Progress in utilization of antenatal and delivery care services in Bangladesh: Where does the equity gap lie?

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Abstract: Despite a central element of the Millennium Development Goals (MDGs), the progress in making pregnancy and childbearing safer for women has been slow in many developing countries. Though Bangladesh has achieved commendable progress in reducing maternal mortality in recent decades, the country faces pervasive inequity in antennal (ANC) and delivery care services. The purpose of this study is to provide recent estimates of trend in inequity in antenatal and delivery care services in Bangladesh during 2004-2011. We employ rich-poor ratio, concentration curve and concentration index to examine the trends of inequities in ANC and delivery care services using the latest three waves of Bangladesh Demographic and Health Survey. This study uses logistic regression analysis to investigate the relationship between socioeconomic factors and six indicators of ANC and delivery care. Concentration index for 4+ ANC visits dropped from 0.42 in 2004 to 0.31 in 2011 while it remained around 0.20 for receiving ANC from medically trained provider. Findings indicate that inequity in delivery at health facility and delivery by caesarean section decreased by about 33% in between 2004 and 2011. Women from the richest households were about 3 times more likely to have 4+ ANC visits (OR=2.91, 95% CI: 2.24-3.78), delivery at health facility (OR=3.16, 95% CI: 2.40-4.17), and skilled assistance at birth (OR=3.32, 95% CI: 2.51-4.38) compared to women from the poorest households. There was an overall progress in reducing inequity in utilization of maternal health care but rural area lagged behind to achieve equity compared to urban area. The evidence of inequity in maternal health care utilization highlights that the country faces not only a persistent equity gap between rich and poor women but also substantial rural-urban inequity. It is essential to design multi-sectoral and concerted interventions from an equity perspective to accelerate safe motherhood and childbirth in Bangladesh.

Keywords: Antennal care, Bangladesh, delivery care, concentration index, inequity.

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Introduction

Despite a central element of the Millennium Development Goals (MDGs), the progress in making pregnancy and childbearing safer for women has been slow. Over a quarter million women still die every year of preventable causes related to pregnancy and childbirth (WHO, 2014). Maternal health-related indicators are among the worst performing in the MDG effort and only few countries are on track to achieve the target to reduce maternal mortality by 75% before 2015 (Lozano *et al.*, 2011; UN, 2014). While some countries have been able to document considerable development in achieving health related MDG targets, there is a debate whether this is an inclusive and equitable progress (Barros *et al.*, 2012; Zere *et al.*, 2012). Although average progress is satisfactory in some countries, maternal deaths due to inadequate health care utilization are more pronounced among the less-educated, poor, as well as rural residents (Ronsmans and Graham, 2006). So, equity perspectives has become important in policy setting to accelerate maternal health-related MDG targets (UNICEF, 2010).

The maternal health related MDG targets for Bangladesh include reducing the maternal mortality ratio by three-quarters, increasing the proportion of births attended by skilled health personnel to 50%, and obtaining universal access to reproductive health care between 1990 and 2015. Despite commendable progress in reducing maternal mortality over the last two decades, Bangladesh lags behind in achieving other targets of maternal health care. The country has made noticeable progress in uptake of maternal care services over the last two decades but progress is rather slow in reducing pervasive rural-urban and wealth-related equity gaps (Khan *et al.*, 2011). Over the years, inequity has become a central issue in maternal health care service utilization in Bangladesh (Zere *et al.*, 2013). A common feature of inequity is that the uptake of maternal health care services has persistently been lower among the poorer, less educated, and section of population living in rural and remote areas in Bangladesh (Houweling *et al.*, 2007; Rahman, 2009; Amin *et al.*, 2010; National Institute of Population Research and Training (NIPORT) *et al.*, 2013).

The reduction in maternal mortality and improvement of safe motherhood services have been a central policy focus since the late 1990s, as reflected in the Health and Population Sector Strategy (HPSS)(Government of Bangladesh (GOB), 1997) and the rights' based National Strategy for Maternal Health (Ministry of Health and Family Welfare(MOHFW), 2001). A central program feature has been to efficiently deliver an essential services package (ESP) consisting of comprehensive services for pregnancy, delivery, and neonatal care; contraception; safe, legal abortion; maternal nutrition; and prevention and control of reproductive tract infections. Focusing

on pro-poor coverage, ESPs are made available at the primary level health care facilities throughout the country (Ministry of Health and Family Welfare(MOHFW), 2001). Like many low-income countries, the government provides primary health care services to its rural people through a decentralized network of primary level health facilities. In addition, there is an array of informal sector providers such as community health workers (in both public and private sectors), unqualified allopathic practitioners (e.g. village doctors, drug sellers at pharmacies) and traditional healers (herbalists, homeopaths, *ayurvedic*, non-secular faith healers, and traditional birth attendants in rural areas (Uddin *et al.* 2009; Ahmed *et al.*, 2009).

As Bangladesh moves forward to the post-MDG era, the pervasive inequity in utilization of maternal health services should systematically be identified and addressed. Earlier studies on maternal health service utilization in Bangladesh focus on socioeconomic, demographic, and regional barriers to service utilization. These studies were limited by the small number of maternal healthcare indicators (Chakraborty *et al.*, 2003; Collin *et al.*, 2007), focus on specific, non-representative subpopulations, (Amin *et al.*, 2010; Choudhury and Ahmed, 2011), and non-presence of absolute and relative equity assessments. Moreover, only few studies examined trends in the distribution of maternal health services over time. The purpose of this study is to examine the trend of inequity in maternal health care services over 2004-2011 using data from the three latest rounds of Bangladesh Demographic and Health survey (BDHS). Our contributions are two folds in the current literature studying inequity in maternal health care services in Bangladesh. First, we provide updated estimates of trend in inequity of antenatal and delivery care services using a comprehensive set of indicators. Second, we use equity ratios, concentration index, concentration curves, and regression analysis in a single study to capture different aspects of inequity in maternal healthcare service utilization.

Materials and Methods

Data source and analytic sample

This study uses data from the three most recent rounds (2004, 2007, and 2011) of the Bangladesh Demographic and Health Survey (BDHS). It is a nationally representative population based household survey containing information in the areas of maternal and child health, mortality, fertility, family planning, and nutrition. Following multi-stage stratified sampling procedure, data was collected through core set of survey questionnaire following the MEASURE DHS model, which ensure standardization and comparability of surveys across countries (Subramanian *et al.*,

2011). The latest three BDHSs consist of 11,601 and 11,485 ever-married women aged 10-49 in 2004 and 2007 respectively and 18,072 ever-married women aged 12-49 in 2011. We first limit the sample to women of reproductive ages (15-49). We then restrict our analysis to women who had at least one live birth preceding three years of the survey to maintain consistency between the dependent variables and explanatory variables and to minimize the effects of time. If women had more than one live birth in past three years, only care received for the most recent live birth is considered. Our final analytic sample consists of 3730, 3365, and 4648 women aged 15-49 in 2004, 2007, and 2011 respectively. We restrict our analysis to the latest three surveys because all indicators of maternal health care services studied in this paper are only available in these three surveys.

Outcome variables

The indicators of of maternal health care services are divided into two categories: antenatal care (ANC) and delivery care. ANC includes: a) adequate number of ANC visits, b) receiving ANC from medically trained provider, and c) receiving sufficient doses of tetanus toxoid (TT) injection during pregnancy while the delivery care includes: a) giving birth at a health facility, b) receiving skilled assistance at birth, and c) birth delivered by caesarean section.

Antenatal care

We consider at least four visits to be the threshold level for ANC coverage based on the review of the effectiveness of four or more recommended ANC visits (WHO, 2002). In our analysis, 4+ ANC visits indicate whether the woman has at least four antenatal visits or not. ANC from medically trained provider is defined as a binary variable indicating whether a woman receives ANC from a medically-trained provider (a qualified doctor, nurse, midwife, paramedic, family welfare visitor, community skilled birth attendant, medical assistant or sub-assistant community medical officer) or not. Adequate doses of TT injections are necessary to prevent maternal and neonatal deaths. A woman needs at least two doses of TT injection during pregnancy for full protection without prior dose of TT injection. Receiving at least two doses of TT injection is a binary variable indicating whether a woman receives 2+ TT injection during her last pregnancy or not.

Delivery care

Giving birth at a health facility (at government or private hospital, government health centre, government health post, maternal and child welfare centre, NGO static clinic or sub-district health complex.) is a binary variable, which indicates whether the birth occurred at a health facility and not. Receiving skilled assistance at birth is also a binary variable. The skilled assistant or personnel

attended a birth includes a doctor, nurse/midwife, family welfare visitor or community skilled birth attendant. The third variable in delivery care is whether a woman had birth by caesarean (C) section. C-section is a measure of women's access to skilled care for complicated deliveries.

Predictor variables

The selection of explanatory variables in this study follows existing literature (Chakraborty *et al.*, 2003; Collin *et al.*, 2007; Amin *et al.*, 2010; Story and Burgard, 2012) that document their significant association with different indicators of maternal healthcare in Bangladesh. Demographic characteristics include woman's age, woman's age at first birth, parity, place of residence and region. We use age of women as a continuous variable in this study while age at first birth is grouped into four categories. Typically, an overwhelming majority of women in Bangladesh gives birth of their first child before they cross their teen age (NIPORT *et a*l., 2013a). We, therefore, use categories of age at first birth using 11-14 age as reference group, to see whether differential age at first birth has any influence on maternal healthcare utilization. We also include parity measured by the reported number of living children.

Socioeconomic characteristics include woman's education, woman's employment, husband's education, and household wealth. Education is self-reported and BDHS collects the highest year of education completed by both women and their husbands. Employment is divided into two categories: currently unemployed and employed. Economic status is measured using the wealth index in the BDHS. The wealth index is a composite measure of a household's cumulative living standard. The wealth index is calculated using easy-to-collect data on a household's ownership of selected assets and dwelling characteristics, such as televisions and bicycles; materials used for housing construction; and types of water access and sanitation facilities (Rutstein and Johnson, 2004). This index places individual households on a continuous scale of relative wealth. Finally, all interviewed households are separated into five wealth quintiles. Wealth quintiles are used to compare the influence of wealth on various population, health, and nutrition indicators (Filmer and Pritchett, 2001). We also include women's involvement in micro credit programme as an indicator of higher ability to pay for health care services (Amin *et al.*, 1998; Osmani, 1998).

We finally include woman's health care decision-making autonomy index and exposure to mass media index following other studies (Haque *et al.*, 2012; Jesmin *et al.*, 2013) from Bangladesh. To measure the aspects of familial healthcare decision-making, the DHS asked the following questions: 1) Who has final say on the woman's own healthcare? 2) Who has final say on child healthcare?

and 3) Can woman go to health centre alone or with her young children? The response options for the first two questions were: (a) respondent alone, (b) respondent and husband/partner, (c) respondent and other person, (d) husband/partner alone, (e) someone else, f) other. For first two questions, a value of 1 was assigned if the response was (a), (b), or (c), and 0 for (d), (e), or (f). For the last question, a value of 1 was assigned if the response was 'go to health centre alone', 'go to health centre with young children', or 'go to health centre with husband' and 0 was assigned for if the woman can't go to health centre. To create an index, we summed up all the scores for each respondent. The equally weighted summed score ranged from 0 to 3, with 0 indicating no participation, and 3 indicating the highest level of participation. Finally, we create four categories of health care decision making autonomy with 0 representing 'no', 1 indicating 'low', 2 representing 'medium', and 3 representing 'high' autonomy. We construct an index of exposure to mass media using women's reporting of frequency of exposure to radio, television, and newspapers in a typical week. For each medium, a value of 0 was assigned if the respondent did not have access to the medium at all, a value of 1 was assigned if the respondent used the medium less than once a week, a value of 2 assigned if the respondent used the medium at least once a week. We sum the scores for each medium and divide the score into three groups to create the mass media exposure index in which 0 indicates no exposure at all, 1-3 indicates irregular exposure, and 4-6 indicates regular exposure.

Statistical analysis

We estimate individual service coverage level in each survey year tabulating maternal health care service variables by wealth quintiles, place of residences and regions. We calculate richest to poorest and urban to rural ratios to present the absolute inequity in maternal health care service utilization. We also employ concentration curve (CC) and concentration index (CI) as the standard equity measures to estimate wealth related inequity in each maternal health care service. We interpret measured inequity through concentration curve and index as horizontal inequity in utilization since every pregnant woman is in equal need for maternal health care irrespective of other background characteristics. Since need is not important in utilization of maternal health care from a rights based perspective, we interpret CC and CI as the measures of not only inequity but also horizontal inequity in our study (Wagstaff *et al.*, 1991a; Hossain, 2010).

The concentration curve is a graphical illustration to identify whether socioeconomic inequality in a health sector variable exists and compare the level of inequity over time or across countries. The CC plots the cumulative sample individuals, ranked by wealth, against the cumulative proportion

of health indicator (Zere *et al.*, 2007). The diagonal line from the origin reflects perfect equality. If a health indicator is desirable (e.g. health facility delivery), a CC that lies above the diagonal line demonstrates the presence of inequities favouring the poor. The further the CC lies from the line of equality, the greater the degree on inequity. As our objective is to measure inequity in health care service utilization among pregnant women, CC lying below the line of equality reflect disproportionate service utilization benefiting richer women. We draw the CCs for each of the six indicators of maternal care from the BDHSs 2004, 2007, and 2011 in the same graph to compare changes in inequities. Furthermore, to test the statistical dominance of the curves, we utilize the multiple comparison approach (m.c.a.) and the intersection union principal (i.u.p.) of dominance testing following (Owen O'Donnell *et al.*, 2008). The CC does not quantify the magnitude of inequity for convenient comparison across time. So, we use CI, defined as twice the area between the CC and the line of equality, to measure the extent of inequality systematically associated with wealth (Wagstaff and van Doorslaer, 2004). The index takes a value between -1 and +1. A value of 0 implies that the health care utilization is equally distributed across the socioeconomic groups (Wagstaff *et al.*, 1991b). A negative CI in our case indicates higher utilization among the poor (pro-poor) while a positive one indicates better utilization amongst wealthier group (pro-rich). However, in case of binary health indicators value of CI may not lie between -1 to +1. The lower and upper bounds for CI can depend on the mean values of the variables (Wagstaff, 2005). Therefore, we normalize the CI dividing by the reciprocal of the mean, since the mean of the outcome variable changes from one survey round to the other (Owen O'Donnell *et al.*, 2008).

We further implement pooled logistic regression analysis to estimate the correlates of utilization of maternal health care by pooling three rounds of the BDHS. We include survey fixed effect for each survey to capture survey-specific differences. The possibility of multi-collinearity among explanatory variables is tested using variance inflation factors (VIFs) before including into pooled logistic regression analysis. Since data in BDHSs are collected through stratified multi-stage sampling method, individual sample survey weights and stratification are taken into account in all estimations. Following DHS Sampling and Household Listing Manual (ICF International, 2012) , we use annual female population in Bangladesh from the Population Division of the United Nations (UNDESA, 2013) to calculate an appropriate weight for each observation in the analyses.

Results

Trend in maternal health service use

Table 1 reports an overview of coverage of maternal health care services in Bangladesh during 2004-2011. The proportion of pregnant women who had 4+ ANC visits increased from about 17% to 26% between 2004 and 2011. The fraction of pregnant women who received ANC from medically trained personnel remained stagnant around 50% during this period. The percentage of women taking 2+TT during their pregnancy decreased from 60% to 42%. About 12% of the women in 2004 delivered their last birth at a health facility, which increased to more than 29% in 2011. We also find similar trend for skilled birth assistance and C-section delivery in the study period.

(Insert table 1 here)

Inequity in maternal health service utilization

The data presented in (Table 1) also shows the changes in equity gap between rich and poor as well as urban and rural area. Overall, the equity gap progressively narrowed mostly in C-section delivery, followed by health facility delivery, 4+ ANC visits, and skilled birth assistance between 2004 and 2011. The richest (quintile 5) to poorest (quintile 1) ratio in use of C-section delivery greatly declined from 119:1 in 2004 to 15:1 in 2011. This ratio for health facility delivery noticeably declined from 15:1 in 2004 to 6:1 in 2011. However, rich-poor gap remained around 3:1 in receiving ANC services from medically trained professionals during 2004-2011. The urban-rural difference in utilization of maternal health care service is another aspect of concern in Bangladesh. The most equitable urban-rural coverage was for utilization of 2+ TT injections and ANC from a medically trained provider (Table 1). The urban-rural ratio sharply declined for C-section delivery, followed by skilled assistance at birth, and health facility delivery. For example, women in urban area were two times more likely to use health facility delivery and skilled assistance at birth than those in rural area in 2011 compared to 3.6 times in 2004. There were also regional variations in maternal health care service utilization. Trend in coverage of maternal health service utilization over 2004-2011 indicates that Sylhet division consistently reported slow increase in maternal health service utilization. For example, coverage level for the indicator of 2+ TT injections were about two times higher in Barisal were than in Sylhet in 2011.

(Insert figure 1 here)

To get a comparative understanding of the trend in inequity of selected maternal health care indicators in Bangladesh during 2004-2011, we present concentration curves for each outcome variable in figure 1. The CCs are everywhere below the line of equality in all three surveys for every indicators, except 2+ TT injections during pregnancy. It demonstrates disproportionate service utilization of important maternal health care services (other than 2+ TT injections) in Bangladesh over the period of 2004-2011. However, it is apparent that there is a decreasing trend in inequity of maternal health service utilization except for ANC from medically trained provider during the study period. It is evident by CCs moving closer to line of equality in 2011. The extent of inequity remained stagnant over this period for the indicator of ANC from medically trained provider. We further implement dominance test to estimate the statistical difference between CCs for successive survey years as well as between the CCs from the earliest and most recent survey years. Results from both approaches of dominance testing suggest that CCs for every indicator (except ANC from medically trained provider) in 2011 exhibit strong dominance over the curves in 2004 in (Table 2). This finding thus confirms that inequity in utilization of maternal health care decreased over the study period.

(Insert table 2 here)

We report concentration indices with 95% confidence interval at national level as well as separately for rural and urban areas in table 3. The positive values of the CI indicate evidence of the inequity in the provision of maternal care services in all three waves. At national level, CI for 4+ ANC visits dropped from 0.42 in 2004 to 0.31 in 2011 while it remained around 0.20 for ANC from medically trained provider indicator (Table 3). In 2004, the highest inequity was in C-section delivery utilization (CI: 0.60) while there was also almost no inequity in 2+ TT injections (CI: 0.05) at national level. In 2011, CIs were 0.40 and 0.01 for C-section delivery and 2+ TT injections respectively. Inequity in skilled birth assistance continued to decrease between 2004 and 2011. The CIs for health facility delivery and C-section delivery appears to be decreased by about 33% in 2011 compared to those in 2004. In general, we find evidence of inequity in utilization maternal health services in Bangladesh but it has become more equitable in recent years.

(Insert table 3 here)

We also find a similar picture for the disaggregated analysis at rural and urban areas. The CIs for utilization of health facility delivery were 0.45 for rural area and 0.44 for urban area in 2004 while it became 0.32 and 0.22 respectively in 2011. Findings from table 3 clearly indicate that the urban

area outperformed rural area in reducing inequity in maternal health care service utilization over the period of 2004 to 2011. In other words, there was an overall progress in reducing inequity for these indicators of maternal health care but rural area always lagged behind to achieve equity compared to urban area.

Multivariate analysis

Table 4 presents the odds ratios (OR) with 95 % confidence interval from logistic regression analysis. We find that women with higher age at first birth were more likely to have delivery at health facility, skilled assistance at birth, and delivery by C-section than women who gave their at first birth at younger age. For instance, women who gave their first birth at the age of 25 or more were about 3 times more likely to have delivery at health facility and delivery by C-section than women who gave birth at the age of 14 or less. Analysis suggests that women with higher parity consistently used maternal care services less often than those with parity one. For example, women with 3 or more living children were about three times less likely than women with one living child to have 2+ TT injections, delivery at health facility, skilled assistance at birth, and delivery by C-section. Women with three or more living children were about 40% less likely to have 4+ ANC visits and ANC from a medically trained provider than women with one living child. Table 4 also presents that urban women were more likely to receive maternal health services than their rural counterpart. For example, women in urban areas were 50% or more likely than women living in rural areas to receive ANC from medically trained provider and skilled assistance at birth. Urban women were about 80% and 70% more likely than rural women to have 4+ ANC visit and delivery at health facility respectively. It is apparent that there are persistent divisional differences in utilization of maternal health services. Compared to Barisal, use of C-section was almost twice in Dhaka (OR= 1.96) and Khulna division (OR=1.90). Skilled birth assistance was 57% higher in Dhaka (OR=1.57) and 56% higher in Rajshahi (OR=1.56) compared to Barisal.

(Insert table 4 here)

Results (Table 4) indicate that women from wealthier households were consistently more likely to utilize maternal care services than women from poorer households. For example, women from the richest households (quintile 5) were about 3 times more likely than women from the poorest households (quintile 1) to have 4+ ANC visits (OR=2.91, 95% CI: 2.24-3.78), delivery at health facility (OR=3.16, 95% CI: 2.40-4.17), and skilled assistance service (OR=3.32, 95% CI: 2.51-4.38). Women from the richest households were four times more likely than women from the poorest

households to receive ANC from a medically trained provider. Furthermore, women from the richest households are about five times (OR=4.89, 95% CI: 3.17-7.54) more likely than women from the poorest households to use C-section delivery. Women and their husbands' education appear to be significantly associated with increased use of maternal health services. There was no significant relationship between indicators on ANC and the employment of women and the association between indicators on ANC and delivery care indicators is not very strong.

Women's exposure to mass media appears to be significantly associated with maternal care service utilization. Odds ratios (Table 4) reveal that women with regular exposure to mass media exposure were 27% more likely than women with no media exposure to have 4+ ANC visits, ANC from a medically trained provider, and delivery at health facility. Women with higher media exposure were 36% more likely than women with no media exposure to have births delivered by C-section. Women's autonomy in healthcare decision-making was associated with increased use of ANC services. For example, women with higher degree of autonomy were 50% more likely to have ANC from a medically trained provider, and 4+ ANC visits than women with no autonomy. Micro credit involvement also had positive association with ANC services but we find no significant relation with delivery care indicators. Survey specific odds ratios indicate that use of several maternal health services noticeably increased over the last seven years. Most improvement is found in using C-section delivery, followed by skilled birth assistance and delivery at health facility. For example, use of C-section delivery increased by 4 times in 2011 compared to 2004. Rather slow progress is observed in accelerating the use of recommended 4+ ANC in 2011 (OR=1.29). On the other hand, use of ANC from a medically trained provider and 2+ TT injections declined since 2004. Compared to usage rate in 2004, use of ANC from a medically trained provider and receiving 2+ TT injections were reduced by 34% and 56% respectively in 2011.

Discussion

Bangladesh has achieved marked improvement in overall indicators of maternal health and health care service utilization during the last decade (Adams *et al.*, 2013). However, there exists not only a large gap between rich and poor women but also significant urban–rural differences in access to and use of maternal health care services in Bangladesh (Jahan, 2007; Adams *et al.*, 2013). Hence, the purpose of this study is to examine the trend and pattern of inequities in utilization of maternal health services in Bangladesh using the three recent rounds of BDHSs. In this study, we use rich-poor ratios, CC and CIs to measure the trend and level of inequities related to household wealth.

We also perform logistic regression analysis in pooled data over seven years examine the relation between socioeconomic factors and six indicators of maternal health care utilization.

The general finding is that coverage level in maternal health care increased for all outcomes except for 2+ TT injections during 2004-2011 in Bangladesh. Since the country has almost achieved universal coverage (9 out of 10 women) for TT injections before pregnancy in 2011, it is usual to find a reduction in usage of 2+ TT injections during pregnancy (NIPORT *et al.,* 2013b). Between 2004 and 2011, coverage level for delivery care at health facilities and skilled assistance at birth was more than doubled, while 4+ ANC visits and receiving ANC from medically trained provider increased only by 9% and 3% respectively. There is a strong evidence that performance of rural area to increase utilization of selected indicators of maternal health care service utilization was always poorer than urban area in Bangladesh. However, this gap is narrowing slowly over time. When we disaggregate our analysis at regional level, we find that Sylhet division always performed worst in terms of accelerating coverage of maternal health care while Khulna division led all divisions for almost every indicators. Our findings also suggest that rich-poor ratio gradually decreased during this period except for ANC from medically trained provider.

To be specific, our findings indicate that the proportion of women using ANC services increased during 2004-2011 in Bangladesh but this progress is highly unlikely to reach the target of 50% coverage for 4+ ANC visit by 2016, a goal set by Health Population Nutrition Sector Development Program (HPNSDP). Only one fourth of pregnant women had the WHO recommended 4+ ANC visits in 2011. There is also significant differences among six administrative divisions in terms of accelerating 4+ ANC visits. The general trend is that Khulna tops the list and Sylhet remains lowest in increasing coverage level for 4+ ANC visits and ANC from medically trained provider. We find evidence of wealth related inequity in maternal health care utilization though there is a decreasing trend over time. For instance, compared to poorest wealth quintile, use of delivery care from health facility, and skilled birth assistance were six times higher among women from richest quintile in 2011, which was fifteen times higher in 2004. Similar pattern also appears in receiving 4+ ANC visit and delivery by C-section. Despite low coverage and inequity in receiving adequate ANC visits and ANC from medically trained provider, progress on TT vaccination among women during pregnancy is excellent in Bangladesh. There is almost equitable distribution in case of 2+ TT injection among women in their last pregnancy since 2004. (Karim *et al.*, 2006) find similar results in their study at rural level of Bangladesh and they argue that the narrowing gap between the poor and the non-poor in this indicator is due to the availability of this service free of charge and easy of accessibility.

Our analysis suggests that though uptake of services increased, the inequity persistently sustained over 2004-2011. This may imply that richer households were more able and willing to pay for services from the increasingly widespread private health facilities, and poorer households are constantly disadvantaged in affording and accessing the needed care. The key concern is how to reduce this persistent wealth-based inequity. Previous studies demonstrate that some targeted interventions in the form of creating enabling environment by expanding the services, and incentive schemes had been very effective in benefiting the poorer segments of society in utilizing critical maternal care services in Asia and elsewhere (Ir *et al.*, 2010; Ahmed and Khan, 2011; Sosa-Rubí *et al.*, 2011; Nguyen *et al.*, 2012). In addition, mobilizing services through community health workers have been reported to be effective in improving equity in maternal care services in Bangladesh (Quayyum *et al.*, 2013). We suggest policy makers to continue to scale up such effective incentive schemes, and community based program efforts targeting poorer section of population in Bangladesh.

Our analysis highlights that low utilization of maternal health care is more evident among women with lower socioeconomic status and is consistent with results from similar studies (Collin *et al.*, 2007; Houweling *et al.*, 2007; Zere *et al.*, 2007; Koblinsky *et al.*, 2008). We find that women with better education and educated husbands were more likely to utilize ANC services. It is perhaps because educated women are more likely to realize the benefits of using maternal healthcare services (Matsumura and Gubhaju, 2001). Studies also document that education increases female autonomy and decision-making power within the household care services (Raghupathy, 1996; Matsumura and Gubhaju, 2001). Our findings document that women exposed to mass media were more likely to use maternal health care services. It is possibly due to the increased dissemination of health education messages through popular mass media. We find that microcredit membership of the mother and women's decision-making autonomy in family health affairs appear to be significantly associated with the increased use of antenatal care services, which is also in line with previous Bangladeshi studies (Osmani, 1998; Amin *et al.*, 2010; Haque *et al.*, 2012). The experience from Bangladesh shows that poor mothers are likely to contribute to household resources through their microcredit participation, and thus increase the households' ability to pay for health services (Amin *et al.*, 2010). Microcredit institutions also play complementary roles in providing their members with health service related information, which increase women's access and timely utilization of needed services. With respect to demographic factors, parity appears to affect utilization negatively. Previous studies also reported a negative association between parity and utilization of maternal services in many developing countries (Anwar *et al.*, 2004; van Eijk *et al.*,

2006; Babalola and Fatusi, 2009). One possible explanation for the low utilization among high parity women is that women with higher number of births usually tend to develop confidence due to their experience and knowledge accumulated from previous pregnancies and births, and therefore, they are less motivated to opt for services from health facilities or health professionals in developing countries (Regassa, 2011).

We take a note about the questionable progress in the proportion of births delivered by C-sections at health facilities. The high prevalence of C-sections done at health facilities (17% of all deliveries in 2011), which has even exceeded WHO threshold level, indicates that many of these surgeries are likely to be clinically unnecessary (Cavallaro *et al.*, 2013). The downside of high rate of C-sections in poor countries like Bangladesh is that these countries have a limited capacity to provide safe surgical births. As a result, if unnecessary C-sections persists, many women who actually need this service will be pushed out of the healthcare system. Future research may consider understanding the causes of high prevalence of such expensive services in the poor countries. Policy makers should particularly focus on designing monitoring programs and surveillance mechanism that could identify at what points of health care system and in what circumstances unnecessary C-sections are increasing in the country.

The findings from our study are not beyond limitations. First, our discussion is limited to trends over the seven-year period as data on all six indicators are not available in the earlier rounds of BDHS. Second, we cannot draw any causal interpretation from regression analysis due to cross sectional nature of the data. Finally, we have not extended our analysis to decompose the contributions of different socioeconomic factors in inequity because we cover broad aspects of maternal health care utilization over time.

Conclusion

Average country progress may not result in sustainable health outcome if the improvement remains inequitable. Assessing the trend in inequities of maternal health services in a low-income country like Bangladesh is important for policy design to accelerate the overall improvement as well as to narrow the equity gap in access to and use of essential maternal health care services. Bangladesh has achieved impressive progress in reducing the maternal mortality rate in recent decade. The focus of this study is to identify where the inequity existed and monitor what progresses achieved in the reduction of inequity in utilization of maternal health care over 2004-2011 in Bangladesh.

Findings from this study reveal a persistent increase in uptake of antenatal and delivery care services over the study period. Nevertheless, maternal health care utilization rates are still quite low, which makes it difficult to relate the progress in maternal health care services to the large decrease in maternal mortality in Bangladesh in the last decade. As far as the MDG target on reduction of maternal mortality is concerned, a recent countdown study showed that Bangladesh is likely to achieve it (El Arifeen *et al.*, 2014). However, equitable progress on indicators of maternal health care studied in this paper are not quite satisfactory, as a whole. This study highlights that the country faces not only a large persistent equity gap between rich and poor households but also significant urban–rural differences. In addition, certain population groups with low socioeconomic status are consistently lagging behind in utilizing the needed services. Therefore, it is high time to design multi-sectoral and concerted interventions from an equity perspective to accelerate safe motherhood and childbirth in Bangladesh.

Table 1: Estimates of utilization of ANC and delivery care services in Bangladesh, 2004-2011

	Antenatal Care									Delivery Care								
	(4+) ANC Visits (%)			Medically Trained ANC (%)			(2+) Tetanus Injection (%)			Delivery at Health Facility (%)			Skilled Birth Assistance (%)			C-Section Delivery (%)		
Year	2004	2007	2011	2004	2007	2011	2004	2007	2011	2004	2007	2011	2004	2007	2011	2004	2007	2011
National	17.13	22.32	26.03	49.24	51.46	52.69	60.03	55.23	42.21	12.12	18.60	29.21	12.63	18.72	26.32	5.74	9.61	17.23
Wealth Index																		
Poorest	4.24	9.48	10.59	25.45	29.91	28.41	54.18	54.86	40.73	2.52	6.66	10.07	2.83	6.00	8.79	0.16	2.91	2.72
Poorer	7.07	11.37	14.90	39.14	36.26	36.78	56.87	55.35	44.88	3.34	5.63	16.61	3.26	5.21	13.63	0.79	1.61	9.25
Middle	13.01	15.45	20.95	49.44	44.78	49.89	60.78	54.83	42.27	6.76	9.99	24.71	7.55	11.16	22.21	2.16	4.29	14.52
Richer	19.54	27.97	32.83	62.99	63.28	63.50	65.94	53.56	36.54	14.84	20.71	39.90	13.40	20.93	35.46	4.73	9.69	23.03
Richest	47.99	49.36	53.31	82.46	83.84	85.59	67.61	54.83	45.86	38.31	48.58	60.02	36.88	48.99	56.54	19.07	30.01	41.07
Ratio: Richest to Poorest	11.33	5.21	5.03	3.24	2.80	3.01	1.25	1.00	1.13	15.21	7.29	5.96	13.04	8.17	6.43	119.13	10.31	15.10
Residence																		
Rural	11.73	17.58	19.82	43.52	45.45	45.74	59.72	55.42	40.52	7.71	13.10	23.02	7.54	13.35	20.80	2.34	6.75	13.77
Urban	36.70	38.32	44.80	72.92	69.96	70.91	63.22	52.08	46.82	28.14	33.94	49.48	27.43	33.75	44.57	14.15	18.40	28.87
Ratio: Urban to Rural	3.13	2.18	2.26	1.68	1.54	1.55	1.06	0.94	1.16	3.65	2.59	2.15	3.64	2.53	2.14	6.04	2.73	2.10
Region																		
Barisal	11.62	17.52	26.97	39.58	42.60	47.17	68.37	67.66	55.99	7.12	11.22	21.86	9.21	10.66	19.69	3.32	4.44	13.11
Chittagong	14.80	20.24	20.34	46.70	50.57	54.08	60.13	50.10	40.99	7.91	16.06	25.43	7.95	16.43	23.02	2.88	7.75	14.02
Dhaka	19.26	21.43	26.57	50.01	48.93	50.98	60.43	58.95	44.76	15.45	20.10	30.22	14.99	20.94	27.70	7.35	12.48	20.45
Khulna	19.23	27.89	33.34	56.95	65.18	61.29	54.62	50.82	34.02	18.87	27.11	45.70	18.16	27.87	39.91	5.44	11.85	26.29
Rajshahi	17.47	26.77	28.93	51.95	50.52	48.56	63.98	54.34	43.11	9.66	15.74	28.68	8.13	15.00	25.91	3.17	7.68	15.08
Sylhet	10.26	13.29	15.78	43.85	48.37	46.05	53.47	46.26	29.24	7.73	11.21	21.56	9.64	10.47	19.02	3.58	5.90	12.41

Table 2: Test of dominance between concentration curves of ANC and delivery care utilization in Bangladesh, 2004-2011

	Year 1	Year 2	Significant Level	Rule	Result
(4+)ANC Visits	2004	2007	5%	mca	2007 dominates 2004
	2004	2007	5%	iup	Non-dominance
	2007	2011	5%	mca	Non-dominance
	2007	2011	5%	iup	Non-dominance
	2004	2011	5%	mca	2011 dominates 2004
	2004	2011	5%	iup	2011 dominates 2004
Medically Trained ANC	2004	2007	5%	mca	Non-dominance
	2004	2007	5%	iup	Non-dominance
	2007	2011	5%	mca	Non-dominance
	2007	2011	5%	iup	Non-dominance
	2004	2011	5%	mca	Non-dominance
	2004	2011	5%	iup	Non-dominance
(2+)Tetanus Injection	2004	2007	5%	mca	2007 dominates 2004
	2004	2007	5%	iup	Non-dominance
	2007	2011	5%	mca	Non-dominance
	2007	2011	5%	iup	Non-dominance
	2004	2011	5%	mca	2011 dominates 2004
	2004	2011	5%	iup	2011 dominates 2004
Health Facility Delivery	2004	2007	5%	mca	Non-dominance
	2004	2007	5%	iup	Non-dominance
	2007	2011	5%	mca	2011 dominates 2007
	2007	2011	5%	iup	Non-dominance
	2004	2011	5%	mca	2011 dominates 2004
	2004	2011	5%	iup	2011 dominates 2004
Skilled Birth Assistance	2004	2007	5%	mca	Non-dominance
	2004	2007	5%	iup	Non-dominance
	2007	2011	5%	mca	2011 dominates 2007
	2007	2011	5%	iup	Non-dominance
	2004	2011	5%	mca	2011 dominates 2004
	2004	2011	5%	iup	2011 dominates 2004
C-Section Delivery	2004	2007	5%	mca	2007 dominates 2004
	2004	2007	5%	iup	Non-dominance
	2007	2011	5%	mca	2011 dominates 2007
	2007	2011	5%	iup	Curves cross
	2004	2011	5%	mca	2011 dominates 2004
	2004	2011	5%	iup	2011 dominates 2004

Table 3 Concentration index (95% confidence interval) showing the trends in inequity of ANC and delivery care utilization in Bangladesh , 2004-2011

	National			Rural			Urban		
	Year	CI		CI			CI		
(4+)ANC Visits	2004	0.42	(0.41, 0.43)	0.38	(0.36, 0.39)		0.36	(0.34, 0.38)	
	2007	0.32	(0.31, 0.34)	0.28	(0.27, 0.31)		0.32	(0.30, 0.33)	
	2011	0.31	(0.30, 0.32)	0.27	(0.26, 0.28)		0.21	(0.20, 0.23)	
Medically Trained ANC	2004	0.21	(0.21, 0.22)	0.21	(0.20, 0.21)		0.13	(0.13, 0.14)	
	2007	0.20	(0.20, 0.21)	0.20	(0.19, 0.21)		0.14	(0.13, 0.15)	
	2011	0.21	(0.21, 0.22)	0.22	(0.21, 0.22)		0.13	(0.12, 0.14)	
(2+)Tetanus Injection	2004	0.05	(0.04, 0.05)	0.04	(0.04, 0.05)		0.06	(0.05, 0.07)	
	2007	0.00	(-0.01, 0.01)	0.00	(-0.01, 0.01)		0.03	(0.02, 0.04)	
	2011	0.01	(0.00, 0.01)	-0.03	(-0.04, -0.02)		0.05	(0.04, 0.06)	
Delivery at Health Facility	2004	0.49	(0.47, 0.50)	0.45	(0.42, 0.47)		0.44	(0.41, 0.46)	
	2007	0.41	(0.39, 0.43)	0.37	(0.34, 0.42)		0.38	(0.36, 0.40)	
	2011	0.33	(0.32, 0.34)	0.32	(0.31, 0.33)		0.22	(0.21, 0.23)	
Skilled Birth Assistance	2004	0.47	(0.45, 0.49)	0.41	(0.39, 0.43)		0.44	(0.42, 0.46)	
	2007	0.42	(0.41, 0.43)	0.39	(0.36, 0.42)		0.40	(0.38, 0.42)	
	2011	0.34	(0.34, 0.35)	0.33	(0.32, 0.34)		0.27	(0.25, 0.28)	
C-Section Delivery	2004	0.60	(0.58, 0.63)	0.57	(0.54, 0.61)		0.47	(0.47, 0.47)	
	2007	0.48	(0.46, 0.51)	0.47	(0.43, 0.51)		0.49	(0.47, 0.54)	
	2011	0.40	(0.39, 0.41)	0.42	(0.41, 0.43)		0.35	(0.32, 0.37)	

Table 4: Results of multivariate logistic regression of ANC and delivery care utilization in Bangladesh , 2004-2011

Variable	Antenatal Care			Delivery Care		
	(4+)ANC Visits	Medically Trained ANC	(2+)Tetanus Injection	Delivery at Health Facility	Skilled Birth Assistance	C-Section Delivery
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Age	1.00 (0.99,1.02)	1.02* (1.00,1.03)	1.01 (1.00,1.02)	1.04***(1.02,1.06)	1.04***(1.02,1.07)	1.05*** (1.02,1.08)
Age at birth (Ref=11-14)						
Age at birth (15-19)	0.77*(0.61,0.97)	1.02 (0.88,1.18)	0.84* (0.72,0.97)	1.16 (0.91,1.48)	1.10 (0.86,1.42)	1.48* (1.00,2.19)
Age at birth(20-24)	0.91 (0.69,1.22)	1.09 (0.90,1.32)	0.76** (0.63,0.92)	1.45* (1.08,1.94)	1.44* (1.07,1.93)	2.14*** (1.39,3.28)
Age at birth(25-42)	1.12 (0.72,1.74)	1.04 (0.75,1.44)	0.90 (0.65,1.24)	2.74*** (1.78,4.24)	2.41*** (1.58,3.69)	3.37*** (1.93,5.90)
Parity (Ref=1)						
Parity (2)	0.83*(0.72,0.97)	0.70***(0.61,0.80)	0.51*** (0.45,0.58)	0.59*** (0.50,0.69)	0.57***(0.48,0.67)	0.64*** (0.53,0.78)
Parity (3+)	0.59***(0.47,0.75)	0.57***(0.47,0.68)	0.31*** (0.25,0.37)	0.36*** (0.28,0.48)	0.38***(0.29,0.51)	0.37*** (0.25,0.54)
Urban (ref=rural)	1.80*** (1.53,2.12)	1.56*** (1.35,1.81)	0.96 (0.85,1.08)	1.69*** (1.43,1.99)	1.54*** (1.31,1.81)	1.12 (0.92,1.35)
Division (ref=Barisal)						
Chittagong	0.78 (0.59,1.04)	1.19 (0.97,1.46)	0.57*** (0.47,0.70)	1.13 (0.87,1.46)	1.08 (0.85,1.38)	1.07 (0.79,1.44)
Dhaka	0.96 (0.74,1.24)	1.15 (0.94,1.39)	0.65*** (0.53,0.79)	1.61*** (1.25,2.07)	1.57*** (1.24,1.99)	1.96*** (1.44,2.67)
Khulna	1.13 (0.86,1.49)	1.59*** (1.27,1.99)	0.43*** (0.35,0.53)	2.61*** (2.02,3.38)	2.36*** (1.86,2.99)	1.90*** (1.39,2.61)
Rajshahi	1.56** (1.19,2.03)	1.48*** (1.20,1.82)	0.60*** (0.49,0.74)	1.78***(1.38,2.29)	1.56*** (1.23,1.98)	1.52** (1.12,2.06)
Sylhet	0.74 (0.55,1.00)	1.39* (1.07,1.82)	0.43*** (0.34,0.54)	1.20 (0.91,1.58)	1.15 (0.89,1.48)	1.24 (0.89,1.71)
Wealth quintile (Ref=Poorest)						
Poorer	1.00 (0.78,1.30)	1.15 (0.99,1.34)	1.04 (0.90,1.20)	0.92 (0.70,1.19)	0.87 (0.65,1.15)	1.41 (0.91,2.19)
Middle	1.24 (0.98,1.56)	1.44*** (1.22,1.70)	1.05 (0.91,1.22)	1.18 (0.91,1.52)	1.30 (1.00,1.70)	1.92** (1.26,2.92)
Richer	1.70*** (1.33,2.19)	1.98*** (1.65,2.36)	1.00 (0.84,1.18)	1.82*** (1.41,2.34)	1.82*** (1.41,2.36)	2.63*** (1.72,4.03)
Richest	2.91*** (2.24,3.78)	4.06*** (3.25,5.06)	1.26* (1.04,1.52)	3.16*** (2.40,4.17)	3.32*** (2.51,4.38)	4.89*** (3.17,7.54)
Microcredit Involvement(Ref=No)	1.22** (1.07,1.38)	1.14* (1.02,1.27)	1.01 (0.91,1.12)	1.10 (0.95,1.26)	1.08 (0.93,1.25)	1.10 (0.91,1.32)
Mass media exposure (Ref=No)						
Irregular	1.04 (0.83,1.29)	1.10 (0.94,1.28)	1.09 (0.94,1.27)	1.09 (0.86,1.37)	1.10 (0.87,1.39)	1.29 (0.94,1.76)
Regular	1.27* (1.06,1.51)	1.27*** (1.11,1.44)	1.06 (0.95,1.18)	1.26* (1.04,1.52)	1.21* (1.01,1.45)	1.36* (1.06,1.73)
Health care decision making autonomy (Ref= No)						
Low	1.21* (1.00,1.46)	1.33*** (1.15,1.55)	1.01 (0.88,1.16)	1.04 (0.85,1.27)	1.09 (0.89,1.34)	1.28 (0.99,1.68)
Medium	1.36** (1.13,1.64)	1.29*** (1.12,1.48)	1.03 (0.91,1.17)	1.00 (0.82,1.21)	1.06 (0.87,1.29)	1.28 (0.99,1.64)
High	1.53*** (1.28,1.84)	1.51*** (1.30,1.75)	1.11 (0.96,1.28)	1.05 (0.87,1.28)	1.12 (0.92,1.36)	1.10 (0.86,1.41)
Employment(Ref=No)	0.86 (0.72,1.03)	1.03 (0.88,1.19)	0.94 (0.83,1.08)	0.77* (0.63,0.95)	0.82* (0.67,0.99)	0.74* (0.58,0.96)
Own education	1.12*** (1.09,1.14)	1.11*** (1.09,1.13)	0.96*** (0.94,0.98)	1.12*** (1.09,1.15)	1.11*** (1.08,1.14)	1.10*** (1.07,1.13)
Husband's education	1.05*** (1.04,1.07)	1.05*** (1.04,1.07)	1.00 (0.99,1.02)	1.06*** (1.04,1.08)	1.06*** (1.04,1.08)	1.08*** (1.05,1.10)
Survey fixed effects (Ref=2004)						
Survey 2 (Year=2007)	1.10 (0.90,1.33)	0.79** (0.67,0.93)	0.77*** (0.67,0.88)	1.35** (1.10,1.64)	1.40*** (1.15,1.70)	1.74*** (1.39,2.17)
Survey 3 (Year=2011)	1.29** (1.09,1.52)	0.76*** (0.66,0.89)	0.44*** (0.38,0.50)	2.91*** (2.41,3.51)	2.47*** (2.05,2.97)	4.03*** (3.27,4.95)

Significant at *** p<0.01, ** p<0.05, * p<0.1

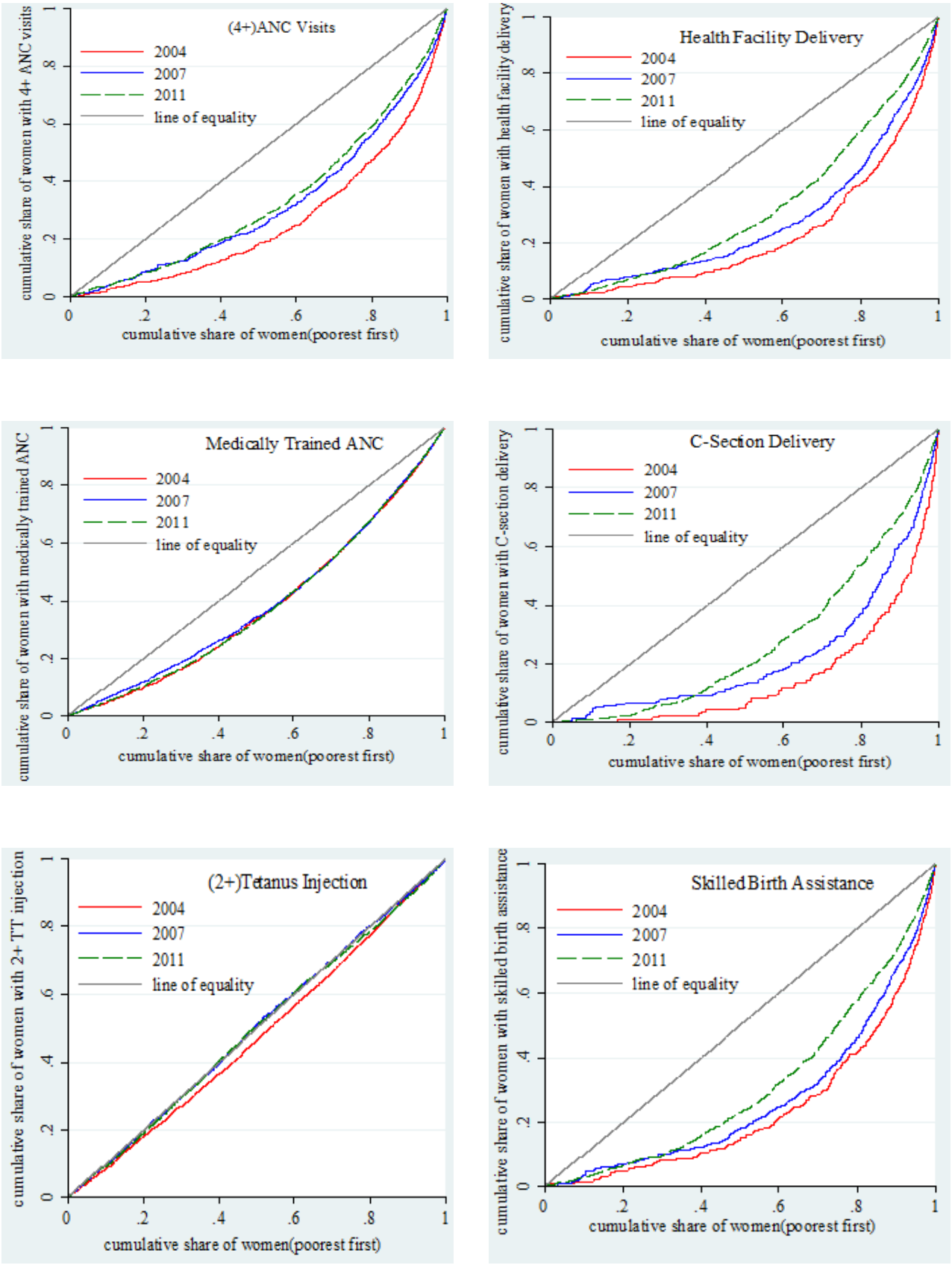

Figure 1 Concentration curves for ANC and delivery care utilization in Bangladesh, 2004-2011

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