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Trends and Patterns of Inequalities in Utilizing Facility Delivery among Reproductive Age Women in Bangladesh: A Decomposition Analysis of 2007, 2011, 2014 and 2017-18 Demographic Survey Data

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Title Page:

Trends and Patterns of Inequalities in Utilizing Facility Delivery among Reproductive Age Women in Bangladesh: A Decomposition Analysis of 2007, 2011, 2014 and 2017-18 Demographic Survey Data

Md. Ashfikur Rahman[1]*, Sumaya Sultana[1], Satyajit Kundu[3], Md. Akhtarul Islam[4], Harun Or Rahisd[4], Zahidul Islam Khan[5], Mortuza Tohan[1], Nusrat Jahan[1], Bayezid Khan[1], Md. Hasan Howlader[1]

[1]Development Studies Discipline, Social Science School, Khulna University, Khulna 9208, Bangladesh
Email: ashfikur@ku.ac.bd
ORCID: https://orcid.org/0000-0002-5517-8557
Email: sumayashurmy@gmail.com
Email: mortuzacreations@gmail.com
Email: nusratds16@gmail.com
Email: bayezidkhan@ku.ac.bd
ORCID: https://orcid.org/0000-0002-5792-0903
Email: hasan_ds@ku.ac.bd
ORCID: https://orcid.org/0000-0001-6603-7189

[3]Faculty of Nutrition and Food Science, Patuakhali Science and Technology University, Patuakhali, Bangladesh
[3]School of Public Health, Southeast University, Nanjing 210009, China
Email: satyajitnfs@gmail.com
ORCID: https://orcid.org/0000-0001-9610-1479

[4]Statistics Discipline, Khulna University, Khulna-9208, Bangladesh
Email: akhtarulstat@ku.ac.bd
ORCID: https://orcid.org/0000-0003-2396-2168

[4]Email: harunrasid97@gmail.com
ORCID: https://orcid.org/0000-0002-8697-4388

[6]Statistics Department, East West University, Dhaka-1212, Bangladesh
Email: zahid.drmc3809@gmail.com
ORCID: https://orcid.org/0000-0001-6592-5395

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Corresponding author:

Md. Ashfikur Rahman

Faculty Member

Development Studies Discipline, Social Science School

Khulna University, Khulna 9208

Bangladesh

Email: ashfikur@ku.ac.bd

ashfikurr@gmail.com

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Trends and Patterns of Inequalities in Utilizing Facility Delivery among Reproductive Age Women in Bangladesh: A Decomposition Analysis of 2007, 2011, 2014 and 2017-18 Demographic Survey Data

Abstract

Objectives: The study aimed to identify the associated factors of facility delivery as well as to measure the socio-economic inequalities in the use of facility delivery in Bangladesh.

Setting: The study entailed an analysis of nationally representative cross-sectional secondary data of the Bangladesh Deomographic and Health Survey (BDHS) from 2007 to 2018.

Participants: A total of 11,959 (weighted) Bangladeshi women aged 15 to 49 years were the participants of this study.

Result: The prevalence of utilizing facility delivery in Bangladesh has increased from 14.48% in 2007 to 49.26% in 2018. This study found that women from urban areas, who were overweight and had any level of education, from wealthier families, had ANC, whose partners had any level of education and involved in business were more likely to have facility births compared to their respective counterparts. The Concentration index (CIX) for facility delivery utilization was (0.308) in respect to household wealth status (p<0.001), indicating that utilizing facility delivery was more concentrated among the rich group of people. Decomposition analysis also indicated that wealth quintiles (18.31%), mother's education (8.78%), place of residence (7.75%), birth order (5.56%),

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partner's education (4.30%) and ANC seeking (8.51%), were the major contributors to the pro-rich socio-economic inequalities in utilizing facility delivery.

Conclusion: This study found a pro-rich inequality in utilizing facility delivery in Bangladesh. In order to enhance the use of facility delivery in Bangladesh, there is a need to address the existed socio-economic inequalities in facility delivery.

Keywords: Socioeconomic inequalities, Concentration index, Decomposition analysis, Facility delivery, Bangladesh

Strengths and limitations of this study

- ➢ This study used the four nationally representative surveys data with appropriate statistical technique to estimate the prevalence of utilizing facility delivery and its associated factors as well as the inequalities of using facility delivery over socioeconomic determinants. Therefore, the study results could be generalizable across the country.
- ➢ The inherent limitations of cross-sectional study design limited our ability to infer causality.
- ➢ Some important factors related to the health of the respondent, and the delivery facility was not possible due to the unavailability and missing information of those variables in BDHS data

INTRODUCTION

The Maternal Mortality Rate (MMR) is still a major health concern around the world, particularly in developing nations like Bangladesh. Maternal mortality, according to the World Health Organization*, is defined as a "woman's death while pregnant or within 42 days of delivery or termination of pregnancy from any cause linked to, or aggravated by, pregnancy or its management, but excludes deaths from incidental or unintentional causes"*[1]. In 2010, there were an estimated 287000 maternal deaths globally, the majority of which occurred in low- and middle-income countries (LMICs)[2] and in 2017, approximately 295 000 women died during and after pregnancy and childbirth, with the vast half of these cases (94 percent) occurring in low-resource settings, and the overwhelming majority of these deaths could have been avoided. [3]. The MMR in low income countries in 2017 was 462 per 100 000 live births versus 11 per 100 000 live

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births in high income countries[3]. This depicts that high number of maternal deaths in some areas of the world reflects inequalities in access to quality health services and highlights the gap between rich and poor.

Maternal mortality reduction has long been a global health priority, with a target in the UN Millennium Development Goals (MDG) framework and a significant issue of the UN Secretary-Global General's Strategy for Women's and Children's Health launched in September 2010[4,5]. The Millennium Development Goal (MDGs 1990-2015) emphasized the importance of minimizing maternal and child mortality by 75% foster the reduction of maternal mortality rate (MMR) to 38% worldwide[6]. According to the Sustainable Development Goal 3, MMR will be decreased to less than 70 deaths per 100,000 live births by 2030. (SDG 3). Bangladesh, Nepal, and Pakistan have all made significant progress in lowering MMR during the last few decades. Between 2010 and 2017, Bangladesh's MMR dropped to 173/100,000 live births, Nepal's to 186/100,0000, and Pakistan's to 140/100,0000.[2]. Outrageously MMR rates in these countries are still comparatively high compared to rates in other LMICs around the world.

To reduce maternal mortality, the factors behind these deaths have to be identified. The majority of these deaths are attributable to pregnancy-related delivery complications that are largely preventable by relocating childbirth from the home to a health care facility [7–10]. Other issues may exist prior to pregnancy, but they worsen throughout pregnancy, especially if they are not addressed as part of the woman's healthcare. Previous studies documented that poor health-seeking behavior, weak health systems, low socio-economic status, cultural and personal health beliefs, lack of availability of appropriate health services, high cost, long distance, lack of transportation facilities, and poor quality of treatments have all been identified as major barriers to low health-care utilization[11,12]. Women who give birth at home in South Asia are more likely to be exposed to unsafe and unclean conditions, putting the lives of mothers and newborns in danger[13]. Several studies have found that using facility-based delivery services, family planning, and antenatal and postnatal care enables faster maternal death reductions[8,14].

This article analyses socioeconomic inequalities in the utilisation of facility delivery in Bangladesh over time, based on its context. Investigating the extent to which socio-economic inequalities exist in facility delivery can aid in identifying the underlying causes of these disparities, thereby informing the appropriate parties on how to address them. There is few research that analyze the socioeconomic factors of maternal health

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inequality in Bangladesh using Demographic and Health Survey (BDHS) data over a period of time. The prime objectives of this research study are three-folds: (i) to analyze the factors of facility delivery in Bangladesh using the BDHS data from 2007 to 2017; (ii) to measure the socioeconomic inequality in the use of facility delivery; (iii) through decomposition analysis, identify the primary components that explain socio-economic inequality in facility delivery over the period of time.

METHODS

Data sources

Secondary data from the Bangladesh Demographic and Health Surveys (BDHS) was used in this study (BDHS 2007, 2011, 2014 and 2017-18). Demographic and health surveys are undertaken on a regular basis to determine the health status of the population. A DHS survey gives a comprehensive picture of the study population, covering overall maternal and child health as well as a range of other health-care subject areas. The dataset has been made freely available for academics and researchers to utilize on the internet. The Institutional Review Board and country-specific review committees ethically authorized all DHS survey protocols. The survey strategy, methodology, sampling, and questionnaires are all detailed in the final report.

Outcome variable

Place of delivery (0=Home, 1=Facility) was the outcome variable in our analyses. The place of delivery was considered 'facility' if a woman gave birth in a government hospital, district hospital, maternal and child welfare center (MCWC), Upazila health complex, health and family welfare center, private hospital/clinic, private medical college/hospital, rural health center, basic health unit, primary health care center and outreach clinic, or in a clinic run by family planning association. It was considered 'home delivery' if a woman gave birth at the respondent's own or relative's/neighbor's home.

Explanatory variables

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Following the variables were choosen based on the literature review place of residence, division, age of the mother, age at first birth , mother's BMI, mother's education, mother's employment status, number of anc visits, husband's education, husband's occupation, household wealth status. ANC seeking was coded if the mother had taken atleast four or more ANC during their last pregnancy. New division was generated using two divisions Maymensign and Rangpur because they were not created during the earileir survey 2007 and 2011.

Statistical analysis

The background characteristics of the study populations have been described using descriptive statistics, and weighted prevalence with 95% confidence intervals was reported. The association between the predictor variable and the delivery location was investigated using Chi-square testing. Multivariate logistic regression was used to estimate the net influence of predictor variables on the outcome variable after confounding variables were removed. In the adjusted model, the factors that are statistically significant at the 0.05 level are shown in the results section. Unadjusted/crude odds ratios (cOR) and adjusted odds ratios (aOR) are presented in this article (AOR). All analyses were carried out using Stata/MP 16 (StataCorp, College Station, Texas, USA).

Inequality measurement

The concentration curve (CC) and concentration index (CIX) were employed in their relative formulations (with no correction) to study the inequalities in facility utilization across analyzable socioeconomic factors of the population (women)[18]. The CIX in this study represents horizontal inequity, because each woman in the study was assumed to have the same need for a facility birth. CC was calculated by plotting the cumulative proportion of women ranked by their wealth index score (poorest first) against the cumulative proportion of facility deliveries on the y-axis. The absolute equality was shown by the 45-degree slope from the origin. The use of institutional delivery is equal among women if the CC intersects with the line of equality. If, on the other hand, the CC subtends the line of equality below (above), then there is inequality in the use of institutional delivery, which is skewed against women from low (high) socioeconomic backgrounds. Futher, the greater the degree of inequality, the more the CC deviates

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from the line of equality. CIX was calculated to estimate the level of wealth-related inequality.CIX is widened as twice the region between the line of equality and CC[18].

The following are some of the benefits of adopting CIX as a measure of healthcare inequality: It considers the socio-economic dimension of healthcare inequalities because individuals are classified based on their socio-economic status rather than their health status; it captures the experience of the entire population; and it is sensitive to changes in population distribution across socio-economic groups. The CIX takes a value between -1 and $+1$. When institutional delivery is evenly spread across socioeconomic categories, CIX equals zero. The usage of institutional delivery is concentrated among the upper socioeconomic classes if CIX has a positive value (pro-rich). A negative CIX score, on the other hand, indicates that institutional delivery is mostly used by the poor (pro-poor)[19]. In contrast, a negative value of CIX indicates that institutional delivery is primarily used by lower socioeconomic groups (pro-poor). The calculation of CIX was done by using "convenient covariance" formula described by O'Donnell et al. [18], as shown in the Eq. 1 below.

$$CIX = \frac{2}{\mu} cov(h, r)$$

Here h is the health sector variable, μ is its mean, and $r = i/N$ is the fractional rank of individual i in the living standards distribution, with $i = 1$ for the poorest and $i = N$ for the richest. The user-written STATA commands Lorenz[20] and conindex[21] were used to produce CC and measure CIX, respectively.

Decomposition of CIX

The relative CIX was decomposed to identify the proportion of inequality due to underlying determinant inequality. The findings were evaluated and interpreted using Wagstaff's et al.[18] and O'Donnell et al.[21] approach. The contribution of each determinant of facility delivery to overall wealth-related inequality is determined as the product of the determinant's sensitivity to facility delivery (elasticity) and the degree of wealth-related inequality in that determinant (CIX of determinant). The residual is the portion of the CIX that is not explained by the determinants.

Ethics Approval

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The study used deidentified data from the Demographic Health Survey program, which has already received ethical approval from the participating countries, no further ethical permission was sought to carry out this research. Data was collected from online source (https://dhsprogram.com) with appropriate request.

RESULTS

Background characteristics of the study objects

Table 1 shows te socioeconomic and demographic features of women aged 15 to 49 years. The table contains the results derived from 30,940 observations recorded in 2007, 2011, 2014, 2017-18 and overall results using the data from all the years under consideration.

From the overall results, we can see that, maximum number of women (67.30%) belonged to rural residence, and they are mostly from Chittagong (18.88%) and Dhaka (17.24%), however, 21.67% of them belonged to the poorest group and 19.80% belonged to the poorer group. The women aged 15-24 years age group (48.81%) are observed to be higher in number, most of them had secondary education (42.90%) and, 97.54% had improved water, 57.76% had improved sanitation, but only 25.02% belonged to the working group. Moreover, 59.14% women had normal BMI and 37.26% already had their first child. Among the mothers 68.28% had no ANC, but most of them (81.04%) had their last birth normally. Additionally, in case of the partners' education, most of them had primary education (30.67%) and mainly occupied in non-agricultural professions (51.87%).

Table 1. Background characteristics of the study participants						
Variables	**Frequency**	**Percentage**	**2007**	**2011**	**2014**	**2017**
Total	30,940	100.00	6,032 (19.50)	8,573 (27.71)	7,761 (25.08)	8,574 (27.71)
Places of Residence						
Urban	10,116	32.70	2,054 (20.30)	2,621 (25.91)	2,446 (24.18)	2,995 (29.61)
Rural	20,824	67.30	3,978 (19.10)	5,952(28.58)	5,315 (25.52)	5,579 (26.79)
Division						
Barisal	3,522	11.38	779 (22.12)	955 (27.12)	897 (25.47)	891 (25.30)
Chittagong	5,842	18.88	1,235 (21.14)	1,710 (29.27)	1,487 (25.45)	1,410 (24.14)
Dhaka	5,333	17.24	1,266 (23.74)	1,421 (26.65)	1,363 (25.56)	1,283 (24.06)
Khulna	3,403	11.00	701 (20.60)	963 (28.30)	853 (25.07)	886 (26.04)
Rajshahi	3,961	12.80	958 (24.19)	1,056 (26.66)	941 (23.76)	1,006 (25.40)
Sylhet	4,017	12.98	1,093 (27.21)	1,089 (27.11)	945 (23.53)	890 (22.16)
New Division	4,862	15.71	0 (0.00)	1,379 (28.36)	1,275 (26.22)	2,208 (45.41)

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Age of the mother (years)						
15–24	15,101	48.81	2,963 (19.62)	4,275 (28.31)	3,810 (25.23)	4,053 (26.84)
25–34	13,138	42.46	2,434 (18.53)	3,555 (27.06)	3,332 (25.36)	3,817 (29.05)
35–49	2,701	8.73	635 (23.51)	743 (27.51)	619 (22.92)	704 (26.06)
Mother's BMI						
<18.50 Underweight	7,226	23.71	1,917 (26.53)	2,316 (32.05)	1,743 (24.12)	1,250 (17.30)
18.51-24.99 Normal	18,027	59.14	3,494 (19.38)	5,029 (27.90)	4,501 (24.97)	5,003 (27.75)
≥25.0 Overweight/Obese	5,229	17.15	545 (10.42)	1,038 (19.85)	1,454 (27.81)	2,192 (41.92)
Mother's education						
No education	5,134	16.60	1,638 (31.90)	1,654 (32.22)	1,215 (23.67)	627(12.21)
Primary	9,183	29.68	1,890 (20.58)	2,627(28.61)	2,171 (23.64)	2,495 (27.17)
Secondary	13,273	42.90	2,060 (15.52)	3,628 (27.33)	3,559 (26.81)	4,026 (30.33)
Higher	3,347	10.82	441 (13.18)	664 (19.84)	816 (24.38)	1,426 42.61)
Mothers' working status						
No work	23,197	74.98	4,591 (19.79)	7,726 (33.31)	5,808 (25.04)	5,072 (21.86)
Working	7,741	25.02	1,441 (18.62)	847 (10.94)	1,951 (25.20)	3,502 (45.24)
Partner's education						
No Education	7,750	25.17	2,063 (26.62)	2,428 (31.33)	1,966 (25.37)	1,293 (16.68)
Primary	9,442	30.67	1,709 (18.10)	2,511 (26.59)	2,350 (24.89)	2,872 (30.42)
Secondary	9,044	29.38	1,539 (17.02)	2,491 (27.54)	2,326 (25.72)	2,688 (29.72)
Higher	4,550	14.78	717 (15.76)	1,143 (25.12)	1,117 (24.55)	1,573 (34.57)
Partner's occupation						
Agricultural and Farming	7,375	24.05	1,499 (20.33)	2,338 (31.70)	1,892 (25.65)	1,646 (22.32)
Non-Agricultural	15,909	51.87	3,030 (19.05)	4,113 (25.85)	3,910 (24.58)	4,856 (30.52)
Business	6,793	22.15	1,325 (19.51)	1,905 (28.04)	1,739 (25.60)	1,824 (26.85)
No Works	594	1.94	150 (25.25)	175 (29.46)	186 (31.31)	83 (13.97)
Birth order						
First Child	11,528	37.26	2,020 (17.52)	3,089 (26.80)	3,069 (26.62)	3,350 (29.06)
Second Child	9,106	29.43	1,566 (17.20)	2,485 (27.29)	2,300 (25.26)	2,755 (30.25)
Third Child	5,094	16.46	1,006 (19.75)	1,454 (28.54)	1,207 (23.69)	1,427 (28.01)
≥ Fourth	5,212	16.85	1,440 (27.63)	1,545 (27.63)	1,185 (22.74)	1,042 (19.99)
Sanitation facilities						
Improved sanitation	16,072	57.76	2,241 (13.94)	4,130 (25.70)	4,832 (30.06)	4,869 (30.29)
Unimproved sanitation	10,787	38.77	2,824 (26.18)	3,255 (26.18)	2,066 (19.15)	2,642 (24.49)
Open defecation (no facility/bush/field)	967	3.48	370 (38.26)	333 (34.44)	192 (19.86)	72 (7.45)
ANC Visit						
No ANC	14,676	68.28	3751(25.56)	5322(36.26)	3031(20.65)	2572(17.53)
Any ANC	6,819	31.72	1116(16.37)	1909(28.0)	1421(20.84)	2373(34.80)
Improved Water						
Improved source	27,151	97.54	5,224 (19.24)	7,574 (27.90)	6,918 (25.48)	7,435 (27.38)
Unimproved source	685	2.46	215 (31.39)	144 (21.02)	178 (25.99)	148 (21.61)
Household wealth status						
Poorest	6,706	21.67	1,201 (17.91)	1,908 (28.45)	1,704 (25.41)	1,893 (28.23)
Poorer	6,126	19.80	1,264 (20.63)	1,666 (27.20)	1,483 (24.21)	1,713 (27.96)
Middle	5,788	18.71	1,128 (19.49)	1,631 (28.18)	1,494 (25.81)	1,535 (26.52)
Richer	6,096	19.70	1,132 (18.57)	1,678 (27.53)	1,586 (26.02)	1,700 (27.89)
Richest	6,224	20.12	1,307 (21.00)	1,690 (27.15)	1,494 (24.00)	1,733 (27.84)

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Prevalence of facility delivery

Table 2 shows that, in 2007, 16.76% women had facility delivery which increased over the years and in 2017-18 the percentage of facility delivery was 50.49%. From the analysis of this study, we can see that, in all three age groups most of the women had home delivery and women aged 15-24 had more facility delivery (32.07%) than the women in other age groups. Most of the women who were underweight went through home delivery (81.41%), but women who were overweight were more likely to have facility births (60.45%). Among women who had no ANC about 78.52% had home delivery and 59.72% had facility delivery who had any number of ANC. In case of birth orders, home delivery was found to be more frequent in all the categories and it increased with the increasing number of births, whereas the chance of facility birth was most during the first birth but decreased over the increasing number of births. However, the women who had their last birth caesarean had a high percentage (98.21%) of having facility birth. The percentage of home delivery was found to be greater than facility birth in both urban (52.74%) and rural (76.09%) areas of Bangladesh. However, the urban areas (47.26%) had more facility births than the rural areas (23.91%). The percentage of home delivery was found to be higher than facility birth even when the observations were categorized according to divisions and Khulna division was found to have more facility births (45.65%) compared to others. Facility birth was found to be more common among the wealthiest families (62.25%) but in all the other groups home delivery was found to be more frequent. The women and the partners who had higher education are more likely to have facility birth, 75.05% and 66.87% respectively. Women's working status, improved sanitation and water facilities do not seem to increase the rate of facility births, in all these cases the percentage of home delivery was found to be higher. Moreover, From Table 2, the prevalence rate shows that women residing in urban areas (48.89%, 95% CI: 47.60-50.19), higher educated mother (72.08%, 95% CI: 70.22-73.87), last birth by caesarean section (97.96%, 95% CI: 97.51-98.33), richest in wealth index (61.09%, 95% CI: 59.65-62.51) are more likely to have facility delivery than their counterparts. Figure 1 shows that the facility births have become more prevalent over the time from 2007 (14.48) to 2017 (49.26).

Table 2. Prevalence of using facility delivery across different socioeconomic varaibles				
Variables	**Home delivery (n/%)**	**Facility birth (n/%)**	**P-value**	**Weighted Prevalence (95% CI)**

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Place of residence			<0.001	
Urban	4,182 (52.74)	3,748 (47.26)		48.89 (47.60-50.19)
Rural	12,564 (76.09)	3,948 (23.91)		24.03 (23.43-24.65)
Divisions				
Barishal	2,109 (74.55)	720 (25.45)		22.55 (20.45-24.79)
Chattogram	3,427 (72.84)	1,278 (27.16)		26.49 (25.33-27.68)
Dhaka	2,831 (66.16)	1,448 (33.84)		32.50 (31.46-33.57)
Khulna	1,492 (54.35)	1,253 (45.65)		42.53 (40.49-44.61)
Rajshahi	2,199 (68.80)	997 (31.20)		24.22 (22.80-25.70)
Sylhet	2,360 (71.97)	919 (28.03)		28.84 (27.09-30.64)
New Division	2,328 (68.29)	1,081 (31.71)		30.83 (28.89-32.85)
Age of the mother (years)			<0.001	
15-24	8,538 (67.93)	4,030 (32.07)		30.88 (30.08-31.68)
25-34	6,748 (68.13)	3,156 (31.87)		29.75 (28.86-30.66)
35-49	1,460 (74.11)	510 (25.89)		23.54 (21.68-25.51)
Mother's BMI			<0.001	
<18.50 Underweight	5,046 (81.41)	1,152 (18.59)		17.70 (16.77-18.67)
18.51-24.99 Normal	10,064 (69.97)	4,320 (30.03)		28.65 (27.92-29.39)
≥ 25.0 Overweight/Obese	1,377 (39.55)	2,105 (60.45)		57.49 (55.81-59.16)
Mothers' education			<0.001	
No education	3,887 (91.29)	371 (8.71)		08.59 (07.80-09.56)
Primary	5,890 (81.19)	1,365 (18.81)		18.23 (17.36-19.12)
Secondary	6,326 (61.06)	4,035 (38.94)		37.53 (36.60-38.46)
Higher	640 (24.95)	1,925 (75.05)		72.08 (70.22-73.87)
Mothers' working status			<0.001	
No Work	13,048 (67.96)	6,152 (32.04)		30.48 (29.83-31.13)
Working	3,697 (70.55)	1,543 (29.45)		27.73 (26.56-28.93)
Partner's education			<0.001	
No education	5,501 (87.54)	783 (12.46)		15.85 (14.98-16.76)
Primary	5,633 (76.50)	1,730 (23.50)		33.36 (32.53-34.19)
Secondary	4,392 (61.26)	2,778 (38.74)		38.43 (37.11-39.77)
Higher	1,177 (33.13)	2,376 (66.87)		32.69 (28.66-36.98)
Partner's occupation			<0.001	
Agriculture	4,887 (82.69)	1,023 (17.31)		15.85 (14.98-16.76)
Non agriculture	8,200 (65.67)	4,287 (34.33)		33.36 (32.53-34.19)
Business	3,227 (59.91)	2,159 (40.09)		38.43 (37.11-39.77)
No works	327 (66.87)	162 (33.13)		32.69 (28.66-36.98)
ANC visit			<0.001	
No ANC	11,524 (78.52)	3,152 (21.48)		20.78(20.14-21.43)
Any ANC	2,746 (40.28)	4,071 (59.72)		57.97(56.76-59.16)
Birth order			<0.001	
First Child	5,213 (57.42)	3,866 (42.58)		40.75 (39.75-41.76)
Second Child	4,745 (67.01)	2,336 (32.99)		31.02 (29.96-32.10)
Third Child	3,042 (75.19)	1,004 (24.81)		23.57 (22.29-24.89)
≥ Fourth	3,746 (88.43)	490 (11.57)		10.43 (09.54-11.39)
Sanitation facilities			<0.001	
Improved sanitation	7,110 (58.71)	5,000 (41.29)		39.56 (38.68-40.45)
Unimproved	7,284 (82.15)	1,583 (17.85)		17.72 (16.95-18.56)
Open defecation	760 (90.05)	84 (9.95)		7.95 (6.40-9.76)
Improved water			<0.001	

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Improved source	14,696 (69,03)	6,593 (30.97)		29.31 (28.71-29.99)
Unimproved source	464 (86.25)	74 (13.75)		13.25 (10.37-16.79)
Household wealth status			<0.001	
Poorest	4,556 (87.20)	669 (12.80)		12.00 (11.17-12.89)
Poorer	4,001 (81.97)	880 (18.03)		17.98 (16.94-19.06)
Middle	3,350 (73.03)	1,237 (26.97)		26.23 (25.00-27.50)
Richer	2,972 (61.88)	1,831 (38.12)		37.47 (36.11-38.85)
Richest	1,867 (37.75)	3,079 (62.25)		61.09 (59.65-62.51)
Survey Year			<0.001	
2007	5021(83.24)	1011(16.76)		14.48 (13.60-15.39)
2011	6267(73.10)	2306(26.90)		24.49 (23.59-25.41)
2014	2842(61.04)	1814(38.96)		37.45 (36.09-38.82)
2017-18	2616(50.49)	2565(49.51)		49.26 (47.90-50.62)
CI: Confidence Interval				

Factors associated with facility delivery (Regression model)

The confidence intervals (CI) for the bivariate and multivariate regression models at 95% are presented in table 3 as unadjusted odds ratio (UOR) and adjusted odds ratio (AOR) respectively. The analyses showed that in all three years 2011, 2014, 2017 the facility birth increased compared to 2007 as the reference category, where in 2017 it was about 4 times higher. In both bivariate and multivariate analyses, it was found that women living in the urban areas; from Dhaka division and Khulna division; who are overweight; who had any level of education; belonging to wealthier families; had ANC; whose partners had any level of education and involved in business are more likely to have facility births compared to their respective counterparts. On the other hand, women from the divisions other than Dhaka and Khulna; belonged to age groups 25-34 years and 35-49 years; underweight; employed; had any number of children; had improved water and sanitation; whose partners were involved in agricultural or non-agricultural works were found to belong in the lower odds of facility birth.

The analysis shows that women in the age group 25-34 years were about 1.54 times (CI: 1.39-1.71) and in the age group 35-49 years were about 2.43 times (CI: 2.01-2.93) more likely to have facility birth compared to the age group 15-24 years. The women residing in the urban areas were 1.44 times (CI: 1.32-1.58) more likely to have facility birth. Overweight women were found to be 1.84 times (CI: 1.66-2.04) more likely to have facility birth, whereas underweight women were 0.83 times (CI: 0.75-0.91) less likely. Women who had any number of ANC were 2.38 times (CI: 2.20-2.58) more likely to have facility births and it tends to decrease with having more children over the time. Education played a great role in this study, where the findings show that with the

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increase of education level, more women tend to receive facility birth. Similar result was found with the increase of education level of partners. In case of the wealth status, the adjusted OR was observed to be increasing as the wealth status increased.

Table 3. Factors associated with facility delivery over times by background status				
Variables	UOR (95% CI)	P-Value	AOR (95% CI)	P-Value
Divisions				
Barishal	0.74 (0.66-0.82)	<0.001	0.76 (0.65-0.89)	0.001
Chattogram	0.80 (0.72-0.89)	<0.001	0.80 (0.70-0.92)	0.002
Dhaka	1.10 (1.00-1.21)	0.048	1.01 (0.88-1.17)	0.814
Khulna	1.80 (1.62-2.00)	<0.001	1.74 (1.49-2.00)	<0.001
Rajshahi	0.98 (0.89-1.08)	0.652	1.18 (1.01-1.36)	0.029
Sylhet	0.83 (0.75-0.93)	0.001	1.12 (0.96-1.29)	0.143
New division (RC)				
Place of Residence				
Urban	2.85 ((2.69-3.01)		1.44 (1.32-1.58)	<0.001
Rural (RC)				
Age of the mother (years)				
15-24(RC)				
25-34	0.99 (0.93-1.04)	0.750	1.54 (1.39-1.71)	<0.001
35-49	0.74 (0.66-0.82)	<0.001	2.43 (2.01-2.93)	<0.001
Mother's BMI				
<18.50 Underweight	0.53 (0.49-0.58)	<0.001	0.83 (0.75-0.91)	<0.001
18.51-24.99 Normal (RC)				
≥ 25.0 Overweight/Obese	3.57 (3.29-3.85)	<0.001	1.84 (1.66-2.04)	<0.001
Mother's education				
No education (RC)				
Primary	2.42 (2.14-2.74)	<0.001	1.33 (1,14-1.54)	<0.001
Secondary	6.68 (5.96-7.48)	<0.001	1.84 (1.58-2.15)	<0.001
Higher	31.51 (27.42-36.21)	<0.001	2.90 (2.37-3.56)	<0.001
Mother's working status				
Not Working (RC)				
Working	0.88 (0.82-0.94)	<0.001	.75 (0.67-0.81)	<0.001
Partner's education				
No education (RC)				
Primary	2.16 (1.97-2.37)	<0.001	1.07 (0.95-1.20)	0.250
Secondary	4.44 (4.07-4.86)	<0.001	1.24 (1,09-1.41)	0.001
Higher	14.18 (12.80-15.71)	<0.001	1.76 (1.49-2.06)	<0.001
Partner's occupation				
Agriculture and farming	0.42 (0.34-0.51)	<0.001	0.80 (0.61-1.05)	0.115
Non agriculture	1.06 (0.87-1.28)	0.583	0.90 (0.70-1.17)	0.459
Business	1.35 (1.11-1.64)	0.003	1.02 (0.78-1.32)	0.870
No works (RC)				
Household wealth status				
Poorest (RC)				

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Poorer	1.49(1.34-1.67)	<0.001	1.09 (0.95-1.25)	0.213
Middle	2.51(2.27-2.79)	<0.001	1.40 (1.23-1.62)	<0.001
Richer	4.19(3.79-4.66)	<0.001	1.79 (1.55-2.06)	<0.001
Richest	11.23(10.17-12.40)	<0.001	2.81 (2.38-3.30)	<0.001
ANC visit				
No ANC (RC)				
Any ANC	5.42 (5.09-5.77)	<0.001	2.38 (2.20-2.58)	<0.001
Birth order				
First child (RC)				
Second child	0.66 (0.622-0.70)	<0.001	0.54 (0.49-0.59)	<0.001
Third child	0.44 (0.40-0.48)	<0.001	0.40 (0.35-0.46)	<0.001
≥ Fourth	0.17 (0.16-0.19)	<0.001	0.24 (0.20-0.29)	<0.001
Sanitation facilities				
Improved sanitation facility (RC)				
Unimproved sanitation facility	0.30 (0.28-0.32)	<0.001	0.86 (0.79-0.95)	0.002
Open defecation (no facility/bush/field)	0.16 (0.12-0.19)	<0.001	0.92 (0.70-1.22)	0.594
Improved water				
Improved source (RC)				
Unimproved source	0.36 (0.27-0.46)	<0.001	0.56 (0.41-0.76)	<0.001
Year of survey				
2007 (RC)				
2011	1.82 (1.68-1.99)	<0.001	1.79 (1.60-2.02)	<0.001
2014	3.16 (2.89-3.46)	<0.001	3.08 (2.72-3.50)	<0.001
2017	4.87 (4.46-5.31)	<0.001	4.31 (3.79-4.91)	<0.001

RC: Reference Category; **CI**: Confidence Interval; **UOR:** Unadjusted Odds Ratio; **AOR:** Adjusted Odds ratio

Table 4. Decomposition of concentration index for measuring socioeconomic inequalities

Variables	Elasticity	CIX	Contribution to overall CIX = .30846363 (p<0.001)	
			Absolute contribution	Percentage contribution
Year of survey				
2007 (RC)				
2011	0.04996	-0.01743	-0.00087	-0.28225
2014	0.09074	0.00994	0.00090	0.29238
2017	0.12860	0.01957	0.00252	0.81592
Subtotal			***0.00255***	***0.82605***
Divisions				
Barishal	-0.00542	-0.19839	0.00108	0.34856
Chattogram	-0.01758	0.07951	-0.00140	-0.45309
Dhaka	-0.03364	0.11964	0.00402	-1.30471
Khulna	0.01602	0.05020	0.00080	0.26078

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Rajshahi	0.00138	-0.13950	-0.00019	-0.06254
Sylhet	0.00478	-0.13677	-0.00065	-0.21211
New Division (RC)				
Subtotal			*0.00366*	*-1.42311*
Place of residence				
Urban	0.05529	0.43257	0.02392	**7.75364**
Rural (RC)				
Age of the mother (years)				
15-24 years (RC)				
25-34 years	0.04567	0.02065	0.00094	0.30579
35-49 years	0.01955	-0.05456	-0.00107	-0.34573
Subtotal			*-0.00013*	*-0.03994*
Mother's education				
No education (RC)				
Primary	0.04190	-0.18996	-0.00796	-2.58021
Secondary	0.10407	0.14406	0.01499	4.86050
Higher	0.03779	0.53015	0.02003	6.49471
Subtotal			**0.02706**	**8.775**
Birth order				
First Child	0.16166	0.09870	0.01595	5.17229
Second Child	0.07459	0.03847	0.00287	0.93024
Third Child	0.02953	-0.05621	-0.00166	-0.53810
≥ Fourth (RC)				
Subtotal			**0.01716**	**5.56443**
Mother's BMI				
18.51-24.99 Normal (RC)				
< 18.50 Underweight	-0.01096	-0.21452	0.00235	0.76229
≥ 25.0 Overweight/Obese	0.01821	0.35794	0.00652	2.11304
Subtotal			*0.00887*	*2.87533*
Mother's working status				
Not working (RC)				
Working	-0.01294	-0.10246	**0.00133**	**0.42985**
ANC visit				
No ANC (RC)				
Any ANC	0.10026	0.26187	**0.02625**	**8.51151**
Partner's education				
No education (RC)				
Primary	0.00327	-0.12889	-0.00042	-0.13665
Secondary	0.02011	0.19627	0.00395	1.27947
Higher	0.01948	0.49977	0.00974	3.15675
Subtotal			*0.01327*	*4.29957*
Partner's occupation				
Agricultural and Farming	-0.04176	-0.31438	0.01313	4.25599

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Non-Agricultural	-0.05003	0.06158	-0.00308	-0.99866
Business	-0.01499	0.22144	-0.00332	-1.07585
No works (RC)				
Subtotal			***0.00673***	***0.00673***
Sanitation facilities				
Improved source (RC)				
Unimproved source	-0.01235	-0.25974	**0.00321**	**1.03965**
Open defecation (no facility/bush/field)	-0.00085	-0.56021	**0.00048**	**0.15433**
Improved water				
Improved source (RC)				
Unimproved source	-0.00609	-0.24382	**0.00148**	**0.48111**
Household wealth status				
Poorest (RC)				
Poorer	0.00623	-0.34487	**-0.00215**	**-0.69619**
Middle	0.01628	0.05059	**0.00082**	**0.26691**
Richer	0.03177	0.43868	**0.01394**	**4.51757**
Richest	0.05369	0.81707	**0.04387**	**14.22174**
Subtotal			***0.05648***	***18.31003***
Explained CIX				
Residual CIX				
CIX: Concentration Index; **RC**: Reference Category				

Decomposition of concentration index for facility delivery

Table 4 demonstrates the effects of several socioeconomic and demographic determinants in the utilisation of facility delivery and its inequalities. The column 'Elasticity' indicates the amount of change in the dependent variable (socioeconomic inequality in facility delivery) that occurs when the explanatory factors change by one unit. Elasticity with a positive or negative sign implies an increasing or decreasing trend in the facility delivery in conjunction with a positive change in the factor[22,23]. The distribution of the determinants in terms of wealth quintiles is shown by the column 'CIX.' The positive or negative direction of the CI signifies that the factors were more concentrated in either wealthy or impoverished groups. The percentage contribution illustrates how much each determinant in the model contributes to overall socioeconomic inequalities. A positive percentage contribution means a factor contributes to increase observed socioeconomic disparities of facility delivery. A negative percentage contribution, on the other hand, denotes a factor that is expected to reduce facility delivery-related socioeconomic inequalities. Decomposition analysis also showed that wealth quintiles (18.31%), mother's education (8.78%), place of residence (7.75%), birth order (5.56%) and partner's education (4.30%) and ANC seeking

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(8.51%), were the major contributors to the pro-rich socio-economic inequalities in utilizing facility delivery.

Insert Figure 1

Figure 1. Prevalence of utilizing facility delivery over time in Bangladesh (weighted)

Figure 1 depicts the overall prevalence of the likelihood of using facility delivery during the course of the year. With the passage of time, it is apparent that the facility delivery has increased. In 2007, the prevalence was only 14.48%, but it climbed by at least tenfold in 2011 (24.49 %), and in 2017-18, nearly half of all women used a facility delivery with skilled birth attendants SBA).

Insert Figure 2

Figure 2. Lorenz curve for inequality estimation

Figure 2 also illustrates the inequalities in facility delivery between the four different years using a Lorenz curve, where we can observe that all four concentration curves (CC) appeared below the line of equality, which implies that facility delivery was more prevalent among women who are from wealthy families. However, the CC appeared to become closer to the line of equality and over the years. In 2007 the distance between the line of equality and concentration curve was found to be the highest, but the gap decreased in 2017.

DISCUSSION

The current study investigated the socioeconomic inequalities associated with facility delivery among Bangladeshi population using the most recent set of demographic and health survey data. Socioeconomic inequality analysis has developed into a critical instrument for influencing policy decisions that are driven by inequities. The analysis discovered that facility delivery are more prevalent and concentrated among the wealthiest Bangladeshis in urban areas, and the prevalence is significantly reduced than in the previous round study. Household wealth status, women's education, ANC seeking,

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birth order, partner's education, and residing in urban regions all played a significant role in the pro-rich socioeconomic inequalities in facilitiy delivery.

Utilizing four consecutive nationally representatives BDHS data, this study revealed that there exist numerous socio-economic inequalities in using facility delivery. The level of socio-economic inequality in facility birth in Bangladesh is one of the uppermost among the South and East Asian countries[24]. The result of our study showed that the maximum number of respondents (67.30%) are from the rural areas, and most of them (81.04%) had their last birth normally, and the rural areas had lower (23.91%) facility births than the urban areas (47.26%). Results of this study indicated that respondents from the lower age group (15-24 years) and overweight had more facility delivery. Moreover, respondents from the wealthiest families and from the Khulna division were found to be more occupied with facility births. During the last ten years, starting from 2007 to 2017-18, the percentages of facility delivery have increased from 16.76% to 50.49% but are still low[25]. This study showed that respondents in 2017 had a higher likelihood of having facility births than the respondent in 2007 but still not sufficient. Facility birth is increasing but at a slower rate, and several studies showed similar results[26–28]. Regional difference in utilizing facilties is observed in this study and indicated that respondents from the Khulna and Dhaka division were more likely to have facility birth than the respondent from the new division. Regional differences and inequalities in utilizing facility delivery are common, and similar results exist like this study[28,29]. Young-aged respondents have more likelihood of having a delivery facility than respondents of a higher age group. Several studies showed the same results, and this is maybe the older women consider home delivery convenient and not risky[28,30]. Also, there is a big difference between the younger and older women in their knowledge and health care facility-seeking behavior. Younger women are keener about the knowledge and health care facilities[30]. There is a significant indication from the results mention that respondents from urban areas were more likely to use facility births compared to the respondent from rural areas in developing countries like Bangladesh[26,28,31–33]. Moreover, overweighted respondents have a higher likelihood of having facilities delivery compared to normal weighted respondents. Existing studies showed that respondents with not normal weight has a higher likelihood of having facility delivery[34–36]. A respondent may have more complicacy due to the overweight, and consequently, overweighted respondent tends to use more facility delivery.

Education is another significant influencing factor for the inequality in utilizing facility delivery. Respondents with a primary, secondary, or higher level of education were more likely to receive facility birth than the respondent with no education. Education plays the key element in making a woman independent and autonomous to make their own

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health care decisions as they become more concerned about their health. This behavior eventually enhanced the respondent's concern about the facility delivery[30,37,38]. Surprisingly, employed respondent were less likely to gain the chance the use facility delivery than those not working[35,36]. Maybe respondents with working status experience time constraints that decrease their chances of receiving facility delivery[29,39].

Again, respondents with educated partners have higher odds of utilizing facility delivery than the respondents with uneducated partners. Similar results exist about the existing inequalities of receiving facility delivery created by the education of the respondent and their husband[33,40–43]. Better health consciousness comes from better education, and educated families have higher chances of utilizing health care facilities. Household wealth status also plays a crucial role in the socio-economic inequalities in utilizing facility delivery. This study demonstrates that respondents from middle and rich families were more likely to utilize facility delivery than the respondents from low-income families. Obviously, the educated respondents with educated partners have a higher probability of getting a high-paid job or earning more money and being able to afford the expenses of maternal health care services like delivery facilities[30,38]. This finding of education and wealth index influencing inequalities of receiving facility delivery is consistent with the previous studies conducted in different countries[44–47]. These inequalities are influenced by different socio-economic and demographic reasons and their interactions[27,33,48]. Moreover, low-income households usually spend the majority of their income on food and daily necessities. Health care facilities and the educational cost is a burden for this group of people, and they are bound to use home-based facilities for their delivery. Consequently, low-educated and poor respondents are frequently deprived of facility delivery.

Additionally, this study revealed that respondents with an improved water supply and improved sanitation facilities have higher odds of utilizing facility delivery compared to the respondents with no improved water supply and unimproved sanitation facilities, which is a match with previous studies[49]. Sanitation and improved water facility of a respondent are mainly related to their education level and wealth status and hence showed the exact relation of more likelihood of utilizing facility delivery. Respondent on their first birth has their facility delivery compared to the respondents with second or higher birth order, which is similar to other previous studies like[44,50,51]. Like other studies' results, this study showed that respondents with antenatal care (ANC) have a higher likelihood of taking facility delivery than respondents with no ANC visit[35,52,53]. An ANC visit creates the consciousness among the respondent about the danger signs of labor and pregnancy complications which lead the respondent to utilize the facility delivery[35].

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Limitations and strength

The study has some limitations that includes some important factors related to the health of the respondent,and the delivery facility occurred due to the unavailability and missing information of those variables in BDHS data. Also, the cross-sectional nature of the study does not allow to draw causal conclusion. Nonetheless , the study showed many strengths by utilizing the data from a large sample of a nationwide representative and population-based survey. Another strength of the study is the use of a more thorough decomposition analysis to determine the factors that influence socioeconomic inequalities in facility delivery use.

Conclusions

This study found that women from urban areas who were overweight, had any level of education, were from affluent families, had ANC, and whose partners had any level of education and were involved in business were more likely to have facility delivery. This study also revealed a pro-rich inequality in facility delivery utilization in Bangladesh, indicating that facility delivery utilization was more concentrated among the wealthy groups. In order to increase the utilization of facility delivery in Bangladesh, existing socioeconomic inequalities in facility delivery must be addressed. In light of these findings, it is imperative to develop an intervention that focuses specifically on these significant associated factors in order to increase facility births. In addition, policy decision making could prioritise the design and implemention of various poverty alleviation programmes to reduce the socioeconomic inequalities in facility delivery in Bangladesh.

Contributors MAR accepts full responsibility for the work and/or the conduct of the study, had access to the data, and controlled the decision to publish. MAR also takes responsibility for the integrity and accuracy of the data analysis. MAR and SS performed the statistical analysis. MAR, SS, SKM, MAK, ZIK and HoR produced the first draft of the manuscript. MAR, SKM, MHH, BK, NJ, reviewed andundertook the scientifc editing of the manuscript both for statistical correctness and language appropriateness. All authors read   and   approved   the   fnal   version   for   publication.

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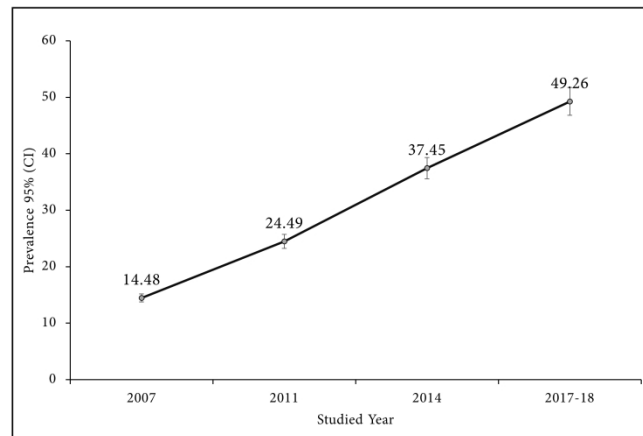
Legends

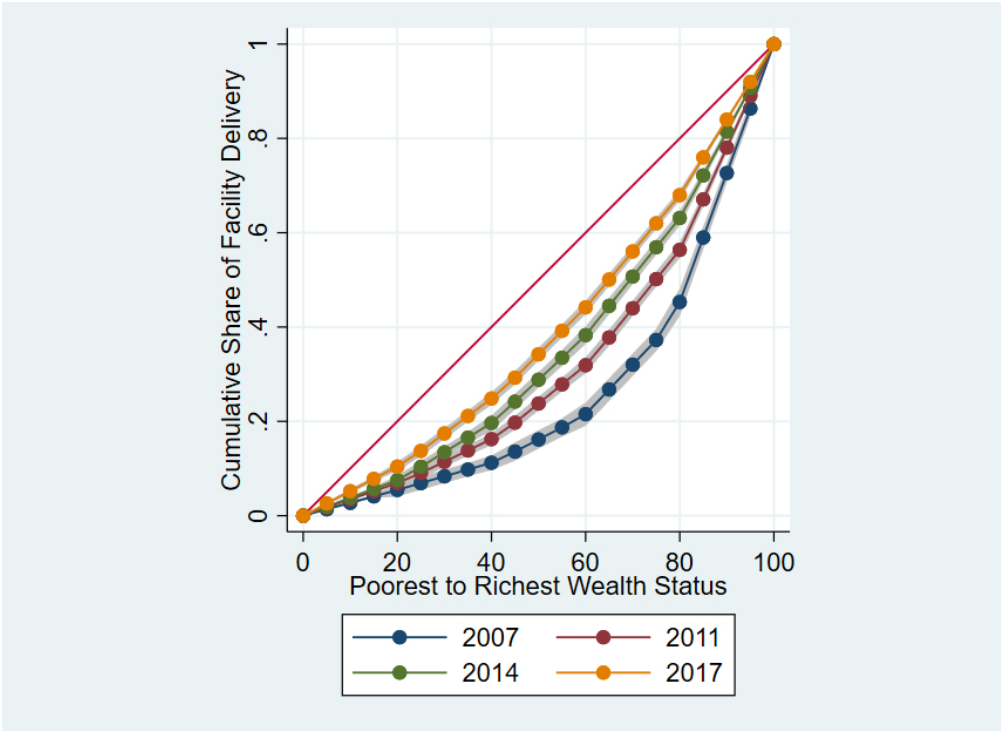**Figure 1**. Prevalence of utilizing facility delivery over time in Bangladesh (weighted)

Figure 2. Lorenz curve for inequality estimation

25

338x190mm (300 x 300 DPI)

300x219mm (72 x 72 DPI)

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	Page 1-2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	Page 1-2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	Page 3-4
Objectives	3	State specific objectives, including any prespecified hypotheses	Page 3-4
Methods			
Study design	4	Present key elements of study design early in the paper	Page 6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Page 2
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	Page 6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	Page 5
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Page 5-6
Bias	9	Describe any efforts to address potential sources of bias	Not applicable
Study size	10	Explain how the study size was arrived at	Page 5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Page 6 to 7
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	Page 5-7
		(*b*) Describe any methods used to examine subgroups and interactions	Not applicable
		(*c*) Explain how missing data were addressed	Not applicable
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	Not applicable
		(*e*) Describe any sensitivity analyses	Not applicable
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—e.g., numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	Page 7
		(b) Give reasons for non-participation at each stage	Not applicable
		(c) Consider use of a flow diagram	Not applicable
Descriptive data	14*	(a) Give characteristics of study participants (e.g., demographic, clinical, social) and information on exposures and potential confounders	Page 7 to 10
		(b) Indicate number of participants with missing data for each variable of interest	Not applicable
Outcome data	15*	Report numbers of outcome events or summary measures	Not applicable
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (e.g., 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Page 5-7
		(*b*) Report category boundaries when continuous variables were categorized	Not applicable
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	Not applicable
Other analyses	17	Report other analyses done—e.g., analyses of subgroups and interactions, and sensitivity analyses	Not applicable
Discussion			
Key results	18	Summarise key results with reference to study objectives	Page 16
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	Page 18
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Page 17-18
Generalisability	21	Discuss the generalisability (external validity) of the study results	Page 18
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Page 19

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Trends and Patterns of Inequalities in Utilizing Facility Delivery among Reproductive Age Women in Bangladesh: A Decomposition Analysis of 2007-2017Demographic and Health Survey Data

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1 *Title Page:*

2 **Trends and Patterns of Inequalities in Utilizing Facility Delivery among**
3 **Reproductive Age Women in Bangladesh: A Decomposition Analysis of**
4 **2007-2017Demographic and Health Survey Data**

5

6 **Md. Ashfikur Rahman[1]*, Sumaya Sultana[1], Satyajit Kundu[3], Md. Akhtarul Islam[4],**
7 **Harun Or Rahisd[4], Zahidul Islam Khan[5], Mortuza Tohan[1], Nusrat Jahan[1], Bayezid**
8 **Khan[1], Md. Hasan Howlader[1]**

9 [1]Development Studies Discipline, Social Science School, Khulna University, Khulna 9208,
10 Bangladesh
11 Email: ashfikur@ds.ku.ac.bd
12 ORCID: https://orcid.org/0000-0002-5517-8557
13 Email: sumayashurmy@gmail.com
14 Email: mortuzacreations@gmail.com
15 Email: nusratds16@gmail.com
16 Email: bayezidkhan@ku.ac.bd
17 ORCID: https://orcid.org/0000-0002-5792-0903
18 Email: hasan_ds@ku.ac.bd
19 ORCID: https://orcid.org/0000-0001-6603-7189
20

21 [3]Faculty of Nutrition and Food Science, Patuakhali Science and Technology University,
22 Patuakhali, Bangladesh
23 [3]School of Public Health, Southeast University, Nanjing 210009, China
24 [3]Global Health Institute, North South University, Dhaka 1229, Bangladesh
25 Email: satyajitnfs@gmail.com
26 ORCID: https://orcid.org/0000-0001-9610-1479

27 [4]Statistics Discipline, Khulna University, Khulna-9208, Bangladesh
28 Email: akhtarulstat@ku.ac.bd
29 ORCID: https://orcid.org/0000-0003-2396-2168
30

31 [4]Email: harunrasid97@gmail.com
32 ORCID: https://orcid.org/0000-0002-8697-4388
33

34 [6]Statistics Department, East West University, Dhaka-1212, Bangladesh
35 Email: zahid.drmc3809@gmail.com
36 ORCID: https://orcid.org/0000-0001-6592-5395
37

38

39

40 **Corresponding author:**
41 Md. Ashfikur Rahman
42 Faculty Member

1

43 Development Studies Discipline, Social Science School
44 Khulna University, Khulna 9208
45 Bangladesh
46 **Email:** ashfikur@ku.ac.bd, ashfikurr@gmail.com

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49 **Trends and Patterns of Inequalities in Utilizing Facility Delivery among**
50 **Reproductive Age Women in Bangladesh: A Decomposition Analysis of**
51 **2007- 2017 Demographic Health Survey Data**

Abstract

53 **Objectives** The prime objective of the study was to measure the prevalence of facility
54 delivery, assess socio-economic inequalities and to determine the potential associated
55 factors in the usage of facility delivery in Bangladesh.

56 **Setting** The study involved the investigation of cross-sectional secondary data that was
57 nationally representative from the Bangladesh Demographic and Health Survey (BDHS)
58 between 2007 and 2017–18.

59 **Participants** The participants in this study, which included 30,940 (weighted) Bangladeshi
60 women between the ages of 15 and 49.

61 **Methods** Decomposition analysis and multivariable logistic regression were both used to
62 analyse the data in regard to achieve the study objectives.

63 **Results** The prevalence of utilizing facility delivery in Bangladesh has increased from
64 14.48% in 2007 to 49.26% in 2017-18. The Concentration index (CIX) for facility delivery
65 utilization was (0.308**)** in respect to household wealth status (p<0.001), indicating that
66 utilizing facility delivery was more concentrated among the rich group of people.
67 Decomposition analysis also indicated that wealth quintiles (18.31%), mother's education
68 (8.78%), place of residence (7.75%), birth order (5.56%), partner's education (4.30%) and
69 ANC seeking (8.51%), were the major contributors to the pro-rich socio-economic
70 inequalities in utilizing facility delivery. This study found that women from urban areas,
71 who were overweight and had any level of education, from wealthier families, had ANC,
72 whose partners had any level of education and involved in business were more likely to
73 have facility births compared to their respective counterparts.

74 **Conclusion** This study found a pro-rich inequality in utilizing facility delivery in
75 Bangladesh. The socio-economic disparities in facility delivery must be addressed if facility
76 delivery usage is to increase in Bangladesh.

2

Keywords: Socioeconomic inequalities, Concentration index, Decomposition analysis, Facility delivery, Bangladesh

Strengths and limitations of this study

- ➢ This study used the four nationally representative surveys data with appropriate statistical technique to estimate the prevalence of utilizing facility delivery and its associated factors as well as the inequalities of using facility delivery over socioeconomic determinants. Therefore, the study results could be generalizable across the country.
- ➢ Our capacity to infer causality was constrained by the inherent drawbacks of cross-sectional study design.
- ➢ Some important factors related to the health of the respondent were not included due to the unavailability and missing information of those variables in BDHS data.

INTRODUCTION

The Maternal Mortality Ratio (MMR) is still a major health concern around the world, particularly in developing nations like Bangladesh. Maternal mortality, according to the World Health Organization, *is defined as "woman's death while pregnant or within 42 days of delivery or termination of pregnancy from any cause linked to, or aggravated by, pregnancy or its management, but excludes deaths from incidental or unintentional causes"*[1]. Globally, there were reportedly 287,000 maternal deaths in 2010, with low- and middle-income nations accounting for the majority of these deaths (LMICs)[2] and in 2017, approximately 295 000 women died both during and after pregnancy and delivery, with 94 percent of these deaths happening in low-resource settings; the vast majority of these deaths were preventable[3]. The MMR in low income countries in 2017 was 462 per 100 000 live births versus 11 per 100 000 live births in high income countries[3]. This depicts that high number of maternal deaths in some areas of the world reflects inequalities in access to quality health services and highlights the gap between rich and poor.

Reducing maternal mortality has long been a top global health concern; it is an MDG target and a key component of the UN Secretary- Global General's Strategy for Women's and Children's Health, which was unveiled in September 2010[4,5]. The Millennium Development Goals (MDGs 1990–2015) underlined the significance of reducing mother and infant mortality by 75% and promoting a global MMR reduction of 38%[6]. According to the Sustainable Development Goal 3, MMR will be decreased to less than 70 deaths per 100,000 live births by 2030. Bangladesh, Nepal, and Pakistan have all made significant progress in lowering MMR during the last few decades. Between 2010 and 2017, Bangladesh's MMR dropped to 173/100,000 live births, Nepal's to 186/100,0000, and

3

114 Pakistan's to 140/100,0000.[2]. In comparison to other LMICs around the world, the MMR
115 rates in these nations are still extremely high.
116

117 To reduce maternal mortality, the factors behind these deaths have to be identified. The
118 majority of these deaths are attributable to pregnancy-related delivery complications that
119 are largely preventable by relocating childbirth from the home to a health care facility [7–
120 10]. Other disorders might have existed before pregnancy, but if they are not treated as
121 part of the woman's treatment, they become more severe during pregnancy. Previous
122 research has identified a number of key factors that contribute to low health-care
123 utilisation, including poor health-seeking behaviour, weak health systems, low
124 socioeconomic status, cultural and personal health beliefs, a lack of access to appropriate
125 health services, high costs, long distances, a lack of transportation options, and poor
126 treatment quality[11,12]. Women who give birth at home in South Asia are more likely to
127 be exposed to unsafe and unclean conditions, putting the lives of mothers and newborns in
128 danger[13]. Several studies have found that using facility-based delivery services, family
129 planning, and antenatal and postnatal care enables maternal death reductions[8,14].

130 The main rationale of this article is to analyse the socio-economic inequalities in the
131 utilisation of facility delivery in Bangladesh over time, based on its context using four
132 rounds dataset to measure the trend and its contributing factors. Investigating the extent to
133 which socio-economic inequalities exist in facility delivery can aid in identifying the
134 underlying causes of these disparities, thereby informing the appropriate parties on how to
135 address them. There is few research that analyze the socioeconomic factors of maternal
136 health inequality in Bangladesh using Demographic and Health Survey (BDHS) data over a
137 period of time. The prime objectives of this study are three-folds: (i) to analyze the factors
138 of facility delivery in Bangladesh using the BDHS data from 2007 to 2017 to estimate the
139 prevalence and trend of using facility delivery over time using four rounds dataset; (ii) to
140 measure the socioeconomic inequality in the use of facility delivery; (iii) through
141 decomposition analysis, identify the primary components that explain socio-economic
142 inequality in facility delivery over the period of time.
143

METHODS

144

Data sources

145

146 Secondary data from the Bangladesh Demographic and Health Surveys (BDHS) was used in
147 this study (BDHS 2007, 2011, 2014 and 2017-18) [15]. Demographic and health surveys
148 are undertaken on a regular basis to determine the health status of the population. DHS
149 survey gives a comprehensive picture of the study population, covering overall maternal
150 and child health as well as a range of other health-care subject areas. The dataset has been
151 made freely available for academics and researchers to utilize on the internet. The

4

152 Institutional Review Board and country-specific review committees ethically authorized all
153 DHS survey protocols. The survey strategy, methodology, sampling, and questionnaires are
154 all detailed in the final report. Data was weighted using the appropriate method suggested
155 by DHS platform in order to do it we used svy command.

156

Outcome variable

158 The outcome variable in our studies was the place of delivery (0=Home, 1=Facility). If a
159 woman gave birth in a hospital run by the government, a district hospital, a maternal and
160 child welfare centre (MCWC), an Upazila health complex, a health and family welfare
161 centre, a private hospital or clinic, a private medical college or hospital, a rural health
162 centre, a basic health unit, a primary health care centre, an outreach clinic, or a clinic run by
163 a family planning association, the location of the birth was considered a "facility." If a lady
164 gave birth at the respondent's, a relative's, or a neighbor's home, it was regarded as a
165 "home delivery."

166

Explanatory variables

168 Following the variables were chosen based on the literature review[16–23] place of
169 residence, division, age of the mother, , mother's education, mother's employment status,
170 number of ANC visits, husband's education, husband's occupation, household wealth status;
171 health-related characteristics, mother's BMI, age at first birth and ANC seeking was coded if
172 the mother had taken at least four or more ANC during their last pregnancy. New division
173 was generated using two divisions Mymensingh and Rangpur because they were not
174 created during the earlier survey 2007 and 2011.

175

Statistical analysis

177 The background characteristics of the study populations have been described using
178 descriptive statistics, and weighted prevalence with 95% confidence intervals was
179 reported. The association between the predictor variable and the delivery location was
180 investigated using Chi-square testing. Multivariable logistic regression was used to
181 estimate the net influence of predictor variables on the outcome variable after confounding
182 variables were removed. We adjusted the multivariable and decomposition model based on
183 the p value less than (p<0.05). In the adjusted model, the factors that are statistically
184 significant at the 0.05 level are shown in the results section. Unadjusted/crude odds ratios
185 (cOR) and adjusted odds ratios (aOR) are presented in this article (AOR). All analyses were
186 carried out using Stata/MP 16 (StataCorp, College Station, Texas, USA).

187

188

5

Inequality measurement

190 The concentration curve (CC) and concentration index (CIX) were employed in their
191 relative formulations (with no correction) to study the inequalities in facility utilization
192 across analyzable socioeconomic factors of the population (women)[24]. The CIX in this
193 study represents horizontal inequity, because each woman in the study was assumed to
194 have the same need for a facility birth. CC was calculated by plotting the cumulative
195 proportion of women ranked by their wealth index score (poorest first) against the
196 cumulative proportion of facility deliveries on the y-axis. The absolute equality was shown
197 by the 45-degree slope from the origin. The use of institutional delivery is equal among
198 women if the CC intersects with the line of equality. If, on the other hand, the CC subtends
199 the line of equality below (above), then there is inequality in the use of institutional
200 delivery, which is skewed against women from low (high) socioeconomic backgrounds.
201 Further, the greater the degree of inequality, the more the CC deviates from the line of
202 equality. CIX was calculated to estimate the level of wealth-related inequality. CIX is
203 widened as twice the region between the line of equality and CC[24].

204 The following are some of the benefits of adopting CIX as a measure of healthcare
205 inequality: It considers the socio-economic dimension of healthcare inequalities because
206 individuals are classified based on their socio-economic status rather than their health
207 status; it captures the experience of the entire population; and it is sensitive to changes in
208 population distribution across socio-economic groups. The CIX takes a value between -1
209 and $+1$. When institutional delivery is evenly spread across socioeconomic categories, CIX
210 equals zero. The usage of institutional delivery is concentrated among the upper
211 socioeconomic classes if CIX has a positive value (pro-rich). A negative CIX score, on the
212 other hand, indicates that institutional delivery is mostly used by the poor (pro-
213 poor)[25].CIX was calculated using the "convenient covariance" formula provided by
214 O'Donnell et al.[24], as shown in the **Eq. 1** below.

215

216 $$CIX = \frac{2}{\mu} cov(h, r)$$

217

218 Here h is the health sector variable, μ is its mean, and $r = i/N$ is the fractional rank of
219 individual i in the living standards distribution, with $i = 1$ for the poorest and $i = N$
220 representing the richest. The user-written STATA commands Lorenz[26] and conindex[27]
221 were used to produce CC and measure CIX, respectively.

222

Decomposition of CIX

224 The relative CIX was decomposed to identify the proportion of inequality due to underlying
225 determinant inequality. The findings were evaluated and interpreted using Wagstaff's et

6

226 al.[24] and O'Donnell et al.[27] approach. The contribution of each determinant of facility
227 delivery to overall wealth-related inequality is determined as the product of the
228 determinant's sensitivity to facility delivery (elasticity) and the degree of wealth-related
229 inequality in that determinant (CIX of determinant). The residual is the portion of the CIX
230 that is not explained by the determinants.

231 The "elasticity" column indicates the change in the dependent variable (socioeconomic
232 disparity in facility delivery) resulting from a one-unit change in the explanatory factors. A
233 positive or negative elasticity score indicates an upward or downward trend in facility
234 delivery in response to a favourable change in the determinants.

235

Patient and public involvement

237 No patient involved.

238

RESULTS

Background characteristics of the study participants

241 Table 1 displays the socioeconomic and demographic characteristics of females aged 15 to
242 49. The table displays the results produced from 30,940 observations recorded in 2007,
243 2011, 2014, 2017-18, as well as the overall results derived from the data for all years
244 considered.

245 From the total data, we can conclude that the majority of women (67.30%) resided in rural
246 areas, with the majority hailing from Chittagong (18.88%) and Dhaka (17.24%). However,
247 21.67% of them belonged to the poorest category, and 19.80% to the poorer group. The
248 proportion of women aged 15 to 24 years is highest (48.81%), and secondary education
249 (42.90%), 97.54% had improved water, 57.76% had improved sanitation, but only 25.02%
250 were employed. In addition, 59.14% of women had a normal BMI, and 37.26% have already
251 given birth. Among the moms, 68.28% did not have ANC, yet the majority (81.04%) had a
252 normal last birth. In addition, the majority of partners had a primary education (30.67%)
253 and were primarily employed in non-agricultural occupations (51.87%).

Table 1. Background characteristics of the study participants

Variables	Frequency	Percentage	2007	2011	2014	2017-18
Total	30,940	100.00	6,032 (19.50)	8,573 (27.71)	7,761 (25.08)	8,574 (27.71)
Places of Residence						
Urban	10,116	32.70	2,054 (20.30)	2,621 (25.91)	2,446 (24.18)	2,995 (29.61)
Rural	20,824	67.30	3,978 (19.10)	5,952(28.58)	5,315 (25.52)	5,579 (26.79)
Division						
Barishal	3,522	11.38	779 (22.12)	955 (27.12)	897 (25.47)	891 (25.30)
Chattogram	5,842	18.88	1,235 (21.14)	1,710 (29.27)	1,487 (25.45)	1,410 (24.14)
Dhaka	5,333	17.24	1,266 (23.74)	1,421 (26.65)	1,363 (25.56)	1,283 (24.06)

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Khulna	3,403	11.00	701 (20.60)	963 (28.30)	853 (25.07)	886 (26.04)
Rajshahi	3,961	12.80	958 (24.19)	1,056 (26.66)	941 (23.76)	1,006 (25.40)
Sylhet	4,017	12.98	1,093 (27.21)	1,089 (27.11)	945 (23.53)	890 (22.16)
New Division	4,862	15.71	0 (0.00)	1,379 (28.36)	1,275 (26.22)	2,208 (45.41)
Age of the mother (years)						
15–24	15,101	48.81	2,963 (19.62)	4,275 (28.31)	3,810 (25.23)	4,053 (26.84)
25–34	13,138	42.46	2,434 (18.53)	3,555 (27.06)	3,332 (25.36)	3,817 (29.05)
35–49	2,701	8.73	635 (23.51)	743 (27.51)	619 (22.92)	704 (26.06)
Mother's BMI						
<18.50 Underweight	7,226	23.71	1,917 (26.53)	2,316 (32.05)	1,743 (24.12)	1,250 (17.30)
18.51-24.99 Normal	18,027	59.14	3,494 (19.38)	5,029 (27.90)	4,501 (24.97)	5,003 (27.75)
≥25.0 Overweight/Obese	5,229	17.15	545 (10.42)	1,038 (19.85)	1,454 (27.81)	2,192 (41.92)
Mother's education						
No education	5,134	16.60	1,638 (31.90)	1,654 (32.22)	1,215 (23.67)	627(12.21)
Primary	9,183	29.68	1,890 (20.58)	2,627(28.61)	2,171 (23.64)	2,495 (27.17)
Secondary	13,273	42.90	2,060 (15.52)	3,628 (27.33)	3,559 (26.81)	4,026 (30.33)
Higher	3,347	10.82	441 (13.18)	664 (19.84)	816 (24.38)	1,426 42.61)
Mothers' working status						
No work	23,197	74.98	4,591 (19.79)	7,726 (33.31)	5,808 (25.04)	5,072 (21.86)
Working	7,741	25.02	1,441 (18.62)	847 (10.94)	1,951 (25.20)	3,502 (45.24)
Partner's education						
No Education	7,750	25.17	2,063 (26.62)	2,428 (31.33)	1,966 (25.37)	1,293 (16.68)
Primary	9,442	30.67	1,709 (18.10)	2,511 (26.59)	2,350 (24.89)	2,872 (30.42)
Secondary	9,044	29.38	1,539 (17.02)	2,491 (27.54)	2,326 (25.72)	2,688 (29.72)
Higher	4,550	14.78	717 (15.76)	1,143 (25.12)	1,117 (24.55)	1,573 (34.57)
Partner's occupation						
Agricultural and Farming	7,375	24.05	1,499 (20.33)	2,338 (31.70)	1,892 (25.65)	1,646 (22.32)
Non-Agricultural	15,909	51.87	3,030 (19.05)	4,113 (25.85)	3,910 (24.58)	4,856 (30.52)
Business	6,793	22.15	1,325 (19.51)	1,905 (28.04)	1,739 (25.60)	1,824 (26.85)
No Works	594	1.94	150 (25.25)	175 (29.46)	186 (31.31)	83 (13.97)
Birth order						
First Child	11,528	37.26	2,020 (17.52)	3,089 (26.80)	3,069 (26.62)	3,350 (29.06)
Second Child	9,106	29.43	1,566 (17.20)	2,485 (27.29)	2,300 (25.26)	2,755 (30.25)
Third Child	5,094	16.46	1,006 (19.75)	1,454 (28.54)	1,207 (23.69)	1,427 (28.01)
≥ Fourth	5,212	16.85	1,440 (27.63)	1,545 (27.63)	1,185 (22.74)	1,042 (19.99)
Sanitation facilities						
Improved sanitation	16,072	57.76	2,241 (13.94)	4,130 (25.70)	4,832 (30.06)	4,869 (30.29)
Unimproved sanitation	10,787	38.77	2,824 (26.18)	3,255 (26.18)	2,066 (19.15)	2,642 (24.49)
Open defecation (no facility/bush/field)	967	3.48	370 (38.26)	333 (34.44)	192 (19.86)	72 (7.45)
ANC Visit						
No ANC	14,676	68.28	3751(25.56)	5322(36.26)	3031(20.65)	2572(17.53)
Any ANC	6,819	31.72	1116(16.37)	1909(28.0)	1421(20.84)	2373(34.80)
Improved Water						
Improved source	27,151	97.54	5,224 (19.24)	7,574 (27.90)	6,918 (25.48)	7,435 (27.38)
Unimproved source	685	2.46	215 (31.39)	144 (21.02)	178 (25.99)	148 (21.61)
Household wealth status						
Poorest	6,706	21.67	1,201 (17.91)	1,908 (28.45)	1,704 (25.41)	1,893 (28.23)
Poorer	6,126	19.80	1,264 (20.63)	1,666 (27.20)	1,483 (24.21)	1,713 (27.96)
Middle	5,788	18.71	1,128 (19.49)	1,631 (28.18)	1,494 (25.81)	1,535 (26.52)
Richer	6,096	19.70	1,132 (18.57)	1,678 (27.53)	1,586 (26.02)	1,700 (27.89)

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| Richest | 6,224 | 20.12 | 1,307 (21.00) | 1,690 (27.15) | 1,494 (24.00) | 1,733 (27.84) |

Prevalence of facility delivery

Table 2 shows that, in 2007, 16.76% women had facility delivery which increased over the years and in 2017-18 the percentage of facility delivery was 50.49%. Most of the women who were underweight went through home delivery (81.41%), but women who were overweight were more likely to have facility births (60.45%). Among women who had no ANC 78.52% had home delivery and 59.72% had facility delivery who had any number of ANC. In case of birth orders, home delivery was found to be more frequent in all the categories and it increased with the increasing number of births, whereas the chance of facility birth was most during the first birth but decreased over the increasing number of births. However, the women who had their last birth by caesarean section had a high percentage (98.21%) of having facility birth. The percentage of home delivery was found to be greater than facility birth in both urban (52.74%) and rural (76.09%) areas of Bangladesh. However, the urban areas (47.26%) had more facility births than the rural areas (23.91%). The percentage of home delivery was found to be higher than facility birth even when the observations were categorized according to divisions and Khulna division was found to have more facility births (45.65%) compared to others. Facility birth was found to be more common among the wealthiest families (62.25%) but in all the other groups home delivery was found to be more frequent. The women and the partners who had higher education are more likely to have facility birth, 75.05% and 66.87% respectively. Women's working status, improved sanitation and water facilities do not seem to increase the rate of facility births, in all these cases the percentage of home delivery was found to be higher. Moreover, From **Table 2**, the prevalence rate shows that women residing in urban areas (48.89%), higher educated mother (72.08%), last birth by caesarean section (97.96%), richest in wealth index (61.09%) are more likely to have facility delivery than their counterparts. **Figure 1** shows that the facility births have become more prevalent over the time from 2007 (14.48%) to 2017-18 (49.26%).

Table 2. Prevalence of using facility delivery across different socioeconomic variables				
Variables	**Dependent Variables**		**P-value**	**Weighted Prevalence (95% CI)**
	Home delivery (n/%)	**Facility birth (n/%)**		
Place of residence			<0.001	
Urban	4,182 (52.74)	3,748 (47.26)		48.89 (47.60-50.19)
Rural	12,564 (76.09)	3,948 (23.91)		24.03 (23.43-24.65)
Divisions				
Barishal	2,109 (74.55)	720 (25.45)		22.55 (20.45-24.79)
Chattogram	3,427 (72.84)	1,278 (27.16)		26.49 (25.33-27.68)
Dhaka	2,831 (66.16)	1,448 (33.84)		32.50 (31.46-33.57)
Khulna	1,492 (54.35)	1,253 (45.65)		42.53 (40.49-44.61)
Rajshahi	2,199 (68.80)	997 (31.20)		24.22 (22.80-25.70)
Sylhet	2,360 (71.97)	919 (28.03)		28.84 (27.09-30.64)

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New Division	2,328 (68.29)	1,081 (31.71)		30.83 (28.89-32.85)
Age of the mother (years)			<0.001	
15-24	8,538 (67.93)	4,030 (32.07)		30.88 (30.08-31.68)
25-34	6,748 (68.13)	3,156 (31.87)		29.75 (28.86-30.66)
35-49	1,460 (74.11)	510 (25.89)		23.54 (21.68-25.51)
Mother's BMI			<0.001	
<18.50 Underweight	5,046 (81.41)	1,152 (18.59)		17.70 (16.77-18.67)
18.51-24.99 Normal	10,064 (69.97)	4,320 (30.03)		28.65 (27.92-29.39)
≥ 25.0 Overweight/Obese	1,377 (39.55)	2,105 (60.45)		57.49 (55.81-59.16)
Mothers' education			<0.001	
No education	3,887 (91.29)	371 (8.71)		08.59 (07.80-09.56)
Primary	5,890 (81.19)	1,365 (18.81)		18.23 (17.36-19.12)
Secondary	6,326 (61.06)	4,035 (38.94)		37.53 (36.60-38.46)
Higher	640 (24.95)	1,925 (75.05)		72.08 (70.22-73.87)
Mothers' working status			<0.001	
No Work	13,048 (67.96)	6,152 (32.04)		30.48 (29.83-31.13)
Working	3,697 (70.55)	1,543 (29.45)		27.73 (26.56-28.93)
Partner's education			<0.001	
No education	5,501 (87.54)	783 (12.46)		15.85 (14.98-16.76)
Primary	5,633 (76.50)	1,730 (23.50)		33.36 (32.53-34.19)
Secondary	4,392 (61.26)	2,778 (38.74)		38.43 (37.11-39.77)
Higher	1,177 (33.13)	2,376 (66.87)		32.69 (28.66-36.98)
Partner's occupation			<0.001	
Agriculture	4,887 (82.69)	1,023 (17.31)		15.85 (14.98-16.76)
Non agriculture	8,200 (65.67)	4,287 (34.33)		33.36 (32.53-34.19)
Business	3,227 (59.91)	2,159 (40.09)		38.43 (37.11-39.77)
No works	327 (66.87)	162 (33.13)		32.69 (28.66-36.98)
ANC visit			<0.001	
No ANC	11,524 (78.52)	3,152 (21.48)		20.78(20.14-21.43)
Any ANC	2,746 (40.28)	4,071 (59.72)		57.97(56.76-59.16)
Birth order			<0.001	
First Child	5,213 (57.42)	3,866 (42.58)		40.75 (39.75-41.76)
Second Child	4,745 (67.01)	2,336 (32.99)		31.02 (29.96-32.10)
Third Child	3,042 (75.19)	1,004 (24.81)		23.57 (22.29-24.89)
≥ Fourth	3,746 (88.43)	490 (11.57)		10.43 (09.54-11.39)
Sanitation facilities			<0.001	
Improved sanitation	7,110 (58.71)	5,000 (41.29)		39.56 (38.68-40.45)
Unimproved	7,284 (82.15)	1,583 (17.85)		17.72 (16.95-18.56)
Open defecation	760 (90.05)	84 (9.95)		7.95 (6.40-9.76)
Improved water			<0.001	
Improved source	14,696 (69,03)	6,593 (30.97)		29.31 (28.71-29.99)
Unimproved source	464 (86.25)	74 (13.75)		13.25 (10.37-16.79)
Household wealth status			<0.001	
Poorest	4,556 (87.20)	669 (12.80)		12.00 (11.17-12.89)
Poorer	4,001 (81.97)	880 (18.03)		17.98 (16.94-19.06)
Middle	3,350 (73.03)	1,237 (26.97)		26.23 (25.00-27.50)
Richer	2,972 (61.88)	1,831 (38.12)		37.47 (36.11-38.85)
Richest	1,867 (37.75)	3,079 (62.25)		61.09 (59.65-62.51)
Survey Year			<0.001	
2007	5021(83.24)	1011(16.76)		14.48 (13.60-15.39)
2011	6267(73.10)	2306(26.90)		24.49 (23.59-25.41)
2014	2842(61.04)	1814(38.96)		37.45 (36.09-38.82)
2017-18	2616(50.49)	2565(49.51)		49.26 (47.90-50.62)
CI: Confidence Interval				

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Factors associated with facility delivery (Regression model)

The confidence intervals (CI) for the bivariate and multivariate regression models at 95% are presented in **Table 3** as unadjusted odds ratio (UOR) and adjusted odds ratio (AOR) respectively. The analyses showed that in all three years 2011, 2014, 2017-18 the facility birth increased compared to 2007 as the reference category, where in 2017 it was about 4 times higher. In both bivariate and multivariate analyses, it was found that women living in the urban areas; from Dhaka division and Khulna division; who are overweight; who had any level of education; belonging to wealthier families; had ANC; whose partners had any level of education and involved in business are more likely to have facility births compared to their respective counterparts. On the other hand, women from the divisions other than Dhaka and Khulna; belonged to age groups 25-34 years and 35-49 years; underweight; employed; had any number of children; had improved water and sanitation; whose partners were involved in agricultural or non-agricultural works were found to belong in the lower odds of facility birth.

The analysis shows that women in the age group 25-34 years were about 1.54 times (CI: 1.39-1.71) and in the age group 35-49 years were about 2.43 times (CI: 2.01-2.93) more likely to have facility birth compared to the age group 15-24 years. The women residing in the urban areas were 1.44 times (CI: 1.32-1.58) more likely to have facility birth. Overweight women were found to be 1.84 times (CI: 1.66-2.04) more likely to have facility birth, whereas underweight women were 0.83 times (CI: 0.75-0.91) less likely. Women who had any number of ANC were 2.38 times (CI: 2.20-2.58) more likely to have facility births and it tends to decrease with having more children over the time. Education played a great role to uptake facility delivery, where the findings show that with the increase of education level, more women tend to receive facility birth. Similar result was found with the increase of education level of partners. In case of the wealth status, the adjusted OR was observed to be increasing as the wealth status increased.

Table 3. Factors associated with facility delivery in Bangladesh				
	Dependent Variable			
Variables			**UOR (95% CI)**	**AOR (95% CI)**
Divisions	**Home**	**Facility**		
Barishal	2,109	720	0.74 (0.66-0.82)	0.76 (0.65-0.89)
Chattogram	3,427	1,278	0.80 (0.72-0.89)	0.80 (0.70-0.92)
Dhaka	2,831	1,448	1.10 (1.00-1.21)	1.01 (0.88-1.17)
Khulna	1,492	1,253	1.80 (1.62-2.00)	1.74 (1.49-2.00)
Rajshahi	2,199	997	0.98 (0.89-1.08)	1.18 (1.01-1.36)
Sylhet	2,360	919	0.83 (0.75-0.93)	1.12 (0.96-1.29)
New division (RC)	2,328	1,081		
Place of Residence				
Urban	4,182	3,748	2.85 ((2.69-3.01)	1.44 (1.32-1.58)
Rural (RC)	12,564	3,948		
Age of the mother (years)				

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15-24(RC)	8,538	4,030		
25-34	6,748	3,156	0.99 (0.93-1.04)	1.54 (1.39-1.71)
35-49	1,460	510	0.74 (0.66-0.82)	2.43 (2.01-2.93)
Mother's BMI				
<18.50 Underweight	5,046	1,152	0.53 (0.49-0.58)	0.83 (0.75-0.91)
18.51-24.99 Normal (RC)	10,064	4,320		
≥ 25.0 Overweight/Obese	1,377	2,105	3.57 (3.29-3.85)	1.84 (1.66-2.04)
Mother's education				
No education (RC)	3,887	371		
Primary	5,890	1,365	2.42 (2.14-2.74)	1.33 (1,14-1.54)
Secondary	6,326	4,035	6.68 (5.96-7.48)	1.84 (1.58-2.15)
Higher	640	1,925	31.51 (27.42-36.21)	2.90 (2.37-3.56)
Mother's working status				
Not Working (RC)	13,048	6,152		
Working	3,697	1,543	0.88 (0.82-0.94)	.75 (0.67-0.81)
Partner's education				
No education (RC)	5,501	783		
Primary	5,633	1,730	2.16 (1.97-2.37)	1.07 (0.95-1.20)
Secondary	4,392	2,778	4.44 (4.07-4.86)	1.24 (1,09-1.41)
Higher	1,177	2,376	14.18 (12.80-15.71)	1.76 (1.49-2.06)
Partner's occupation				
Agriculture and farming	4,887	1,023	0.42 (0.34-0.51)	0.80 (0.61-1.05)
Non agriculture	8,200	4,287	1.06 (0.87-1.28)	0.90 (0.70-1.17)
Business	3,227	2,159	1.35 (1.11-1.64)	1.02 (0.78-1.32)
No works (RC)	327	162		
Household wealth status				
Poorest (RC)	4,556	669		
Poorer	4,001	880	1.49(1.34-1.67)	1.09 (0.95-1.25)
Middle	3,350	1,237	2.51(2.27-2.79)	1.40 (1.23-1.62)
Richer	2,972	1,831	4.19(3.79-4.66)	1.79 (1.55-2.06)
Richest	1,867	3,079	11.23(10.17-12.40)	2.81 (2.38-3.30)
ANC visit				
No ANC (RC)	11,524	3,152		
Any ANC	2,746	4,071	5.42 (5.09-5.77)	2.38 (2.20-2.58)
Birth order				
First child (RC)	5,213	3,866		
Second child	4,745	2,336	0.66 (0.622-0.70)	0.54 (0.49-0.59)
Third child	3,042	1,004	0.44 (0.40-0.48)	0.40 (0.35-0.46)
≥ Fourth	3,746	490	0.17 (0.16-0.19)	0.24 (0.20-0.29)
Sanitation facilities				
Improved sanitation facility (RC)	7,110	5,000		
Unimproved sanitation facility	7,284	1,583	0.30 (0.28-0.32)	0.86 (0.79-0.95)
Open defecation (no facility/bush/field)	760	84	0.16 (0.12-0.19)	0.92 (0.70-1.22)
Improved water				
Improved source (RC)	14,696	6,593		
Unimproved source	464	74	0.36 (0.27-0.46)	0.56 (0.41-0.76)

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Year of survey				
2007 (RC)	5021	1011		
2011	6267	2306	1.82 (1.68-1.99)	1.79 (1.60-2.02)
2014	2842	1814	3.16 (2.89-3.46)	3.08 (2.72-3.50)
2017	2616	2565	4.87 (4.46-5.31)	4.31 (3.79-4.91)

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Decomposition of concentration index for facility delivery

310 **Table 4** illustrates the effects of key socioeconomic and demographic characteristics on
311 facility utilisation and its disparities. The column labelled "Elasticity" represents the
312 amount of change in the dependent variable (socioeconomic inequality in facility delivery)
313 caused by a one-unit change in the explanatory factors. Elasticity with a positive or
314 negative sign indicates a rising or falling trend in the facility's output in conjunction with a
315 positive change in the factor[28,29]. This study indicated that the values of the CIX for
316 facility delivery were (CIX: 0.30846363 (p0.001) among Bangladeshi households with a
317 higher socioeconomic status, indicating that the study uncovered a socioeconomic
318 inequality in favour of the wealthy for facility delivery. The column 'CIX' displays the
319 distribution of the determinants in terms of wealth quintiles. The positive or negative
320 direction of the CI indicates whether the factors were more prevalent in wealthy or poor
321 groups. The percentage contribution indicates how much each variable in the model
322 contributes to socioeconomic disparities as a whole. A positive percentage contribution
323 indicates that a factor contributes to the increase of observed socioeconomic gaps in the
324 provision of healthcare facilities. A negative percentage contribution, on the other hand,
325 indicates a component that is anticipated to reduce socioeconomic inequalities connected
326 to facility delivery. Wealth quintiles (18.31%), mother's education (8.78%), place of
327 residence (7.75%), birth order (5.56%), and partner's education (4.30%), as well as ANC
328 seeking (8.51%), were the significant contributors to the pro-rich socioeconomic
329 inequalities in facility delivery.

Variables	Elasticity	CIX	Contribution to overall CIX = 0.30846363 (p<0.001)	
			Absolute contribution	Percentage contribution
Year of survey				
2007 (RC)				
2011	0.04996	-0.01743	-0.00087	-0.28225
2014	0.09074	0.00994	0.00090	0.29238
2017	0.12860	0.01957	0.00252	0.81592
Subtotal			***0.00255***	***0.82605***
Divisions				
Barishal	-0.00542	-0.19839	0.00108	0.34856
Chattogram	-0.01758	0.07951	-0.00140	-0.45309
Dhaka	-0.03364	0.11964	0.00402	-1.30471
Khulna	0.01602	0.05020	0.00080	0.26078

Table 4. Decomposition of concentration index for measuring socioeconomic inequalities

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Rajshahi	0.00138	-0.13950	-0.00019	-0.06254
Sylhet	0.00478	-0.13677	-0.00065	-0.21211
New Division (RC)				
Subtotal			***0.00366***	***-1.42311***
Place of residence				
Urban	0.05529	0.43257	**0.02392**	**7.75364**
Rural (RC)				
Age of the mother (years)				
15-24 years (RC)				
25-34 years	0.04567	0.02065	0.00094	0.30579
35-49 years	0.01955	-0.05456	-0.00107	-0.34573
Subtotal			***-0.00013***	***-0.03994***
Mother's education				
No education (RC)				
Primary	0.04190	-0.18996	-0.00796	-2.58021
Secondary	0.10407	0.14406	0.01499	4.86050
Higher	0.03779	0.53015	0.02003	6.49471
Subtotal			**0.02706**	**8.775**
Birth order				
First Child	0.16166	0.09870	0.01595	5.17229
Second Child	0.07459	0.03847	0.00287	0.93024
Third Child	0.02953	-0.05621	-0.00166	-0.53810
≥ Fourth (RC)				
Subtotal			***0.01716***	***5.56443***
Mother's BMI				
18.51-24.99 Normal (RC)				
< 18.50 Underweight	-0.01096	-0.21452	0.00235	0.76229
≥ 25.0 Overweight/Obese	0.01821	0.35794	0.00652	2.11304
Subtotal			***0.00887***	***2.87533***
Mother's working status				
Not working (RC)				
Working	-0.01294	-0.10246	**0.00133**	**0.42985**
ANC visit				
No ANC (RC)				
Any ANC	0.10026	0.26187	**0.02625**	**8.51151**
Partner's education				
No education (RC)				
Primary	0.00327	-0.12889	-0.00042	-0.13665
Secondary	0.02011	0.19627	0.00395	1.27947
Higher	0.01948	0.49977	0.00974	3.15675
Subtotal			***0.01327***	***4.29957***
Partner's occupation				
Agricultural and Farming	-0.04176	-0.31438	0.01313	4.25599
Non-Agricultural	-0.05003	0.06158	-0.00308	-0.99866
Business	-0.01499	0.22144	-0.00332	-1.07585
No works (RC)				
Subtotal			***0.00673***	***0.00673***
Sanitation facilities				
Improved source (RC)				

14

Unimproved source	-0.01235	-0.25974	0.00321	1.03965
Open defecation (no facility/bush/field)	-0.00085	-0.56021	0.00048	0.15433
Subtotal			*0.00369*	*1.19398*
Improved water				
Improved source (RC)				
Unimproved source	-0.00609	-0.24382	**0.00148**	**0.48111**
Household wealth status				
Poorest (RC)				
Poorer	0.00623	-0.34487	-0.00215	-0.69619
Middle	0.01628	0.05059	0.00082	0.26691
Richer	0.03177	0.43868	0.01394	4.51757
Richest	0.05369	0.81707	0.04387	14.22174
Subtotal			*0.05648*	*18.31003*
Explained CIX			**0.148**	**45.91**
Residual CIX			**0.160**	**54.09**
CIX: Concentration Index; **RC:** Reference Category				

330

331   **Insert Figure 1**

332   **Figure 1**. Prevalence of utilizing facility delivery over time in Bangladesh (weighted)

333

334   **Figure 1** depicts the overall prevalence of the likelihood of using facility delivery during
335   the course of the year. With the passage of time, it is apparent that the facility delivery has
336   increased. In 2007, the prevalence was only 14.48%, but it climbed by at least tenfold in
337   2011 (24.49 %), and in 2017-18, nearly half of all women used a facility delivery with
338   skilled birth attendants (SBA).

339   **Insert Figure 2**

340   **Figure 2**. Lorenz curve for inequality estimation

341   By utilising a Lorenz curve, **Figure 2** also shows the disparities in facility delivery between
342   the four distinct years. We can see that all four concentration curves (CC) fell below the line
343   of equality, suggesting that facility delivery is more common among women from affluent
344   homes. Nevertheless, it seemed as though the CC was moving in the direction of equality.
345   The difference between the line of equality and the concentration curve was found to be at
346   its widest in 2007, but it narrowed in 2017.

347

348

349   **DISCUSSION**
350   The current study examined the socioeconomic inequalities associated with facility births
351   among the Bangladeshi population using the most recent demographic and health survey

15

352 data. An essential instrument for influencing policy choices that are influenced by
353 inequalities is now the analysis of socioeconomic inequality. Facility delivery is more
354 common and concentrated among the richest Bangladeshis living in metropolitan areas,
355 albeit it has substantially declined since the previous round of research. Household
356 financial status, women's education, ANC seeking, birth order, partner's education, and
357 living in urban regions all had a substantial impact on the pro-rich socioeconomic
358 inequalities in facility delivery.

359

360 Utilizing four consecutives nationally representative BDHS data, this study revealed that
361 there exist numerous socio-economic inequalities in using facility delivery. The level of
362 socio-economic inequality in facility birth in Bangladesh is one of the uppermost among the
363 South and East Asian countries[30]. The result of our study showed that the maximum
364 number of respondents (67.30%) are from the rural areas, and most of them (81.04%) had
365 their last birth normally, and the rural areas had lower (23.91%) facility births than the
366 urban areas (47.26%). Results of this study indicated that respondents from the lower age
367 group (15-24 years) and overweight had more facility delivery. Moreover, respondents
368 from the wealthiest families and from the Khulna division were found to be more occupied
369 with facility births. During the last ten years, starting from 2007 to 2017-18, the
370 percentages of facility delivery have increased from 16.76% to 50.49% but are still
371 low[19]. This study showed that respondents in 2017 had a higher likelihood of having
372 facility births than the respondent in 2007 but still not sufficient. Facility birth is increasing
373 but at a slower rate, and several studies showed similar results[18,31,32]. Regional
374 difference in utilizing facilities is observed in this study and indicated that respondents
375 from the Khulna and Dhaka divisions were more likely to have facility birth than the
376 respondent from the new division. Regional differences and inequalities in utilizing facility
377 delivery are common, and similar results exist like this study[32,33]. Young-aged
378 respondents have more likelihood of having a delivery facility than respondents of a higher
379 age group. Several studies showed the same results, and this is maybe the older women
380 consider home delivery convenient and not risky[32,34]. Also, there is a big difference
381 between the younger and older women in their knowledge and health care facility-seeking
382 behavior. Younger women are more interested to seek knowledge and and health care
383 facilities[34]. Women from urban areas were more likely to use facility births in
384 comparison to the respondents from rural areas in developing countries like
385 Bangladesh[16–18,32,35]. Moreover, overweighted respondents have a higher likelihood of
386 having facilities delivery compared to normal weighted respondents. Existing studies
387 showed that respondents with non-normal weight has a higher likelihood of having facility
388 delivery[36–38]. A respondent may have more complicacy due to the overweight, and
389 consequently, overweighted respondent tends to use more facility delivery.

390 Education is another significant influencing factor for the inequality in utilizing facility
391 delivery. Respondents with a primary, secondary, or higher level of education were more
392 likely to receive facility birth than the respondent with no education. Education plays the
393 key role in making a woman independent and autonomous to make their own health care
394 decisions as they become more concerned about their health. This behavior eventually

16

395 enhanced the respondent's concern about the facility delivery[23,34,39]. Surprisingly,
396 employed respondent were less likely to gain the chance the use facility delivery than those
397 not working[37,38]. Maybe respondents with working status experience time constraints
398 that decrease their chances of receiving facility delivery[33,40].

399 Again, respondents with educated partners have higher odds of utilizing facility delivery
400 than the respondents with uneducated partners. Similar results exist about the existing
401 inequalities of receiving facility delivery created by the education of the respondent and
402 their husband[16,41–44]. Education improves health awareness, and families with more
403 education are more likely to utilize health care services. The socioeconomic disparities in
404 facility delivery are also strongly influenced by the affluent position of households. This
405 study reveals that respondents from middle-class and affluent families were more likely to
406 have facility delivery than those from low-income homes. Clearly, educated respondents
407 with educated partners have a greater likelihood of obtaining a high-paying job or earning
408 more money and being able to afford maternal health care services such as delivery
409 facilities[34,39]. This finding of education and wealth index influencing inequalities of
410 receiving facility delivery is consistent with the previous studies conducted in different
411 countries[45–48]. These inequalities are influenced by different socio-economic and
412 demographic reasons and their interactions[16,31,49]. Moreover, the majority of a low-
413 income family's money is typically spent on food and everyday necessities. The cost of
414 health care facilities and education is a hardship for this population; hence they must
415 utilize home-based facilities for their delivery. Therefore, low-educated and
416 underprivileged individuals are typically denied access to facilities.

417 Additionally, this study revealed that respondents with an improved water supply and
418 improved sanitation facilities have higher odds of utilizing facility delivery compared to the
419 respondents with no improved water supply and unimproved sanitation facilities, which is
420 a match with previous studies[50]. Sanitation and better water facilities of a respondent
421 are primarily related to their education level and socioeconomic standing, demonstrating a
422 direct correlation between the two variables. Compared to respondents with a second or
423 higher birth order, first-time mothers are more likely to have a facility delivery for their
424 first child[45,51,52]. Like other studies' results, this study showed that respondents with
425 antenatal care (ANC) have a higher likelihood of taking facility delivery than respondents
426 with no ANC visit[37,53,54]. An ANC visit creates the consciousness among the respondent
427 about the danger signs of labor and pregnancy complications which lead the respondent to
428 utilize the facility delivery[37].

429

430 **Policy implications**
431 This research found a pro-rich inequality existing in Bangladeshi women's use of birthing
432 facilities. Therefore, if public health policies and interventions were implemented to
433 increase the number of births that take place in these settings, such as the provision of
434 birth centres, the training and assurance of Skilled Birth Attendants (SBAs), the use of mass
435 media for health education and raising awareness, the implementation of mandatory
436 female education, the participation of men in pregnancy and childbirth.

17

437

Limitations and strength

439 The study has some limitations that includes some important factors related to the health
440 of the respondents, and the delivery facility occurred due to the unavailability and missing
441 information such as cost of facility or cesarean birth, insurance, distance, waiting time, the
442 healthcare practitioners' behaviour, and availability of transportation facilities. Since this
443 study has been undertaken based on the consecutive nationally representative datasets
444 therefore, generalizability of the findings is more. Also, the cross-sectional nature of the
445 study does not allow to draw causal conclusion. Nonetheless, the study showed many
446 strengths by utilizing the data from a large sample of a nationwide representative and
447 population-based survey. Another strength of the study is the use of a more thorough
448 decomposition analysis to determine the factors that influence socioeconomic inequalities
449 in facility delivery use. This is the robust method to estimate the health-related inequality
450 which is widely used in the public health literature. In addition, using CIX as a measure of
451 inequality index in healthcare has the following benefits: it captures the experience of the
452 entire population; it takes into account the socioeconomic dimension of facility delivery
453 because the classification of individuals is based on their socioeconomic status rather than
454 their health status; it is sensitive to changes in population distribution across
455 socioeconomic groups.

456

Conclusions

458 This study indicated that women from urban areas who were overweight, had any level of
459 education, from wealthy households, had ANC, and whose partners had any level of
460 education and were involved in business profession were more likely to deliver in a
461 hospital. This study also found a pro-rich inequality in facility delivery utilisation in
462 Bangladesh, indicating that facility delivery utilisation was more prevalent among
463 wealthier people. Existing socioeconomic inequalities in facility delivery must be addressed
464 in order to boost the utilisation of facility delivery in Bangladesh. In light of these findings,
465 it is essential to establish an intervention that targets these important linked factors in
466 order to increase births in a hospital. Moreover, policy decision-making might prioritise the
467 design and implementation of various poverty alleviation projects to eliminate
468 socioeconomic disparities in facility delivery in Bangladesh.

18

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480 **Competing interests** None declared.
481 **Patient consent for publication** Not required.
482 **Provenance and peer review** Not commissioned; externally peer reviewed.
483 **Data availability statement** Data can be free accessible upon request to the DHS website
484 (https://dhsprogram.com/data/dataset_admin/index.cfm) [15].

Ethics Approval

486 The study used deidentified data from the Demographic Health Survey program, which has
487 already received ethical approval from the participating countries, no further ethical
488 permission was sought to carry out this research. Data was collected from online source
489 (https://dhsprogram.com) with appropriate request.

490
491

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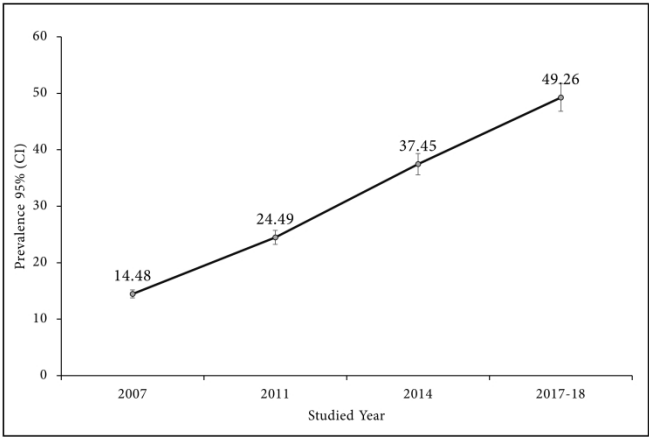
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638

639   **Figure Legends**

640   **Figure 1**. Prevalence of utilizing facility delivery over time in Bangladesh (weighted)

641   **Figure 2**. Lorenz curve for inequality estimation

642

643

338x190mm (300 x 300 DPI)

300x219mm (72 x 72 DPI)

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	Page 1-2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	Page 1-2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	Page 3-4
Objectives	3	State specific objectives, including any prespecified hypotheses	Page 3-4
Methods			
Study design	4	Present key elements of study design early in the paper	Page 6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Page 2
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	Page 6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	Page 5
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Page 5-6
Bias	9	Describe any efforts to address potential sources of bias	Not applicable
Study size	10	Explain how the study size was arrived at	Page 5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Page 6 to 7
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	Page 5-7
		(*b*) Describe any methods used to examine subgroups and interactions	Not applicable
		(*c*) Explain how missing data were addressed	Not applicable
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	Not applicable
		(*e*) Describe any sensitivity analyses	Not applicable
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—e.g., numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	Page 7
		(b) Give reasons for non-participation at each stage	Not applicable
		(c) Consider use of a flow diagram	Not applicable
Descriptive data	14*	(a) Give characteristics of study participants (e.g., demographic, clinical, social) and information on exposures and potential confounders	Page 7 to 10
		(b) Indicate number of participants with missing data for each variable of interest	Not applicable
Outcome data	15*	Report numbers of outcome events or summary measures	Not applicable
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (e.g., 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Page 5-7
		(*b*) Report category boundaries when continuous variables were categorized	Not applicable
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	Not applicable
Other analyses	17	Report other analyses done—e.g., analyses of subgroups and interactions, and sensitivity analyses	Not applicable
Discussion			
Key results	18	Summarise key results with reference to study objectives	Page 16
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	Page 18
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Page 17-18
Generalisability	21	Discuss the generalisability (external validity) of the study results	Page 18
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Page 19

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Trends and Patterns of Inequalities in Utilizing Facility Delivery among Reproductive Age Women in Bangladesh: A Decomposition Analysis of 2007-2017Demographic and Health Survey Data

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Trends and Patterns of Inequalities in Utilizing Facility Delivery among Reproductive Age Women in Bangladesh: A Decomposition Analysis of 2007-2017 Demographic and Health Survey Data

Md. Ashfikur Rahman[1]*, Sumaya Sultana[1], Satyajit Kundu[3], Md. Akhtarul Islam[4], Harun Or Rashid[4], Zahidul Islam Khan[5], Mortuza Tohan[1], Nusrat Jahan[1], Bayezid Khan[1], Md. Hasan Howlader[1]

[1]Development Studies Discipline, Social Science School, Khulna University, Khulna 9208, Bangladesh
Email: ashfikur@ds.ku.ac.bd
ORCID: https://orcid.org/0000-0002-5517-8557
Email: sumayashurmy@gmail.com
Email: mortuzacreations@gmail.com
Email: nusratds16@gmail.com
Email: bayezidkhan@ku.ac.bd
ORCID: https://orcid.org/0000-0002-5792-0903
Email: hasan_ds@ku.ac.bd
ORCID: https://orcid.org/0000-0001-6603-7189

[3]Faculty of Nutrition and Food Science, Patuakhali Science and Technology University, Patuakhali, Bangladesh
[3]School of Public Health, Southeast University, Nanjing 210009, China
[3]Global Health Institute, North South University, Dhaka 1229, Bangladesh
Email: satyajitnfs@gmail.com
ORCID: https://orcid.org/0000-0001-9610-1479

[4]Statistics Discipline, Khulna University, Khulna-9208, Bangladesh
Email: akhtarulstat@ku.ac.bd
ORCID: https://orcid.org/0000-0003-2396-2168

[4]Email: harunrasid97@gmail.com
ORCID: https://orcid.org/0000-0002-8697-4388

[6]Statistics Department, East West University, Dhaka-1212, Bangladesh
Email: zahid.drmc3809@gmail.com
ORCID: https://orcid.org/0000-0001-6592-5395

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40 **Corresponding author:**

41 Md. Ashfikur Rahman

42 Faculty Member

43 Development Studies Discipline, Social Science School

44 Khulna University, Khulna 9208

45 Bangladesh

46 **Email:** ashfikur@ds.ku.ac.bd

47   ashfikurr@gmail.com

48

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50 **Trends and Patterns of Inequalities in Utilizing Facility Delivery among**
51 **Reproductive Age Women in Bangladesh: A Decomposition Analysis**
52 **of 2007- 2017 Demographic Health Survey Data**

Abstract

53

54 **Objectives** The prime objective of the study was to measure the prevalence of facility
55 delivery, assess socio-economic inequalities and to determine the potential associated
56 factors in the usage of facility delivery in Bangladesh.

57 **Setting** The study involved the investigation of cross-sectional secondary data that was
58 nationally representative from the Bangladesh Demographic and Health Survey (BDHS)
59 between 2007 and 2017–18.

60 **Participants** The participants in this study, which included 30,940 (weighted)
61 Bangladeshi women between the ages of 15 and 49.

62 **Methods** Decomposition analysis and multivariable logistic regression were both used
63 to analyze the data in regard to achieve the study objectives.

64 **Results** The prevalence of utilizing facility delivery in Bangladesh has increased from
65 14.48% in 2007 to 49.26% in 2017-18. The Concentration index (CIX) for facility delivery
66 utilization was (0.308**)** in respect to household wealth status (p<0.001), indicating that
67 utilizing facility delivery was more concentrated among the rich group of people.
68 Decomposition analysis also indicated that wealth quintiles (18.31%), mother's

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69 education (8.78%), place of residence (7.75%), birth order (5.56%), partner's education
70 (4.30%) and ANC seeking (8.51%), were the major contributors to the pro-rich socio-
71 economic inequalities in utilizing facility delivery. This study found that women from
72 urban areas, who were overweight and had any level of education, from wealthier
73 families, had ANC, whose partners had any level of education and involved in business
74 were more likely to have facility births compared to their respective counterparts.

75 **Conclusion** This study found a pro-rich inequality in utilizing facility delivery in
76 Bangladesh. The socio-economic disparities in facility delivery must be addressed if
77 facility delivery usage is to increase in Bangladesh.

78 **Keywords:** Socioeconomic inequalities, Concentration index, Decomposition analysis,
79 Facility delivery, Bangladesh

Strengths and limitations of this study

81 ➤ This study used the four nationally representative surveys data with appropriate
82 statistical technique to estimate the prevalence of utilizing facility delivery and its
83 associated factors as well as the inequalities of using facility delivery over
84 socioeconomic determinants. Therefore, the study results could be generalizable
85 across the country.
86 ➤ Our capacity to infer causality was constrained by the inherent drawbacks of
87 cross-sectional study design.
88 ➤ Some important factors related to the health of the respondent were not
89 included due to the unavailability and missing information of those variables in
90 BDHS data.
91 ➤ Using the robust technique concentration index (CIX), a relative measure of
92 inequality was employed to quantify wealth-related inequality in facility delivery
93 utilization.
94 ➤ Cluster effect and sample weighting were taken into consideration in the analysis
95 of the present study.

96

INTRODUCTION

98 The Maternal Mortality Ratio (MMR) is still a major health concern around the world,
99 particularly in developing nations like Bangladesh. Maternal mortality, according to the

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100   World Health Organization*, is defined as "woman's death while pregnant or within 42*
101   *days of delivery or termination of pregnancy from any cause linked to, or aggravated by,*
102   *pregnancy or its management, but excludes deaths from incidental or unintentional*
103   *causes"*[1]. Globally, there were reportedly 287,000 maternal deaths in 2010, with low-
104   and middle-income nations accounting for the majority of these deaths (LMICs)[2] and
105   in 2017, approximately 295 000 women died both during and after pregnancy and
106   delivery, with 94 percent of these deaths happening in low-resource settings; the vast
107   majority of these deaths were preventable[3]. The MMR in low income countries in 2017
108   was 462 per 100 000 live births versus 11 per 100 000 live births in high income
109   countries[3]. This depicts that high number of maternal deaths in some areas of the
110   world reflects inequalities in access to quality health services and highlights the gap
111   between rich and poor.

112   Reducing maternal mortality has long been a top global health concern; it is an MDG
113   target and a key component of the UN Secretary- Global General's Strategy for
114   Women's and Children's Health, which was unveiled in September 2010[4,5]. The
115   Millennium Development Goals (MDGs 1990–2015) underlined the significance of
116   reducing mother and infant mortality by 75% and promoting a global MMR reduction of
117   38%[6]. According to the Sustainable Development Goal 3, MMR will be decreased to
118   less than 70 deaths per 100,000 live births by 2030. Bangladesh, Nepal, and Pakistan
119   have all made significant progress in dropping MMR during the last few decades.
120   Between 2010 and 2017, Bangladesh's MMR dropped to 173/100,000 live births, Nepal's
121   to 186/100,0000, and Pakistan's to 140/100,0000.[2]. In comparison to other LMICs
122   around the world, the MMR rates in these nations are still extremely high. Bangladesh is
123   a developing country having with eight administrative regions (Dhaka, Chattagong,
124   Rajshahi, Khulna, Barishal, Sylhet, Rangpur, Mymensingh) and a total of more than 168
125   million, the data were collected from the eight regions using multistage-cluster
126   sampling.
127

128   To reduce maternal mortality, the factors behind these deaths have to be identified. The
129   majority of these deaths are attributable to pregnancy-related delivery complications
130   that are largely preventable by relocating childbirth from the home to a health care
131   facility [7–10]. Other disorders might have existed before pregnancy, but if they are not
132   treated as part of the woman's treatment, they become more severe during pregnancy.
133   Previous research has identified a number of key factors that contribute to low health-
134   care utilization, including poor health-seeking behaviour, weak health systems, low

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135 socioeconomic status, cultural and personal health beliefs, a lack of access to
136 appropriate health services, high costs, long distances, a lack of transportation options,
137 and poor treatment quality[11,12]. Women who give birth at home in South Asia are
138 more likely to be exposed to unsafe and unclean conditions, putting the lives of mothers
139 and newborns in danger[13]. Several studies have found that using facility-based
140 delivery services, family planning, and antenatal and postnatal care enables maternal
141 death reductions[8,14].

142 The main rationale of this article is to analyze the socio-economic inequalities in the
143 utilization of facility delivery in Bangladesh over time, based on its context using four
144 rounds dataset to measure the trend and its contributing factors. Investigating the
145 extent to which socioeconomic inequalities exist in facility delivery can aid in identifying
146 the underlying causes of these disparities, thereby informing the appropriate parties on
147 how to address them. There is few research that analyze the socioeconomic factors of
148 maternal health inequality in Bangladesh using Demographic and Health Survey (BDHS)
149 data over a period of time. The prime objectives of this study are three-folds: (i) to
150 analyze the factors of facility delivery in Bangladesh using the BDHS data from 2007 to
151 2017-18 to estimate the prevalence and trend of using facility delivery over time using
152 four rounds dataset; (ii) to measure the socioeconomic inequality in the use of facility
153 delivery; (iii) through decomposition analysis, identify the primary components that
154 explain socioeconomic inequality in facility delivery over the period of time.

155

156

METHODS

Data sources

159 Secondary data from the Bangladesh Demographic and Health Surveys (BDHS) was used
160 in this study (BDHS 2007, 2011, 2014 and 2017-18). Demographic and health surveys are
161 undertaken on a regular basis to determine the health status of the population. DHS
162 survey gives a comprehensive picture of the study population, covering overall maternal
163 and child health as well as a range of other health-care subject areas. The dataset has
164 been made freely available for academics and researchers to utilize on the internet. The
165 Institutional Review Board and country-specific review committees ethically authorized
166 all DHS survey protocols. The survey strategy, methodology, sampling, and
167 questionnaires are all detailed in the final report.

5

Outcome variable

169 The outcome variable in our studies was the place of delivery (0=Home, 1=Facility). If a
170 woman gave birth in a hospital run by the government, a district hospital, a maternal
171 and child welfare centre (MCWC), an Upazila health complex, a health and family welfare
172 centre, a private hospital or clinic, a private medical college or hospital, a rural health
173 centre, a basic health unit, a primary health care centre, an outreach clinic, or a clinic run
174 by a family planning association, the location of the birth was considered a "facility." If a
175 lady gave birth at the respondent's, a relative's, or a neighbor's home, it was regarded as
176 a "home delivery."

177

Explanatory variables

179 Following the variables were chosen based on the literature review[15–22] place of
180 residence, division, age of the mother, , mother's education, mother's employment
181 status, number of ANC visits, husband's education, husband's occupation, household
182 wealth status; health-related characteristics, mother's BMI, age at first birth and ANC
183 seeking was coded if the mother had taken at least four or more ANC during their last
184 pregnancy. New division was generated using two divisions Mymensingh and Rangpur
185 because they were not created during the earlier survey 2007 and 2011.

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188

Statistical analysis

190 Data was weighted using the appropriate method suggested by DHS platform in order
191 to do it we used svy command. The background characteristics of the study populations
192 have been described using descriptive statistics, and weighted prevalence with 95%
193 confidence intervals was reported. The association between the predictor variable and
194 the delivery location was investigated using Chi-square testing. Multivariable logistic
195 regression was used to estimate the net influence of predictor variables on the outcome
196 variable after confounding variables were removed. We adjusted the multivariable and
197 decomposition model based on the p value less than (p<0.05). In the adjusted model,
198 the factors that were statistically significant at the (p<0.05) level in the univariate
199 analysis were taken into consideration for final adjustment in the multivariate model.
200 Unadjusted/crude odds ratios (cOR) and adjusted odds ratios (aOR) are presented in this

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201 article (AOR) however, only adjusted results have been interpreted in the main tex. All
202 analyses were carried out using Stata/MP 16 (StataCorp, College Station, Texas, USA).
203

Inequality measurement

205 The concentration curve (CC) and concentration index (CIX) were employed in their
206 relative formulations (with no correction) to study the inequalities in facility utilization
207 across analyzable socioeconomic factors of the population (women)[23]. The CIX in this
208 study represents horizontal inequity, because each woman in the study was assumed to
209 have the same need for a facility birth. CC was calculated by plotting the cumulative
210 proportion of women ranked by their wealth index score (poorest first) against the
211 cumulative proportion of facility deliveries on the y-axis. The absolute equality was
212 shown by the 45-degree slope from the origin. The use of institutional delivery is equal
213 among women if the CC intersects with the line of equality. If, on the other hand, the CC
214 subtends the line of equality below (above), then there is inequality in the use of
215 institutional delivery, which is skewed against women from low (high) socioeconomic
216 backgrounds. Further, the greater the degree of inequality, the more the CC deviates
217 from the line of equality. CIX was calculated to estimate the level of wealth-related
218 inequality. CIX is widened as twice the region between the line of equality and CC[23].

219 The following are some of the benefits of adopting CIX as a measure of healthcare
220 inequality: It considers the socio-economic dimension of healthcare inequalities because
221 individuals are classified based on their socio-economic status rather than their health
222 status; it captures the experience of the entire population; and it is sensitive to changes
223 in population distribution across socio-economic groups. The CIX takes a value between
224 -1 and $+1$. When institutional delivery is evenly spread across socioeconomic
225 categories, CIX equals zero. The usage of institutional delivery is concentrated among
226 the upper socioeconomic classes if CIX has a positive value (pro-rich). A negative CIX
227 score, on the other hand, indicates that institutional delivery is mostly used by the poor
228 (pro-poor)[24].CIX was calculated using the "convenient covariance" formula provided
229 by O'Donnell et al.[23], as shown in the **Eq. 1** below.
230

231 $$CIX = \frac{2}{\mu}$$

232

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233 Here h is the health factor variable (place of delivery), μ is its mean, and $r = i/N$ is the

234 fractional rank of individual i in the living standards distribution, with $i = 1$ for the

235 poorest and $i = N$ representing the richest. The user-written STATA commands

236 Lorenz[25] and conindex[26] were used to produce CC and measure CIX, respectively.

237

Decomposition of CIX

238

239 The relative CIX was decomposed to identify the proportion of inequality due to

240 underlying determinant inequality. The findings were evaluated and interpreted using

241 Wagstaff's et al.[23] and O'Donnell et al.[26] approach. The contribution of each

242 determinant of facility delivery to overall wealth-related inequality is determined as the

243 product of the determinant's sensitivity to facility delivery (elasticity) and the degree of

244 wealth-related inequality in that determinant (CIX of determinant). The residual is the

245 portion of the CIX that is not explained by the determinants.

246 The "elasticity" column indicates the change in the dependent variable (socioeconomic

247 disparity in facility delivery) resulting from a one-unit change in the explanatory factors.

248 A positive or negative elasticity score indicates an upward or downward trend in facility

249 delivery in response to a favorable change in the determinants.

250

Patient and public involvement

251

252 No patient involved.

253

RESULTS

254

Background characteristics of the study participants

255

256 Table 1 displays the socioeconomic and demographic characteristics of females aged 15

257 to 49. The table displays the results produced from 30,940 observations recorded in

258 2007, 2011, 2014, 2017-18, as well as the overall results derived from the data for all

259 years considered.

260 From the total data, we can conclude that the majority of women (67%) resided in rural

261 areas, with the majority hailing from Chattagram (19%) and Dhaka (17%). However, 22%

262 of them belonged to the poorest category, and 19.80% to the poorer group. The

263 proportion of women aged 15 to 24 years is highest (49%), and secondary education

264 (43%), 98% had improved water, 58% had improved sanitation, but only 25% were

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265 employed. In addition, 59% of women had a normal BMI, and 37% have already given
266 birth. Among the moms, 68% did not have ANC, yet the majority (81%) had a normal
267 last birth. In addition, the majority of partners had a primary education (31%) and were
268 primarily employed in non-agricultural occupations (52%).

Table 1. Background characteristics of the study participants

Variables	Frequency	Percentage
Total	30,940	100.00
Surveyed year		
2007	6,032	19.50
2011	8,573	27.71
2014	7,761	25.08
2017-18	8,574	27.71
Places of Residence		
Urban	10,116	32.70
Rural	20,824	67.30
Division		
Barishal	3,522	11.38
Chattogram	5,842	18.88
Dhaka	5,333	17.24
Khulna	3,403	11.00
Rajshahi	3,961	12.80
Sylhet	4,017	12.98
New Division	4,862	15.71
Age of the mother (years)		
15–24	15,101	48.81
25–34	13,138	42.46
35–49	2,701	8.73
Mother's BMI		
<18.50 Underweight	7,226	23.71
18.51-24.99 Normal	18,027	59.14
≥25.0 Overweight/Obese	5,229	17.15
Mother's education		
No education	5,134	16.60
Primary	9,183	29.68
Secondary	13,273	42.90
Higher	3,347	10.82
Mothers' working status		
No work	23,197	74.98
Working	7,741	25.02
Partner's education		
No Education	7,750	25.17
Primary	9,442	30.67
Secondary	9,044	29.38
Higher	4,550	14.78
Partner's occupation		
Agricultural and Farming	7,375	24.05
Non-Agricultural	15,909	51.87

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Business	6,793	22.15
No Works	594	1.94
Birth order		
First Child	11,528	37.26
Second Child	9,106	29.43
Third Child	5,094	16.46
≥ Fourth	5,212	16.85
Sanitation facilities		
Improved sanitation	16,072	57.76
Unimproved sanitation	10,787	38.77
Open defecation (no facility/bush/field)	967	3.48
ANC Visit		
No ANC	14,676	68.28
Any ANC	6,819	31.72
Improved Water		
Improved source	27,151	97.54
Unimproved source	685	2.46
Household wealth status		
Poorest	6,706	21.67
Poorer	6,126	19.80
Middle	5,788	18.71
Richer	6,096	19.70
Richest	6,224	20.12

269

Prevalence of facility delivery

271 **Table 2** shows that, in 2007, 17% women had facility delivery which increased over the
272 years and in 2017-18 the percentage of facility delivery was 50%. Most of the women
273 who were underweight went through home delivery (81%), but women who were
274 overweight were more likely to have facility births (60%). Among women who had no
275 ANC 79% had home delivery and 60% had facility delivery who had any number of ANC.
276 In case of birth orders, home delivery was found to be more frequent in all the
277 categories and it increased with the increasing number of births, whereas the chance of
278 facility birth was most during the first birth but decreased over the increasing number of
279 births. However, the women who had their last birth by caesarean section had a high
280 percentage (98%) of having facility birth. The percentage of home delivery was found to
281 be greater than facility birth in both urban (53%) and rural (76%) areas of Bangladesh.
282 However, the urban areas (47%) had more facility births than the rural areas (24%). The
283 percentage of home delivery was found to be higher than facility birth even when the
284 observations were categorized according to divisions and Khulna division was found to
285 have more facility births (46%) compared to others. Facility birth was found to be more
286 common among the wealthiest families (62%) but in all the other groups home delivery

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287 was found to be more frequent. The women and the partners who had higher education
288 are more likely to have facility birth, 75% and 67% respectively. Women's working status,
289 improved sanitation and water facilities do not seem to increase the rate of facility
290 births, in all these cases the percentage of home delivery was found to be higher.
291 Moreover, From **Table 2**, the prevalence rate shows that women residing in urban areas
292 (49%), higher educated mother (72%), last birth by caesarean section (98%), richest in
293 wealth index (61%) are more likely to have facility delivery than their counterparts.
294 **Figure 1** shows that the facility births have become more prevalent over the time from
295 2007 (14%) to 2017-18 (49%).

Table 2. Prevalence of using facility delivery across different socioeconomic variables			
Variables	**Dependent Variables**		**P-value**	**Weighted Prevalence (95% CI)**
	Home delivery (n/%)	**Facility birth (n/%)**		
Survey Year			<0.001	
2007	5021(83.24)	1011(16.76)		14.48 (13.60-15.39)
2011	6267(73.10)	2306(26.90)		24.49 (23.59-25.41)
2014	2842(61.04)	1814(38.96)		37.45 (36.09-38.82)
2017-18	2616(50.49)	2565(49.51)		49.26 (47.90-50.62)
Place of residence			<0.001	
Urban	4,182 (52.74)	3,748 (47.26)		48.89 (47.60-50.19)
Rural	12,564 (76.09)	3,948 (23.91)		24.03 (23.43-24.65)
Divisions			<0.001	
Barishal	2,109 (74.55)	720 (25.45)		22.55 (20.45-24.79)
Chattogram	3,427 (72.84)	1,278 (27.16)		26.49 (25.33-27.68)
Dhaka	2,831 (66.16)	1,448 (33.84)		32.50 (31.46-33.57)
Khulna	1,492 (54.35)	1,253 (45.65)		42.53 (40.49-44.61)
Rajshahi	2,199 (68.80)	997 (31.20)		24.22 (22.80-25.70)
Sylhet	2,360 (71.97)	919 (28.03)		28.84 (27.09-30.64)
New Division	2,328 (68.29)	1,081 (31.71)		30.83 (28.89-32.85)
Age of the mother (years)			<0.001	
15-24	8,538 (67.93)	4,030 (32.07)		30.88 (30.08-31.68)
25-34	6,748 (68.13)	3,156 (31.87)		29.75 (28.86-30.66)
35-49	1,460 (74.11)	510 (25.89)		23.54 (21.68-25.51)
Mother's BMI			<0.001	
<18.50 Underweight	5,046 (81.41)	1,152 (18.59)		17.70 (16.77-18.67)
18.51-24.99 Normal	10,064 (69.97)	4,320 (30.03)		28.65 (27.92-29.39)
≥ 25.0 Overweight/Obese	1,377 (39.55)	2,105 (60.45)		57.49 (55.81-59.16)
Mothers' education			<0.001	
No education	3,887 (91.29)	371 (8.71)		08.59 (07.80-09.56)
Primary	5,890 (81.19)	1,365 (18.81)		18.23 (17.36-19.12)
Secondary	6,326 (61.06)	4,035 (38.94)		37.53 (36.60-38.46)
Higher	640 (24.95)	1,925 (75.05)		72.08 (70.22-73.87)
Mothers' working status			<0.001	
No Work	13,048 (67.96)	6,152 (32.04)		30.48 (29.83-31.13)

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Working	3,697 (70.55)	1,543 (29.45)		27.73 (26.56-28.93)
Partner's education			<0.001	
No education	5,501 (87.54)	783 (12.46)		15.85 (14.98-16.76)
Primary	5,633 (76.50)	1,730 (23.50)		33.36 (32.53-34.19)
Secondary	4,392 (61.26)	2,778 (38.74)		38.43 (37.11-39.77)
Higher	1,177 (33.13)	2,376 (66.87)		32.69 (28.66-36.98)
Partner's occupation			<0.001	
Agriculture	4,887 (82.69)	1,023 (17.31)		15.85 (14.98-16.76)
Non agriculture	8,200 (65.67)	4,287 (34.33)		33.36 (32.53-34.19)
Business	3,227 (59.91)	2,159 (40.09)		38.43 (37.11-39.77)
No works	327 (66.87)	162 (33.13)		32.69 (28.66-36.98)
ANC visit			<0.001	
No ANC	11,524 (78.52)	3,152 (21.48)		20.78(20.14-21.43)
Any ANC	2,746 (40.28)	4,071 (59.72)		57.97(56.76-59.16)
Birth order			<0.001	
First Child	5,213 (57.42)	3,866 (42.58)		40.75 (39.75-41.76)
Second Child	4,745 (67.01)	2,336 (32.99)		31.02 (29.96-32.10)
Third Child	3,042 (75.19)	1,004 (24.81)		23.57 (22.29-24.89)
≥ Fourth	3,746 (88.43)	490 (11.57)		10.43 (09.54-11.39)
Sanitation facilities			<0.001	
Improved sanitation	7,110 (58.71)	5,000 (41.29)		39.56 (38.68-40.45)
Unimproved	7,284 (82.15)	1,583 (17.85)		17.72 (16.95-18.56)
Open defecation	760 (90.05)	84 (9.95)		7.95 (6.40-9.76)
Improved water			<0.001	
Improved source	14,696 (69,03)	6,593 (30.97)		29.31 (28.71-29.99)
Unimproved source	464 (86.25)	74 (13.75)		13.25 (10.37-16.79)
Household wealth status			<0.001	
Poorest	4,556 (87.20)	669 (12.80)		12.00 (11.17-12.89)
Poorer	4,001 (81.97)	880 (18.03)		17.98 (16.94-19.06)
Middle	3,350 (73.03)	1,237 (26.97)		26.23 (25.00-27.50)
Richer	2,972 (61.88)	1,831 (38.12)		37.47 (36.11-38.85)
Richest	1,867 (37.75)	3,079 (62.25)		61.09 (59.65-62.51)
CI: Confidence Interval				

Factors associated with facility delivery (Regression model)

The confidence intervals (CI) for the bivariate and multivariate regression models at 95% are presented in **Table 3** as unadjusted odds ratio (UOR) and adjusted odds ratio (AOR) respectively. The analyses showed that in all three years 2011, 2014, 2017-18 the facility birth increased compared to 2007 as the reference category, where in 2017 it was about 4 times higher. In both bivariate and multivariate analyses, it was found that women living in the urban areas; from Dhaka division and Khulna division; who are overweight; who had any level of education; belonging to wealthier families; had ANC; whose partners had any level of education and involved in business are more likely to have facility births compared to their respective counterparts. On the other hand, women

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307 from the divisions other than Dhaka and Khulna; belonged to age groups 25-34 years
308 and 35-49 years; underweight; employed; had any number of children; had improved
309 water and sanitation; whose partners were involved in agricultural or non-agricultural
310 works were found to belong in the lower odds of facility birth.

311 The analysis shows that women in the age group 25-34 years were about 1.54 times (CI:
312 1.39-1.71) and in the age group 35-49 years were about 2.43 times (CI: 2.01-2.93) more
313 likely to have facility birth compared to the age group 15-24 years. The women residing
314 in the urban areas were 1.44 times (CI: 1.32-1.58) more likely to have facility birth.
315 Overweight women were found to be 1.84 times (CI: 1.66-2.04) more likely to have
316 facility birth, whereas underweight women were 0.83 times (CI: 0.75-0.91) less likely.
317 Women who had any number of ANC were 2.38 times (CI: 2.20-2.58) more likely to have
318 facility births and it tends to decrease with having more children over the time.
319 Education played a great role to uptake facility delivery, where the findings show that
320 with the increase of education level, more women tend to receive facility birth. Similar
321 result was found with the increase of education level of partners. In case of the wealth
322 status, the adjusted OR was observed to be increasing as the wealth status increased.

323

Table 3. Factors associated with facility delivery in Bangladesh				
	Dependent Variable			
Variables			UOR (95% CI)	AOR (95% CI)
	Home	Facility		
Year of survey				
2007 (RC)	5021	1011		
2011	6267	2306	1.82 (1.68-1.99)	1.79 (1.60-2.02)
2014	2842	1814	3.16 (2.89-3.46)	3.08 (2.72-3.50)
2017	2616	2565	4.87 (4.46-5.31)	4.31 (3.79-4.91)
Place of Residence				
Urban	4,182	3,748	2.85 (2.69-3.01)	1.44 (1.32-1.58)
Rural (RC)	12,564	3,948		
Divisions				
Barishal	2,109	720	0.74 (0.66-0.82)	0.76 (0.65-0.89)
Chattogram	3,427	1,278	0.80 (0.72-0.89)	0.80 (0.70-0.92)
Dhaka	2,831	1,448	1.10 (1.00-1.21)	1.01 (0.88-1.17)
Khulna	1,492	1,253	1.80 (1.62-2.00)	1.74 (1.49-2.00)
Rajshahi	2,199	997	0.98 (0.89-1.08)	1.18 (1.01-1.36)
Sylhet	2,360	919	0.83 (0.75-0.93)	1.12 (0.96-1.29)
New division (RC)	2,328	1,081		
Age of the mother (years)				

13

15-24	8,538	4,030	0.99 (0.93-1.04)	1.54 (1.39-1.71)
25-34	6,748	3,156	0.74 (0.66-0.82)	2.43 (2.01-2.93)
35-49 (RC)	1,460	510		
Mother's BMI				
<18.50 Underweight	5,046	1,152	0.53 (0.49-0.58)	0.83 (0.75-0.91)
18.51-24.99 Normal (RC)	10,064	4,320		
≥ 25.0 Overweight/Obese	1,377	2,105	3.57 (3.29-3.85)	1.84 (1.66-2.04)
Mother's education				
No education (RC)	3,887	371		
Primary	5,890	1,365	2.42 (2.14-2.74)	1.33 (1,14-1.54)
Secondary	6,326	4,035	6.68 (5.96-7.48)	1.84 (1.58-2.15)
Higher	640	1,925	31.51 (27.42-36.21)	2.90 (2.37-3.56)
Mother's working status				
Not Working (RC)	13,048	6,152		
Working	3,697	1,543	0.88 (0.82-0.94)	0.75 (0.67-0.81)
Partner's education				
No education (RC)	5,501	783		
Primary	5,633	1,730	2.16 (1.97-2.37)	1.07 (0.95-1.20)
Secondary	4,392	2,778	4.44 (4.07-4.86)	1.24 (1,09-1.41)
Higher	1,177	2,376	14.18 (12.80-15.71)	1.76 (1.49-2.06)
Partner's occupation				
Agriculture and farming	4,887	1,023	0.42 (0.34-0.51)	0.80 (0.61-1.05)
Non agriculture	8,200	4,287	1.06 (0.87-1.28)	0.90 (0.70-1.17)
Business	3,227	2,159	1.35 (1.11-1.64)	1.02 (0.78-1.32)
No works (RC)	327	162		
ANC visit				
No ANC (RC)	11,524	3,152		
Any ANC	2,746	4,071	5.42 (5.09-5.77)	2.38 (2.20-2.58)
Birth order				
First child (RC)	5,213	3,866		
Second child	4,745	2,336	0.66 (0.622-0.70)	0.54 (0.49-0.59)
Third child	3,042	1,004	0.44 (0.40-0.48)	0.40 (0.35-0.46)
≥ Fourth	3,746	490	0.17 (0.16-0.19)	0.24 (0.20-0.29)
Sanitation facilities				
Improved sanitation facility (RC)	7,110	5,000		
Unimproved sanitation facility	7,284	1,583	0.30 (0.28-0.32)	0.86 (0.79-0.95)
Open defecation (no facility/bush/field)	760	84	0.16 (0.12-0.19)	0.92 (0.70-1.22)
Improved water				
Improved source (RC)	14,696	6,593		
Unimproved source	464	74	0.36 (0.27-0.46)	0.56 (0.41-0.76)
Household wealth status				

14

Poorest (RC)	4,556	669		
Poorer	4,001	880	1.49(1.34-1.67)	1.09 (0.95-1.25)
Middle	3,350	1,237	2.51(2.27-2.79)	1.40 (1.23-1.62)
Richer	2,972	1,831	4.19(3.79-4.66)	1.79 (1.55-2.06)
Richest	1,867	3,079	11.23(10.17-12.40)	2.81 (2.38-3.30)
RC stands for Reference Category; CI stands for Confidence Interval; UOR means Unadjusted Odds Rati; AOR defined as Adjusted Odds ratio				

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Decomposition of concentration index for facility delivery

Table 4 illustrates the effects of key socioeconomic and demographic characteristics on facility utilization and its disparities. The column labelled "Elasticity" represents the amount of change in the dependent variable (socioeconomic inequality in facility delivery) caused by a one-unit change in the explanatory factors. Elasticity with a positive or negative sign indicates a rising or falling trend in the facility's output in conjunction with a positive change in the factor[27,28]. This study indicated that the values of the CIX for facility delivery were (CIX: 0.30846363 (p0.001) among Bangladeshi households with a higher socioeconomic status, indicating that the study uncovered a socioeconomic inequality in favor of the wealthy for facility delivery. The column 'CIX' displays the distribution of the determinants in terms of wealth quintiles. The positive or negative direction of the CI indicates whether the factors were more prevalent in wealthy or poor groups. The percentage contribution indicates how much each variable in the model contributes to socioeconomic disparities as a whole. A positive percentage contribution indicates that a factor contributes to the increase of observed socioeconomic gaps in the provision of healthcare facilities. A negative percentage contribution, on the other hand, indicates a component that is anticipated to reduce socioeconomic inequalities connected to facility delivery. Wealth quintiles (18.31%), mother's education (8.78%), place of residence (7.75%), birth order (5.56%), and partner's education (4.30%), as well as ANC seeking (8.51%), were the significant contributors to the pro-rich socioeconomic inequalities in facility delivery.

Table 4. Decomposition of concentration index for measuring socioeconomic inequalities

Variables	Elasticity	CIX	Contribution to overall CIX = 0.30846363 (p<0.001)	
			Absolute contribution	Percentage contribution
Year of survey				
2007 (RC)				
2011	0.04996	-0.01743	-0.00087	-0.28225

15

2014	0.09074	0.00994	0.00090	0.29238
2017	0.12860	0.01957	0.00252	0.81592
Subtotal			***0.00255***	***0.82605***
Divisions				
Barishal	-0.00542	-0.19839	0.00108	0.34856
Chattogram	-0.01758	0.07951	-0.00140	-0.45309
Dhaka	-0.03364	0.11964	0.00402	-1.30471
Khulna	0.01602	0.05020	0.00080	0.26078
Rajshahi	0.00138	-0.13950	-0.00019	-0.06254
Sylhet	0.00478	-0.13677	-0.00065	-0.21211
New Division (RC)				
Subtotal			***0.00366***	***-1.42311***
Place of residence				
Urban	0.05529	0.43257	0.02392	**7.75364**
Rural (RC)				
Age of the mother (years)				
15-24 years (RC)				
25-34 years	0.04567	0.02065	0.00094	0.30579
35-49 years	0.01955	-0.05456	-0.00107	-0.34573
Subtotal			***-0.00013***	***-0.03994***
Mother's education				
No education (RC)				
Primary	0.04190	-0.18996	-0.00796	-2.58021
Secondary	0.10407	0.14406	0.01499	4.86050
Higher	0.03779	0.53015	0.02003	6.49471
Subtotal			**0.02706**	**8.775**
Birth order				
First Child	0.16166	0.09870	0.01595	5.17229
Second Child	0.07459	0.03847	0.00287	0.93024
Third Child	0.02953	-0.05621	-0.00166	-0.53810
≥ Fourth (RC)				
Subtotal			**0.01716**	**5.56443**
Mother's BMI				
18.51-24.99 Normal (RC)				
< 18.50 Underweight	-0.01096	-0.21452	0.00235	0.76229
≥ 25.0 Overweight/Obese	0.01821	0.35794	0.00652	2.11304
Subtotal			***0.00887***	***2.87533***
Mother's working status				
Not working (RC)				
Working	-0.01294	-0.10246	**0.00133**	**0.42985**
ANC visit				
No ANC (RC)				
Any ANC	0.10026	0.26187	**0.02625**	**8.51151**

Partner's education				
No education (RC)				
Primary	0.00327	-0.12889	-0.00042	-0.13665
Secondary	0.02011	0.19627	0.00395	1.27947
Higher	0.01948	0.49977	0.00974	3.15675
Subtotal			**0.01327**	**4.29957**
Partner's occupation				
Agricultural and Farming	-0.04176	-0.31438	0.01313	4.25599
Non-Agricultural	-0.05003	0.06158	-0.00308	-0.99866
Business	-0.01499	0.22144	-0.00332	-1.07585
No works (RC)				
Subtotal			**0.00673**	**0.00673**
Sanitation facilities				
Improved source (RC)				
Unimproved source	-0.01235	-0.25974	**0.00321**	**1.03965**
Open defecation (no facility/bush/field)	-0.00085	-0.56021	**0.00048**	**0.15433**
Improved water				
Improved source (RC)				
Unimproved source	-0.00609	-0.24382	**0.00148**	**0.48111**
Household wealth status				
Poorest (RC)				
Poorer	0.00623	-0.34487	**-0.00215**	**-0.69619**
Middle	0.01628	0.05059	**0.00082**	**0.26691**
Richer	0.03177	0.43868	**0.01394**	**4.51757**
Richest	0.05369	0.81707	**0.04387**	**14.22174**
Subtotal			**0.05648**	**18.31003**
Explained CIX			0.148 45.91	0.148 45.91
Residual CIX			0.160 54.09	0.160 54.09
CIX: Concentration Index; **RC**: Reference Category				

346

347 **Insert Figure 1**

348 **Figure 1**. Prevalence of utilizing facility delivery over time in Bangladesh (weighted)

349

350 **Figure 1** depicts the overall prevalence of the likelihood of using facility delivery during
351 the course of the year. With the passage of time, it is apparent that the facility delivery
352 has increased. In 2007, the prevalence was only 14.48%, but it climbed by at least
353 tenfold in 2011 (24.49%), and in 2017-18, nearly half of all women used a facility delivery
354 with skilled birth attendants (SBA).

17

355

356 **Insert Figure 2**

357 **Figure 2**. Lorenz curve for inequality estimation

358 By utilizing a Lorenz curve (concentration curve), **Figure 2** also shows the disparities in
359 facility delivery between the four distinct years. We can see that all four concentration
360 curves (CC) fell below the line of equality, suggesting that facility delivery is more
361 common among women from affluent households. Nevertheless, it seemed as though
362 the CC was moving in the direction of equality. The difference between the line of
363 equality and the concentration curve was found to be at its widest in 2007, but it
364 narrowed in 2017.

365

366

367

368

369 **DISCUSSION**

370 The current study examined the socioeconomic inequalities associated with facility
371 births among the Bangladeshi population using the most recent demographic and
372 health survey data. An essential instrument for influencing policy choices that are
373 influenced by inequalities is now the analysis of socioeconomic inequality. Facility
374 delivery is more common and concentrated among the richest Bangladeshis living in
375 metropolitan areas, albeit it has substantially declined since the previous round of
376 research. Household financial status, women's education, ANC seeking, birth order,
377 partner's education, and living in urban regions all had a substantial impact on the pro-
378 rich socioeconomic inequalities in facility delivery.

379

380 Utilizing four consecutives nationally representative BDHS data, this study revealed that
381 there exist numerous socio-economic inequalities in using facility delivery. The level of
382 socio-economic inequality in facility birth in Bangladesh is one of the uppermost among
383 the South and East Asian countries[29]. The result of our study showed that the
384 maximum number of respondents (67.30%) are from the rural areas, and most of them
385 (81.04%) had their last birth normally, and the rural areas had lower (23.91%) facility
386 births than the urban areas (47.26%). Results of this study indicated that respondents
387 from the lower age group (15-24 years) and overweight had more facility delivery.
388 Moreover, respondents from the wealthiest families and from the Khulna division were

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389 found to be more occupied with facility births. During the last ten years, starting from
390 2007 to 2017-18, the percentages of facility delivery have increased from 16.76% to
391 50.49% but are still low[18]. This study showed that respondents in 2017 had a higher
392 likelihood of having facility births than the respondent in 2007 but still not sufficient.
393 Facility birth is increasing but at a slower rate, and several studies showed similar
394 results[17,30,31]. Regional difference in utilizing facilities is observed in this study and
395 indicated that respondents from the Khulna and Dhaka divisions were more likely to
396 have facility birth than the respondent from the new division. Regional differences and
397 inequalities in utilizing facility delivery are common, and similar results exist like this
398 study[31,32]. Young-aged respondents have more likelihood of having a delivery facility
399 than respondents of a higher age group. Several studies showed the same results, and
400 this is maybe the older women consider home delivery convenient and not risky[31,33].
401 Also, there is a big difference between the younger and older women in their knowledge
402 and health care facility-seeking behavior. Younger women are more interested to seek
403 knowledge and health care facilities[33]. Women from urban areas were more likely to
404 use facility births in comparison to the respondents from rural areas in developing
405 countries like Bangladesh[15–17,31,34]. Moreover, overweighted respondents have a
406 higher likelihood of having facilities delivery compared to normal weighted respondents.
407 Existing studies showed that respondents with non-normal weight has a higher
408 likelihood of having facility delivery[35–37]. A respondent may have more complicacy
409 due to the overweight, and consequently, overweighted respondent tends to use more
410 facility delivery.

411 Education is another significant influencing factor for the inequality in utilizing facility
412 delivery. Respondents with a primary, secondary, or higher level of education were more
413 likely to receive facility birth than the respondent with no education. Education plays the
414 key role in making a woman independent and autonomous to make their own health
415 care decisions as they become more concerned about their health. This behavior
416 eventually enhanced the respondent's concern about the facility delivery[22,33,38].
417 Surprisingly, employed respondent were less likely to gain the chance the use facility
418 delivery than those not working[36,37]. Maybe respondents with working status
419 experience time constraints that decrease their chances of receiving facility
420 delivery[32,39].

421 Again, respondents with educated partners have higher odds of utilizing facility delivery
422 than the respondents with uneducated partners. Similar results exist about the existing
423 inequalities of receiving facility delivery created by the education of the respondent and
424 their husband[15,40–43]. Education improves health awareness, and families with more
425 education are more likely to utilize health care services. The socioeconomic disparities in
426 facility delivery are also strongly influenced by the affluent position of households. This

19

427 study reveals that respondents from middle-class and affluent families were more likely
428 to have facility delivery than those from low-income homes. Clearly, educated
429 respondents with educated partners have a greater likelihood of obtaining a high-
430 paying job or earning more money and being able to afford maternal health care
431 services such as delivery facilities[33,38]. This finding of education and wealth index
432 influencing inequalities of receiving facility delivery is consistent with the previous
433 studies conducted in different countries[44–47]. These inequalities are influenced by
434 different socio-economic and demographic reasons and their interactions[15,30,48].
435 Moreover, the majority of a low-income family's money is typically spent on food and
436 everyday necessities. The cost of health care facilities and education is a hardship for this
437 population; hence they must utilize home-based facilities for their delivery. Therefore,
438 low-educated and underprivileged individuals are typically denied access to facilities.

439 Additionally, this study revealed that respondents with an improved water supply and
440 improved sanitation facilities have higher odds of utilizing facility delivery compared to
441 the respondents with no improved water supply and unimproved sanitation facilities,
442 which is a match with previous studies[49]. Sanitation and better water facilities of a
443 respondent are primarily related to their education level and socioeconomic standing,
444 demonstrating a direct correlation between the two variables. Compared to respondents
445 with a second or higher birth order, first-time mothers are more likely to have a facility
446 delivery for their first child[44,50,51]. Like other studies' results, this study showed that
447 respondents with antenatal care (ANC) have a higher likelihood of taking facility delivery
448 than respondents with no ANC visit[36,52,53]. An ANC visit creates the consciousness
449 among the respondent about the danger signs of labor and pregnancy complications
450 which lead the respondent to utilize the facility delivery[36].

451

452

Policy implications and specific recommendations
454 This research found a pro-rich inequality existing in Bangladeshi women's use of
455 birthing facilities. Therefore, if public health policies and interventions were
456 implemented to increase the number of births that take place in these settings, such as
457 the provision of birth centers, the training and assurance of Skilled Birth Attendants
458 (SBAs), the use of mass media for health education and raising awareness, the
459 implementation of mandatory female education, the participation of men in pregnancy
460 and childbirth. In spite of Bangladesh have achieved commendable success in using
461 facility delivery among reproductive-aged women, it is undeniable that women who
462 have less education, poor wealth status are highly deprived form getting facility delivery.
463 •Therefore, immediate priority should be given to the multisectoral interventions to
464 upgrade the facility delivery services covering all over Bangladesh, mostly remote areas.

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465 •Women with poor health conditions, less education, and poor financial status should
466 be covered with aiding facilities for using facility delivery services to motivate them as
467 well as their families.
468 •This study finds that for the first child most women use facility delivery services and this
469 rate goes down as the number goes up. So, policymakers can introduce incentives to
470 attend facility delivery from the second child.
471 •In addition, further cohort study is recommended since cross-sectional study has
472 inherent limitation to establish casualty.
473 •Government might spend more on women's education and uplifting their positions to
474 support the decision of availing facility delivery for every woman.
475 •Further study can be conducted on facility delivery improvement strategy followed by
476 different countries to suggest better specific action plans for Bangladesh.
477 •Identifying how women and their partners' education helps improve the rate of facility
478 delivery and the far-reaching effect of education should be beneficial for the
479 policymakers to be exact with their policies.
480

481 **Limitations and strength**
482 The study has some limitations that includes some important factors related to the
483 health of the respondents, and the delivery facility occurred due to the unavailability
484 and missing information such as cost of facility or cesarean birth, insurance, distance,
485 waiting time, the healthcare practitioners' behaviour, and availability of transportation
486 facilities. Since this study has been undertaken based on the consecutive nationally
487 representative datasets therefore, generalizability of the findings is more. Also, the
488 cross-sectional nature of the study does not allow to draw causal conclusion.
489 Nonetheless, the study showed many strengths by utilizing the data from a large sample
490 of a nationwide representative and population-based survey. Another strength of the
491 study is the use of a more thorough decomposition analysis to determine the factors
492 that influence socioeconomic inequalities in facility delivery use. This is the robust
493 method to estimate the health-related inequality which is widely used in the public
494 health literature. In addition, using CIX as a measure of inequality index in healthcare
495 has the following benefits: it captures the experience of the entire population; it takes
496 into account the socioeconomic dimension of facility delivery because the classification
497 of individuals is based on their socioeconomic status rather than their health status; it is
498 sensitive to changes in population distribution across socioeconomic groups.
499

500 **Conclusions**
501 This study indicated that women from urban areas who were overweight, had any level
502 of education, from wealthy households, had ANC, and whose partners had any level of
503 education and were involved in business profession were more likely to deliver in a

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504 hospital. This study also found a pro-rich inequality in facility delivery utilization in
505 Bangladesh, indicating that facility delivery utilization was more prevalent among
506 wealthier people. Existing socioeconomic inequalities in facility delivery must be
507 addressed in order to boost the utilization of facility delivery in Bangladesh. In light of
508 these findings, it is essential to establish an intervention that targets these important
509 linked factors in order to increase births in a hospital. Moreover, policy decision-making
510 might priorities the design and implementation of various poverty alleviation projects to
511 eliminate socioeconomic disparities in facility delivery in Bangladesh.

Ethics Approval

530 The study used deidentified data from the Demographic Health Survey program, which
531 has already received ethical approval from the participating countries, no further ethical
532 permission was sought to carry out this research. Data was collected from online source
533 (https://dhsprogram.com) with appropriate request.

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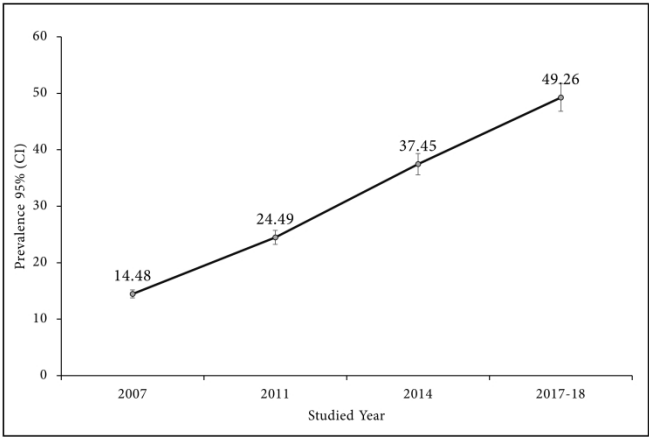672   women in Bangladesh. *Asia Pacific J Public Heal* 2015;**27**:NP1372–88.

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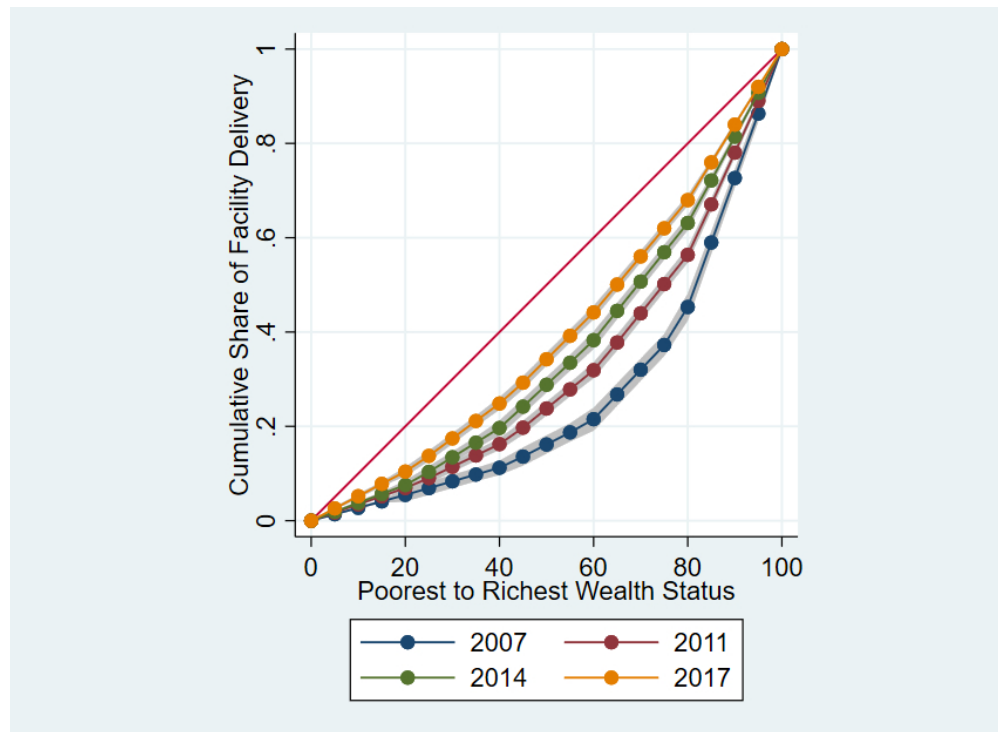678   https://dhsprogram.com/data/dataset_admin/index.cfm

679   **Legends**

680   **Figure 1**. Prevalence of utilizing facility delivery over time in Bangladesh (weighted)

681   **Figure 2**. Lorenz curve for inequality estimation

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338x190mm (300 x 300 DPI)

300x219mm (72 x 72 DPI)

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	Page 1-2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	Page 1-2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	Page 3-4
Objectives	3	State specific objectives, including any prespecified hypotheses	Page 3-4
Methods			
Study design	4	Present key elements of study design early in the paper	Page 6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Page 2
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	Page 6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	Page 5
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Page 5-6
Bias	9	Describe any efforts to address potential sources of bias	Not applicable
Study size	10	Explain how the study size was arrived at	Page 5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Page 6 to 7
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	Page 5-7
		(*b*) Describe any methods used to examine subgroups and interactions	Not applicable
		(*c*) Explain how missing data were addressed	Not applicable
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	Not applicable
		(*e*) Describe any sensitivity analyses	Not applicable
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—e.g., numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	Page 7
		(b) Give reasons for non-participation at each stage	Not applicable
		(c) Consider use of a flow diagram	Not applicable
Descriptive data	14*	(a) Give characteristics of study participants (e.g., demographic, clinical, social) and information on exposures and potential confounders	Page 7 to 10
		(b) Indicate number of participants with missing data for each variable of interest	Not applicable
Outcome data	15*	Report numbers of outcome events or summary measures	Not applicable
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (e.g., 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Page 5-7
		(*b*) Report category boundaries when continuous variables were categorized	Not applicable
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	Not applicable
Other analyses	17	Report other analyses done—e.g., analyses of subgroups and interactions, and sensitivity analyses	Not applicable
Discussion			
Key results	18	Summarise key results with reference to study objectives	Page 16
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	Page 18
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Page 17-18
Generalisability	21	Discuss the generalisability (external validity) of the study results	Page 18
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Page 19

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.