)		1.521 (0.928-2.493)
Dhaka	1.175 (0.820-1.685)		1.195 (0.814-1.752)
Khulna	2.487*** (1.769-3.498)		2.348*** (1.634-3.373)
Rajshahi	3.464*** (2.321-5.169)		2.822*** (1.854-4.295)
Rangpur	2.282*** (1.527-3.412)		2.130*** (1.390-3.263)
Barisal	1.586* (1.044-2.410)		1.268 (0.816-1.969)

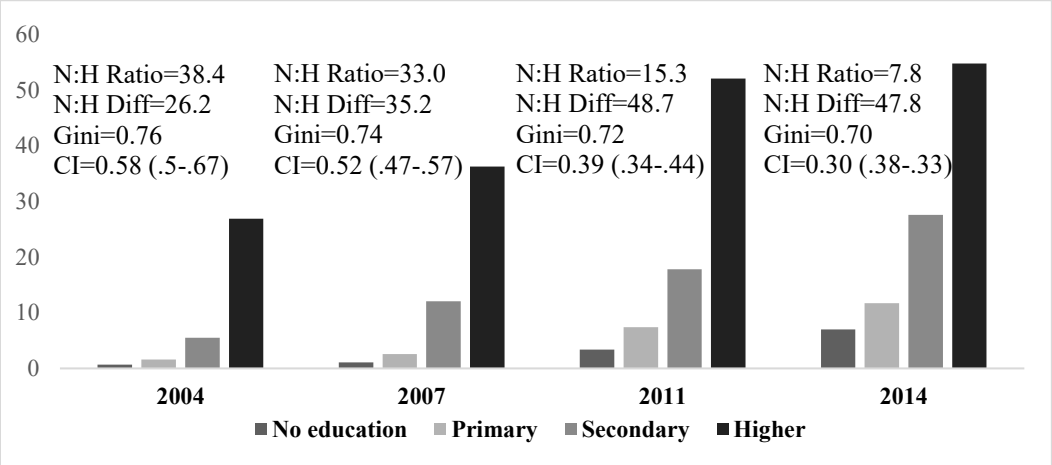
Place of residence (Ref: Rural)			**(Table continued from the last page)**
Urban	1.276** (1.062-1.533)		1.138 (0.938-1.380)
Religion (Ref: Islam)			
Other	1.167 (0.881-1.545)		1.219 (0.909-1.634)
Access to any mass media (Ref: No)			
Yes	1.081 (0.873-1.339)		0.970 (0.775-1.214)
Husband's education (Ref: No)			
Primary	1.251 (0.950-1.646)		1.070 (0.805-1.423)
Secondary	1.649*** (1.250-2.174)		1.354* (1.014-1.809)
Higher	2.565*** (1.847-3.561)		2.085*** (1.476-2.945)
Working status of respondent (Ref: Yes)			
No	1.406*** (1.158-1.706)		1.355** (1.104-1.663)
Age at first birth (Ref: 11-19 years)			
20 and Above (year)		1.953*** (1.648-2.314)	1.790*** (1.495-2.142)
Number of living children (Ref: 0)			
1		0.974 (0.454-2.089)	0.959 (0.430-2.136)
2		0.628 (0.293-1.349)	0.690 (0.309-1.543)
3		0.457* (0.209-0.997)	0.688 (0.302-1.568)
3+		0.231*** (0.101-0.529)	0.396* (0.165-0.951)
Ever experience the death of any children (Ref: No)			
Yes		0.655** (0.502-0.854)	0.901 (0.682-1.190)
Size of a child at birth (Ref: Very large)			
Larger than average		1.448 (0.824-2.546)	1.379 (0.763-2.493)
Average		1.001 (0.587-1.706)	0.859 (0.491-1.503)
Smaller than average		1.030 (0.582-1.823)	0.975 (0.536-1.772)
Very small		1.173 (0.645-2.131)	1.088 (0.579-2.042)
Number of ANC visits (Ref: 0)			
1		3.587*** (2.491-5.167)	3.019*** (2.071-4.402)
2		6.687*** (4.720-9.473)	5.121*** (3.566-7.354)
3		8.922*** (6.280-12.675)	6.538*** (4.538-9.420)
4		10.523*** (7.329-15.108)	6.123*** (4.183-8.961)
4+		13.986*** (10.037-19.48)	7.698*** (5.430-10.912)
Body Mass Index of women (Ref: Underweight)			
Normal		1.513*** (1.233-1.855)	1.161 (0.934-1.444)
Overweight		3.755*** (2.924-4.823)	1.932*** (1.469-2.541)
Obese		5.135*** (3.296-8.000)	2.343*** (1.453-3.777)
Visits by family planning workers (Ref: Yes)			
No		1.372*** (1.150-1.638)	1.290** (1.069-1.556)
Constant	0.012***	0.032***	0.006***
Level of significance * = p ≤ 0.05, ** = p ≤ 0.01 and *** = p ≤ 0.001			

Source: Analysis of BDHS 2014 data

5 Inequalities in C-section in Bangladesh

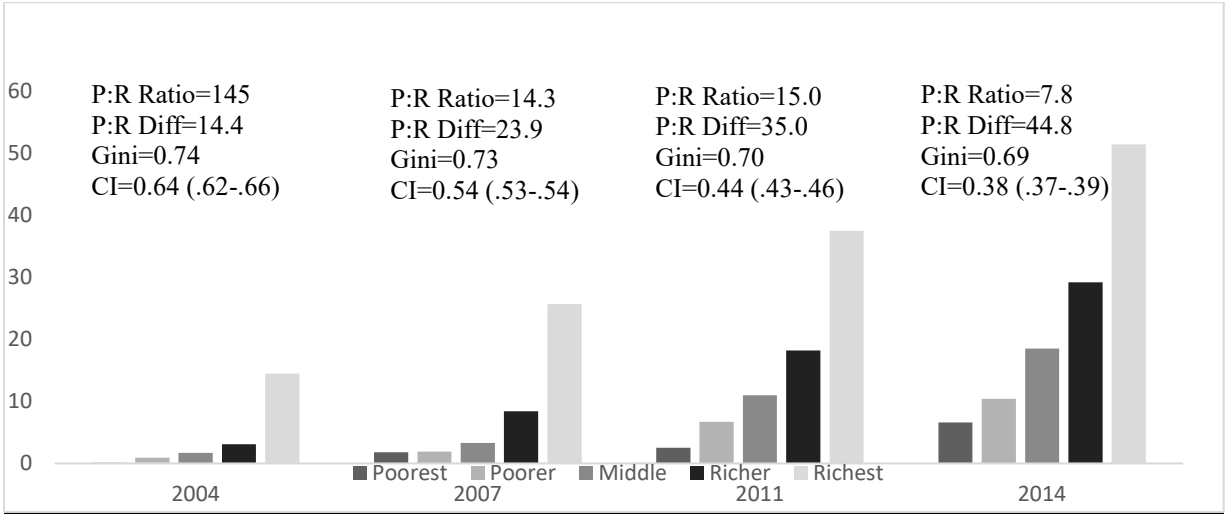
Though inequalities in C-section is decreasing, Figures 3 and 4 reveal that there still exists a large gap between rich and poor households, and between educated and non-educated households with the prevalence of C-section delivery of a child. However, due to increased access to maternal health care in recent years, these inequalities may be declining

Figure 3: Trends and Inequalities of C-section by Education Level



Note: N:H=No education: Higher education, Diff=Difference, Gini=Gini Coefficient, CI=Concentration Index
Source: Analysis of BDHS 2014 data

Figure 4: Trends and Inequalities of C-section by Wealth Index

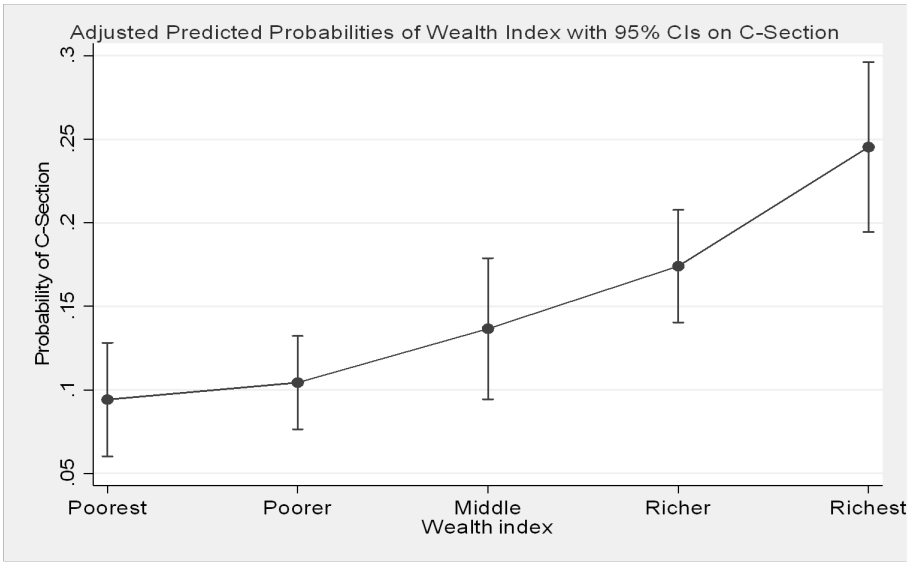


Note: P:R=Poorest: Richest, Diff=Difference, Gini=Gini Coefficient, CI=Concentration Index
Source: Analysis of BDHS 2014 data

6 The marginal impact of wealth and education on C-section

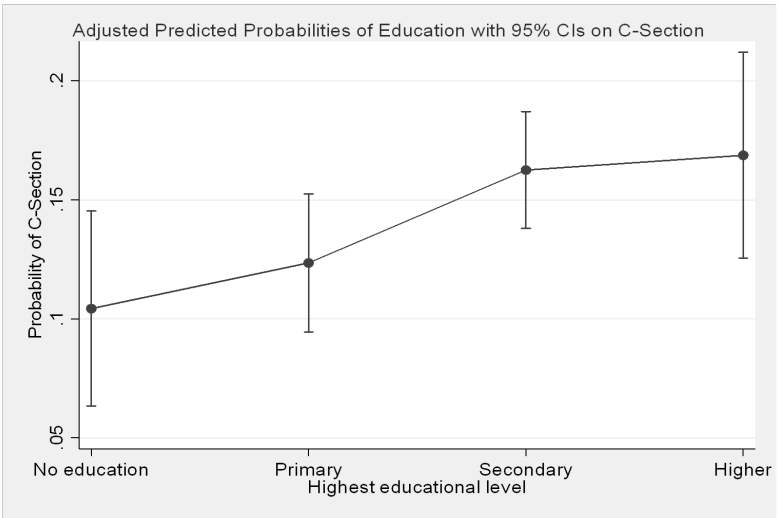
Predicted probabilities of C-section from the regression model (column 4 of Table 2) are plotted in Figure 5. These show that belonging to households not among the poorest have a higher probability of C-section. Figure 6 shows that mothers belonging to the educated category have a higher probability of C-section.

Figure 5: The probability of C-section by wealth (final model)



Source: Analysis of BDHS 2014 data

Figure 6: The probability of C-section by women's education (final model)



Source: Analysis of BDHS 2014 data

7 The avoidable C-section by wealth and education in Bangladesh

Table 3 illustrates two major reasons for choosing C-section delivery in Bangladesh. Bivariate analysis in Table 3 shows that 9.4% of C-section were due to convenience and a perception of lower risk. The incidence was 13.4% among educated women and 11% among women from rich households. The table reveals that 6.8% chose C-section to avoid labor pain. Excluding the convenience and the pain factor, we find the "avoidable" C-section in Bangladesh was 15.1% in 2014. We find that 28.6% of the requests for C-section came from the mother or their family, while the rest came from the physicians.

Table 3: Avoidable C-section delivery by education and wealth in Bangladesh, 2014

Background	Convenience (%)	Sig. of χ^2	Avoid labor pain (%)	Sig. of χ^2	Total Avoidable C-section (%)	Sig. of χ^2
Educational attainment		0.044		0.000		0.000
No education	7.5		3.8		13.2	
Primary	5.8		2.9		8.8	
Secondary	8.8		5.7		13.8	
Higher	13.4		12.7		22.4	
Wealth index		0.033		0.013		0.001
Poorest	3.8		3.8		7.5	
Poorer	5.9		3.0		8.9	
Middle	5.9		4.3		10.1	
Richer	11.5		5.7		14.8	
Richest	11.1		9.7		19.6	
Total	9.4		6.8		15.1	

Source: Analysis of BDHS 2014 data

8 Discussions and conclusions

This empirical study explores the rising trends in C-section delivery as a medical procedure in Bangladesh in recent years. Our research reveals that the rate of this medical procedure varies with age, place of birth, educational level, access to media, and household wealth quintile of the mother. The rate also depends on the frequency of antenatal care visits, mother's body mass index (weight), size of the child at birth, and the place of delivery. Our analysis finds that the rate of increase in C-section delivery is higher at private hospitals than at public hospitals. These findings are similar to previous studies (Aminu et al., 2014; Kamal, 2013; Rahman et al., 2012). The results from bivariate analysis show that among women receiving institutional antenatal care, those with higher education, residents of Khulna division, those belonging to the richest households, and finally women living in urban areas, experience a higher rate of C-section delivery. These findings are similar to what we know from the existing literature on Bangladesh and other developing countries (Althabe et al., 2006; Aminu et al., 2014; Betrán et al., 2007; Kamal, 2013; M. Rahman et al., 2012; Roberts & Nippita, 2015; Ronsmans et al., 2006). Finally, our study also finds that the prevalence of C-section delivery rises with the increased availability of maternity services.

Among socio-economic factors, mothers living in Khulna/Dhaka (Model 1, Model 3), residing in urban areas (Model 1, Model 3), having higher education (Model 1, Model 3), being in wealthier quintile of households (Model 1, Model 3) and four or more visits to the doctor during pregnancy (Model 2, Model 3) are more likely to experience delivery by C section. For Sylhet, although, the region is relatively affluent, it is also relatively "conservative" with a traditional socio-cultural outlook that may favor avoiding surgery. The value of CI and Gini coefficient reflects higher disparities between the poorest and the richest households, and between illiterate and literate women. The marginal impact of the richest wealth quintile of households and educated mothers likely to have more C-sections.

Using multivariate analysis, this study unearths new and often contradictory findings on the relationship between ANC visits and C-section delivery, and between visits by the FP (Family Planning) social workers and C-section delivery. We find that an increased number of ANC visits increases the likelihood of C-section delivery, but visits by family planning workers decreases the likelihood. Institutional coverage such as ANC home visits are likely to detect complicated pregnancies before delivery, which may lead to C-section birth instead of normal delivery. However, home visits by family planning workers lead to a decrease in the frequency of C-sections.

The study highlights two major reasons for preference for C-section delivery in Bangladesh - convenience factor and avoiding labor pain. Both of these factors may be considered "unnecessary and avoidable." Higher educated and wealthy mothers prefer C-section primarily to avoid labor pain, and they feel C-section delivery is more convenient compared to the natural method of child delivery. These factors have led to a steady rise in maternal demand for C-section procedure, which are often unnecessary and avoidable. These two factors alone contribute 15.1% to the total number of C-section deliveries in 2014.

The World Health Organization (WHO) reported that 6.2 million unnecessary C-sections were performed worldwide in 2008. These have a significant negative implications for health equity in a country (Gibbons et al., 2010). The study also identifies that 28.6% of the requests for C-sections came from pregnant mother or her family, while the rest (71.4%) was based on the doctor's recommendation. If we control for the requests from the mother and the families, the rate of C-section delivery in Bangladesh (16.4%) is still considered an "overuse" of this medical procedure. According to the WHO categories, if the rate of avoidable surgeries is 15% or more, this would be an overuse which bring into question the ethical role played by the attending doctor in these worrisome trends (Gibbons et al., 2010; WHO, 1985).

High rates of C-section deliveries have severe implications on health sector resources and on the mother's health. This procedure burdens the hospital infrastructure (equipment, space, doctors, and nurses) and adds to the physical and psychological cost on the mother undergoing the surgery. We recommend that policy measures should be enforced to reduce the incidence of unnecessary C-section surgeries in Bangladesh. Reducing the rate of increase in C-section deliveries and reversing these trends, especially in private hospitals/clinics, should be considered an urgent health issue by the healthcare leaders and policymakers. Here it can be argued that demand from mothers for the surgery may not be the actual reason for C-section. An increase in the inclusion of trained midwives during childbirth may lead to a reduction in C-section deliveries. Last but not the least, the ethical behavior of the attending physician must also be reviewed. Following the United Nations SDG-3 (3.1, 3.7 and 3.8), the Government of Bangladesh should develop specific guidelines and measures, including promoting health education for women of reproductive age to reverse these trends. Women of reproductive age should be educated on how to reduce obesity and lead active healthy living, which leads to lower complications and more normal deliveries.

While interpreting these results, we should note that to confirm these findings, further qualitative research is called for. Given the paucity of data, including information on whether a previous pregnancy was terminated, history of past C-section delivery, cost of delivery, service provider aspects, etc. were not included in our models. Future research should explore why urban, educated, and wealthy mothers prefer C-section, and if the attending physicians and for-profit private facilities specifically target women with these characteristics for higher profits.

Acknowledgments

We acknowledge the Measure DHS (Demographic and Health Surveys) Data Archive, ICF International, USA for access to four rounds of the Bangladesh Demographic and Health Survey (2004-2014) data.

References

Althabe, F., Sosa, C., Belizán, J. M., Gibbons, L., Jacquerioz, F., & Bergel, E. (2006). Cesarean section rates and maternal and neonatal mortality in low-, medium-, and high-income countries: An ecological study. *Birth*, 33(4), 270-277. doi:10.1111/j.1523-536X.2006.00118.x

Aminu, M., Utz, B., Halim, A., & van den Broek, N. (2014). Reasons for performing a caesarean section in public hospitals in rural Bangladesh. *BMC Pregnancy and Childbirth*, 14, 130. doi:10.1186/1471-2393-14-130

Belizán, J. M., Althabe, F., & Cafferata, M. L. (2007). Health consequences of the increasing caesarean section rates. *Epidemiology*, 18(4), 485-486. doi:10.1097/EDE.0b013e318068646a

Betrán, Ana P., Merialdi, M., Lauer, J. A., Bing-Shun, W., Thomas, J., Van Look, P., & Wagner, M. (2007).

Rates of caesarean section: Analysis of global, regional and national estimates. *Paediatric and Perinatal Epidemiology,* 21(2), 98-113. doi:10.1111/j.1365-3016.2007.00786.x

Betrán, Ana Pilar, Ye, J., Moller, A. B., Zhang, J., Gülmezoglu, A. M., & Torloni, M. R. (2016). The increasing trend in caesarean section rates: Global, regional and national estimates: 1990-2014. *PLOS ONE*, 11(2), 1-12. doi:10.1371/journal.pone.0148343

Chen, I., Opiyo, N., Tavender, E., Mortazhejri, S., Rader, T., Petkovic, J., Betran, A. P. (2018). Non-clinical interventions for reducing unnecessary caesarean section. *Cochrane Database of Systematic Reviews,* (9). doi:10.1002/14651858.CD005528.pub3

Gibbons, L., Belizán, J., Lauer, J., Betrán, A., Merialdi, M., & Althabe, F. (2010). The global numbers and costs of additionally needed and unnecessary caesarean sections performed per year: Overuse as a barrier to universal coverage. *World Health Report 2010*. Retrived from: http://www.who.int/healthsystems/topics/financing/healthreport/30C-sectioncosts.pdf

Hasib, Nurul, I. (2015, April 26). DHS points to abnormal rise of C-section in Bangladesh - bdnews24.com. *Bdnews24.Com*. Retrieved from https://bdnews24.com/health/2015/04/26/dhs-points-to-abnormal-rise-of-c-section-in-bangladesh

Jabeen, J., Mansoor, M. H., & Mansoor, A. (2013). Analysis of indications of saesarean sections. *Journal of Rawalpindi Medical College*, 17(1), 101-103. Retrived from: https://www.journalrmc.com/jrmc/volumes/1395214345.pdf

Kingdon, C., Downe, S., & Betran, A. P. (2018a). Non-clinical interventions to reduce unnecessary caesarean section targeted at organisations, facilities and systems: Systematic review of qualitative studies. *PLOS ONE*, 13(9), e0203274. doi:10.1371/journal.pone.0203274

Kingdon, C., Downe, S., & Betran, A. P. (2018b). Women's and communities' views of targeted educational interventions to reduce unnecessary caesarean section: a qualitative evidence synthesis. *Reproductive Health*, 15(1), 130. doi:10.1186/s12978-018-0570-z

Mostafa Kamal, S. M. (2013). Preference for institutional delivery and caesarean sections in Bangladesh. *Journal of Health, Population and Nutrition*, 31(1), 96-109. doi:10.3329/jhpn.v31i1.14754

National Institute of Population Research and Training (NIPORT), Mitra and Associates (MA), & ORC Macro (ORCM). 2001. *Bangladesh demographic and health survey 1999-2000*. Dhaka, Bangladesh and Calverton, Maryland [USA]: National Institute of Population Research and Training, Mitra and Associates, and ORC Macro. Retrieved from https://dhsprogram.com/pubs/pdf/FR119/FR119.pdf

National Institute of Population Research and Training (NIPORT), Mitra and Associates, & ORC Macro. 2005. *Bangladesh demographic and health survey 2004*. Dhaka, Bangladesh and Calverton, Maryland [USA]: National Institute of Population Research and Training, Mitra and Associates, and ORC Macro. Retrived from: http://dhsprogram.com/publications/publication-FR165-DHS-Final-Reports.cfm

National Institute of Population Research and Training (NIPORT), Mitra and Associates, & Macro International. (2009). *Bangladesh demographic and health survey 2007*. Dhaka, Bangladesh and Calverton, Maryland, USA: National Institute of Population Research and Training, Mitra and Associates, and Macro International. Retrieved from: http://dhsprogram.com/publications/publication-FR207-DHS-Final-Reports.cfm

National Institute of Population Research and Training (NIPORT), Mitra and Associates, & ICF International (2013). *Bangladesh Demographic and Health Survey 2011*. Dhaka, Bangladesh and Calverton, Maryland, USA: NIPORT, Mitra and Associates, and ICF International. Retrieved from: http://dhsprogram.com/publications/publication-FR265-DHS-Final-Reports.cfm

National Institute of Population Research and Training (NIPORT), Mitra and Associates, & ICF International. (2016). *Bangladesh Demographic and Health Survey 2014*. Dhaka, Bangladesh and Calverton, Maryland, USA: NIPORT, Mitra and Associates, and ICF International. Retrieved from: http://dhsprogram.com/publications/publication-FR311-DHS-Final-Reports.cfm

Neuman, M., Alcock, G., Azad, K., Kuddus, A., Osrin, D., Shah More, N., & Prost, A. (2014). Prevalence and determinants of caesarean section in private and public health facilities in underserved South Asian communities: Cross-sectional analysis of data from Bangladesh, India and Nepal. *BMJ Open*, 4(12). doi:10.1136/bmjopen-2014-005982

NIPORT, MEASURE Evaluation, & icddrb. (2017). *Bangladesh Maternal Mortality and Health Care Survey 2016*. Retrieved from: http://www.niport.gov.bd/document/notice/BMMS_2016_Summary_Bangla_and_English.pdf

Parliamentary Office of Science and Technology. (2002). Caesarean Sections. *Postnote*, (184), 1-4. doi:10.1136/bmj.324.7343.983/a

Rahman, M. M., Haider, M. R., Moinuddin, M., Rahman, A. E., Ahmed, S., & Mahmud Khan, M. (2018). Determinants of caesarean section in Bangladesh: Cross-sectional analysis of Bangladesh demographic and health survey 2014 data. *PLOS ONE*, 13, 1-14. https://doi.org/10.1371/journal.pone.0202879

Rahman, M., Shariff, A. A., & Shafie, A. (2012). Caesarean risk factors in northern region of Bangladesh: A statistical analysis. *Tropical Journal of Pharmaceutical Research*, 11(5), 823-833.

Rahman, M., Shariff, A. A., Shafie, A., Saaid, R., & Tahir, R. M. (2015). Caesarean delivery and its correlates in Northern Region of Bangladesh: Application of logistic regression and Cox proportional hazard model. *Journal of Health, Population and Nutrition*, 33(1). doi: 10.1186/s41043-015-0020-2

Roberts, C. L., & Nippita, T. A. (2015). International caesarean section rates: The rising tide. *The Lancet Global Health*, 3(5), 241-242. doi:10.1016/S2214-109X(15)70111-7

Ronsmans, C., Holtz, S., & Stanton, C. (2006). Socioeconomic differentials in caesarean rates in developing countries: a retrospective analysis. *Lancet*, 368(9546), 1516–1523. doi:10.1016/S0140-6736(06)69639-6

Torkan, B., Parsay, S., Lamyian, M., Kazemnejad, A., & Montazeri, A. (2009). Postnatal quality of life in women after normal vaginal delivery and caesarean section. *BMC Pregnancy and Childbirth*, 9, 4. doi:10.1186/1471-2393-9-4.

WHO. (1985). Appropriate technology for birth. *Lancet*, 2, 436-437. doi:10.1016/S0140-6736(85)90673-7

WHO. (2018). *WHO recommendations: Non-clinical interventions to reduce unnecessary caesarean sections*. Retrieved from: http://apps.who.int/iris/bitstream/handle/10665/275377/9789241550338-eng.pdf?ua=1

WHO, UNFPA, UNICEF, Mailman School of Public Health, & AMDD. (2009). *Monitoring emergency obstetric care : A Handbook*. Retrieved from: http://www.who.int/reproductivehealth/publications/monitoring/9789241547734/en/