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from the Bangladesh
Demographic and Health Survey**

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Inequality of Opportunity in Accessing Maternal and Newborn Healthcare Services: Evidence from the Bangladesh Demographic and Health Survey

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Abstract

Though there has been a significant reduction in the number of under-five deaths globally over the years, it is still a major public health problem in developing countries. Under-five mortality is known to be the result of a wide variety of inputs, among which the availability of maternal and child health services. However, their coverage and distribution, in low- and middle-income countries, continue to remain inadequate and characterized by significant inequalities. The main aim of this study is to investigate the causes of inequality in accessing the basic maternal and newborn healthcare services in Bangladesh. To this end, we use nationally representative cross-sectional data from the Bangladesh Demographic and Health Survey (BDHS), 2014. Our study builds on the Human Opportunity Index (HOI), developed at the World Bank (2006), which measures the total contribution of individual socioeconomic and demographic circumstances to inequality of opportunity in accessing basic services. We use the Shapley decomposition method to further analyze the marginal contributions of circumstances to the inequality. Our findings reveal that a mother's education, wealth index and place of residence, are closely associated with access to basic maternal and newborn healthcare services.

Keywords: Inequality, healthcare access, opportunities, circumstances, Human Opportunity Index

JEL Classification: I14; J13

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Introduction

According to the most recent estimates by the World Health Organization, in 2019, 5.2 million children under five years died, mostly from preventable and treatable causes (WHO, 2019). In the Sub-Saharan African and central and southern Asian regions, under-five mortality continues to be a critical issue and substantial inequalities between sub-groups of the population still exist within countries (United Nations Inter-Agency Group for Child Mortality - UNIGME, 2018).

Under-five mortality is known to be the result of a wide variety of inputs, among which the availability of maternal and child health services, whose coverage in low- and middle-income countries is still relatively poor especially for disadvantaged groups (Hanmer, et al., 2003).

The main aim of this study is to investigate the inequality of opportunity in accessing basic maternal and newborn healthcare services in Bangladesh. Our study builds on the Human Opportunity Index (HOI) developed at the World Bank (2006) which measures how socioeconomic and demographic circumstances affect inequality of opportunity in accessing basic services (Barros et al., 2012).

For the purposes of our study, we use nationally representative cross-sectional data from the Bangladesh Demographic and Health Survey (BDHS), 2014. The survey was implemented from June to mid-November 2014 under the National Institute of Population Research and Training (NIPORT) of the Ministry of Health and Family Welfare and provides information on demographic status, family planning, maternal and child health and healthcare access to basic services.

Specifically, our study focuses on four maternal and newborn health services: births taking place at a hospital facility; births being attended by a skilled professional; whether the child received any vaccination and postnatal checkup (within 2 months after delivery). We also break down the inequality by circumstances using Shapley's decomposition method. This method indicates the contribution of each circumstance variable to the total inequality of opportunity.

In line with the previous literature, our findings show that the family's economic background, maternal education and place of residence are the most important contributors to inequality of opportunity.

Although in Bangladesh there has been a significant decline in the child and neonatal mortality rates over the last decades, appropriate measures are still required to meet the targets set by Sustainable Development Goal (SDG) (Rajia, 2019); inequality still persists especially owing to difficulties in accessing basic healthcare services due to cultural and economic barriers that negatively impact maternal and child health.

Several studies have been carried out to measure inequality in accessing child and maternal healthcare services in relation to social and economic determinants (see for instance Collin, 2007; Nazmul, 2007; Amin et al., 2010; Anwar et al., 2015; Chowdhury et al., 2017; Singh et al.; 2017). However, to the best of our knowledge, none of these studies have used the HOI index and Shapley's decomposition. Our analysis aims to shed light on these aspects, especially on the circumstances that may influence maternal and child healthcare access, which remain among the most important issues in a developing country such as Bangladesh.

The rest of the paper is organized as follows. Section 2 describes the Bangladesh institutional background and healthcare system. Section 3 reviews the literature which concerns inequality of opportunity in accessing maternal and newborn health services in developing countries. Section 4 describes data, variables and the methodology. Section 5 presents the descriptive statistics, followed by the results obtained from the HOI and the Shapley decomposition. Concluding remarks are made in Section 6.

2. Institutional Background

Bangladesh is a developing country in Southeast Asia sharing borders with India and Myanmar. The Liberation War in 1971 led to the formation of Bangladesh, which was earlier the part of Pakistan, formerly known as East Pakistan. Since 1972, the country has made remarkable progress in terms of economic development: Gross National Income (GNI) per capita rose from \$100 to \$1,480 in 2017 (World Bank, 2017).

The country has been characterized by a fast urbanization over the last decades with 37.41% of the population living in the urban centers of the country in 2019 (Statista, 2020). The

high population density, coupled with high urbanization rates, has created an important challenge on existing infrastructure capacities of urban centers to provide adequate living standards. The issue of Rohingya refugees from Myanmar adds further strain on the infrastructure services.

The country is ranked 7th on the climate risk index in the world: the settlements suffer from frequent flooding, which severely impacts the agricultural and other livelihood activities, leading to economic instability, food insecurity and often results in migration in the country.

The country has made substantial progress over the last decades regarding maternal and child level health indicators. Between 1990 and 2018, the neonatal mortality dropped from 63 to 17 per 1000 live births (UNIGME, 2019). The under-five mortality rate decreased from 144 per 1000 live births in 1990 to 30 per 1000 live births in 2018 (UNIGME, 2019). Nevertheless, the burden of the neonatal and under-five mortality continues to remain an important concern.

The country has a rather low per capita healthcare expenditure, namely about 3.35% of its GDP (Mahmudur, 2018). Socio-economic and geographic inequalities act as barriers for children and mothers to receive adequate healthcare (Jensen et al., 2003; Rubayet et al., 2012). The use of traditional healthcare practices, such as the reliance on a traditional birth attendant, still dominates in the country especially in rural areas of Bangladesh, where most births take place at home.¹ Improving awareness and adequate access to healthcare services for mothers and children remain a concrete issue in order to achieve the targets related to the SDG 3 (Good Health and Well-Being). SDG 3.2.1 for Bangladesh aims at reducing the under-five mortality rate to 25 per 1000 live births by 2030 and SDG 3.2.2 at reducing the neonatal mortality rate to 12 per 1000 live births (SDG Tracker, 2020).

Healthcare in Bangladesh is provided by both public and private organizations. The healthcare system is based on a decentralized structure with a three-tier setup of primary healthcare services with Upzala Health Complexes (UHC) at sub-district level, Union Health and Family Welfare Centres (UHFWC) at the Union (collection of few villages) level, and Community Clinics (CC) at the village level.² These are backed by the District Hospitals providing secondary level care and the tertiary hospitals of various kind in large urban centres.

¹Although Bangladesh has made significant progress in reducing maternal and child mortality in the last decades, childbirth assisted by skilled attendants has not increased as much as expected. In rural areas, professionally trained staff are often in short supply and there is a tendency for women to rely on traditional birth attendants for delivery.

²The Upazila, which replaced the oldest institution called Thana, is an administrative subdistrict in Bangladesh. UHCs are primary healthcare centers and the first point of referral.

The private facilities are usually concentrated in urban areas of the country, where the treatment costs are generally higher and not affordable by the disadvantaged segments of the society. The government-based facilities provide subsidized rates or free treatment for a certain marginalized section of the society, but the majority of treatments are characterized by out-of-pocket expenditure. The government run facilities face the challenge of the lack of infrastructure, lack of skilled professionals, poor service delivery and low-quality care due to inadequate financing (Islam, 2014).

Despite economic progress, which has characterized Bangladesh, the country continues to suffer from several development challenges such as high poverty, climate change related disasters, unplanned urbanization and internal displacement. The most socio-economic vulnerable groups continue to face difficulties in accessing basic healthcare services.

3. Literature Review

As mentioned, under-five mortality remains a major challenge to health systems of low-income countries. Maternal and newborn healthcare services (such as hospital deliveries, skilled attendance at birth, postnatal care and child immunization) can contribute to the reduction of the under-five mortality rate but they are often only accessible to the better-off and the poor-rich gap continues to persist. Many studies, focused on developing countries, have documented the differentials in the uptake of such services, which may be influenced by circumstances such as the family economic status and other socio-geographic indicators such as education and urban-rural residence.

Singh's analysis (2011) on the HOI relied on the Indian National Health Family survey data for 1993 and 2006 to measure inequality in immunization and nutrition among the Indian children. As indicators of immunization, he used whether a child has received vaccines for tuberculosis, diphtheria, whooping cough, tetanus, polio and measles. As indicators of nutrition, he applied the criteria of underweight by analyzing weight for age. The circumstance variables employed in the study were caste of the household head, religion, child gender, place of residence, wealth quintiles, average parental education and number of siblings. The results indicate that there are high levels of inequality for both immunization and nutrition with substantial geographic variations.

The study by Amara et al. (2017) examined inequality of opportunity in maternal and newborn health services and child nutrition in Tunisia using the Multiple Indicator Cluster Survey data for 2011-2012 and HOI index. Among the indicators of maternal and newborn health services they included antenatal care, births taking place at health facilities, births being attended by a skilled health professional, the child having postnatal check-up, health examination and regular immunizations within one year after birth, as well as access to safe water and access to toilets. Nutrition comprised indicators of stunting, wasting, underweight and whether the mother has had blood tests during her pregnancy status (useful to assess maternal micronutrient status). As for circumstance variables, the authors referred to regions and place of residence (urban or rural), number of children under age of five, household composition, age of household head, gender of household head and mother's education. The study found low levels of inequality and with further Shapley's decomposition, the authors found that the mother's education, wealth and place of residence are key factors causing inequalities among the Tunisian children.

Sanoussi et al. (2017) analyzed the inequality of opportunities in accessing maternal and child health care in Togo for 1998 and 2013. They computed the HOI using five indicators of access to healthcare and one composite indicator of access to adequate care for children. The indicators were based on antenatal visits, vital signs measurements during pregnancy, whether the birth was attended by a skilled professional, the place of birth (type of health facility) and whether the child received any vaccination. Based on the aforementioned indicators, a composite indicator for access to maternal and child health care was developed which takes the value one if all the conditions for adequate healthcare are met. Concerning the circumstance indicators, they considered the mother's education, father's education, mother's occupation, father's occupation, household's wealth, gender of child, gender of household head, number of children in the household, region and place of residence (urban or rural). They did not provide any decomposition of the HOI; their findings, however, showed that inequalities in accessing adequate care in Togo increased over time.

Saidi & Hamdaoui (2017) examined inequality of opportunities among children in Tunisia on healthcare access and health status using the Multiple Indicator Cluster Survey for 2012. The study computed HOI for health service utilization and nutrition indicators. For health service utilization, indicators for prenatal care, testing of blood samples and postnatal care were

considered. For nutritional status, indicators were weight for age, length for age and weight for height. The circumstance variables selected were gender, residence, region, mother's education and annual family income. With the use of Shapley's decomposition method, the study found that the mother's education, wealth and geographic factors are the key factors in determining child development outcomes.

Tsawe et al. (2019) analyzed the HOI in the use and access to maternal and reproductive healthcare using the Sierra Leone Demographic and Health Survey data for 2008 and 2013. The dependent variables included in this study were antenatal care visits, skilled antenatal care providers, births delivered in a facility, births assisted by a skilled birth attendant and the use of any method of contraception. The circumstance variables used in the study were maternal age, maternal education and marital status, media saturation, household wealth, number of living children and number of household members, region and place of residence. The study concluded that between 2008 and 2013, the HOI improved in access to maternal and reproductive healthcare. Overall, the authors found that inequalities declined over time and while employing Shapley's decomposition method they found that household wealth status, maternal education and place of residence are the most important factors contributing to the inequality.

4. Data and Methodology

This section comprises the description of data, description of dependent and independent variables selected for the study, followed by the description of the methodological approach to calculate the Human Opportunity Index (HOI) and the decomposition of the inequality index for access to maternal and newborn healthcare services.

4.1 Data and Sample Design

This study uses data from the Bangladesh Demographic and Health Survey (BDHS) 2014. The dataset represents the seventh DHS undertaken in Bangladesh. The survey was implemented from June to mid-November 2014, under the National Institute of Population

Research and Training (NIPORT) of the Ministry of Health and Family Welfare and provides information on demographic status, family planning, maternal, child health and healthcare access to basic services. The BDHS is one of the most comprehensive sources of data available at a household level covering various indicators related to access and use of healthcare services with reported indicators for both mothers and children, along with demographic and household characteristics, and is thus well-suited to this kind of study.

The survey is representative of the entire population of the country covering all the seven administrative regions, namely Barisal, Chittagong, Dhaka, Khulna, Rajshahi, Rangpur and Sylhet.

The BDHS used four Questionnaires, each one specifically regarding the household, women, men and the community. The indicators employed in this study were taken from the Women's Questionnaire which covers the topic of maternal and newborn health. The original sample comprised 7,545 observations. Questions related to place of delivery and skilled professional attendance at birth were reported for births taking place three years preceding the survey for surviving children, thus the observations were reduced to 4541. Further, questions related to postnatal care for children were reported for the last live birth for the mother (NIPORT, 2016). We removed from the sample the observations where children did not survive. After correcting for the missing values for the variables included in our model, the sample includes 1294 observations.³

4.2 Opportunities

In this study, the dependent variables (opportunities) are indicators of maternal and newborn healthcare services access, namely: births taking place at a health facility, whether the birth was attended by a skilled professional, whether the child received any vaccination and postnatal checkup (within 2 months after the birth). All indicators are dummy variables which take a value 1 if the condition is met and 0 otherwise. The same indicators have been widely used in previous studies (see, for instance, Sanoussi et al.; 2017; Amara et al., 2017; Tsawe et al., 2020).

³ The sample weights used in the analysis are those provided in the BDHS dataset.

i. **Births taking place at a health facility.** Births taking place in a hospital or at a health facility is considered one of the most effective measures to reduce maternal mortality and increase chances for children to survive and enjoy a healthy life (Yesuf, 2014). An institutional delivery can better handle complications during delivery and provides a safe environment in ensuring proper health for both the mother and child. Essential newborn care (delayed bath until 72 hours of birth; breastfeeding in one hour after birth; drying and wrapping of the newborn within 5 minutes of birth; application of antiseptic to umbilical cord, etc.) is one of the most fundamental and crucial procedures for neonatal survival (Singh, 2017). An institutionalized delivery provides a greater probability for a child to receive all the recommended essential newborn healthcare in a proper manner.

In our study, the responses were categorized as institutionalized deliveries or birth reported at a health facility against the birth taking place at the respondent's home. As stated above, we constructed a dummy variable which takes a value 1 for births taking place in a health institution such as a hospital/health facility and otherwise 0.

ii. **Births Attended by Skilled Professionals.** Births attended by a skilled professional is another key indicator associated with reductions in mortality and morbidity rate for both mothers and the newborn. Trained and accredited professionals are better equipped to deal with the delivery and to better address the complexities involved in both the mother's and child's health. A child being delivered by a skilled professional has a higher probability of being born healthy and receiving appropriate care. According to Haider (2018), whose analysis was conducted using data from BDHS 2014, unskilled birth attendants tend to perform less essential newborn care practices compared to the skilled birth attendant. It is thus imperative that birth attendants should have proper skills, education and knowledge for delivery that can play a pivotal role in a child's survival.

Responses involving categories with qualified doctors; nurse/midwife/paramedic; community skilled birth attendant; medical assistant; community healthcare provider and trained traditional birth attendant were considered as skilled professionals for delivery. Whereas responses with a family welfare visitor, an untrained traditional birth attendant, unqualified doctors, friends/neighbors, relatives, no one at all and others, were coded as unskilled birth attendance. This indicator was constructed again as a dummy variable with value 1 for birth being attended by a skilled professional and otherwise 0.

iii. **Whether the child received any vaccination.** Vaccination represents one of the most important public health interventions to reduce child deaths from vaccine-preventable diseases. The government of Bangladesh initiated the Expanded Program on Immunization (EPI) in Bangladesh in 1979, with the support of Unicef and WHO. Thanks to EPI, the country has seen a rise in the coverage of immunization services, which include vaccinations against tuberculosis, diphtheria, tetanus, pertussis, poliomyelitis and measles in children less than a year old. The intervention helped the country to achieve a polio-free status in 2001, eradication of neonatal tetanus in 2008 and the highest vaccination coverage rate in comparison with other South Asian countries. Although Bangladesh has had a successful history of immunization and is able to achieve high vaccination coverage against vaccine-preventable diseases, it remains among the top 10 countries with the highest childhood mortality globally (Liu et al., 2015). Immunization coverage suffers from important geographical disparities related to supply-side factors (such as the distance of health facilities and vaccination centers, fragile communication systems in some remote areas) and demand-side factors (religious conservativeness, lower level of literacy that reduces knowledge about the benefits of vaccination for children) that contribute to incomplete vaccination of children (Uddin et al., 2016).

In this study, immunization was coded again as a dummy response, with value 1 if respondents reported that their child has received immunization and 0 otherwise.

iv. **Postnatal checkup for child (within 2 months after birth).** The majority of neonatal deaths happen during childbirth or during the postnatal period (WHO, 2012). The postnatal period, as defined by the WHO, concerns the first six weeks after the birth, which are considered a critical time frame for survival and overall development of health indicators for the child. Postnatal care provides an opportunity to check for early on signs of illness. It can help in preventing complications in the newborn related to meningitis, diarrhea, sepsis and pneumonia (Singh, 2017).

Again, the variable takes value 1 if a child accessed a postnatal checkup within the first 2 months after his/her birth and 0 otherwise.

4.3 Circumstances

Circumstance variables are exogenous variables on which individuals have no control. The circumstance variables allow subdividing the sample into several subgroups ranging from

the most favorable to the least favorable group. Based on the existing literature which employed HOI, a set of circumstances were selected which are also described in Table 1:

- i. **Child gender.** In developing countries, gender still plays a prominent role in access to basic services (Hoyos and Narayan, 2011). It is a critical indicator in assessing the inequality of access to healthcare services for children among Bangladesh and is included as an indicator of circumstance in accordance with the previous literature which relies on HOI.
- ii. **Household head gender.** In developing countries, the head of the household is responsible for the provision of and access to basic services. The indicator will help in representing the inequalities arising due to the gender of household head based on bargaining power and decision making for access to healthcare services for the children.
- iii. **The number of children under the age of five in the household.** This variable may influence a mother's ability to afford the costs of healthcare services access due to a higher need of care that characterizes this age category. Indeed, the profile of total healthcare expenditure by age is J-shaped: expenditure for newborns is high and decreases with age until the age of 15, it increases only slightly until the age of 45, and it becomes higher at an increasing rate later (Gabriele et al., 2006).
- iv. **Mother's education.** This variable has been widely used in the literature based on opportunity approaches, the mother's' education being the proxy for circumstance in almost all the contributions. A mother's' educational attainment has been categorized as "no education", "primary", "secondary" and "higher". No education refers to her not having any formal education, with primary defined as completing grade 5, secondary as completing grade 10 and higher defined as attaining more than grade 10.
- v. **Mother's occupation.** A mother's occupation can be considered an indicator of her relative bargaining power in the family, that may influence her ability in accessing healthcare services. Together with the mother's education, this variable may also capture the effect of the socioeconomic status of a woman on maternal and child health services. Occupational status was defined as employed/unemployed.
- vi. **Household wealth.** As an indicator of household wealth, we employed the wealth index included in the BDHS which is a composite measure of a household's cumulative living

standard calculated through the principle component analysis method by assigning weights to the household assets (ownership of land, vehicles, appliances, etc.) and household characteristics (type of material used for floor, roof, etc.) (Filmer and Pritchett, 2001). Based on the scores generated by each household, the sample is divided in quintiles. The index comprises five categories: i. Poorest, ii. Poorer, iii. Middle, iv. Richer and v. Richest.

- vii. **Place of residence.** This concerns a binary variable that indicated whether the community where the household is located is of urban or rural nature. Several studies have reported a negative impact of living in rural areas on healthcare utilization. Rural areas in Bangladesh are characterized by a lower concentration of health facilities and infrastructures; the distances to health care facilities and the poor condition of roads to arrive at the point of delivery may lead to a decrease in the access to healthcare services (O'Donnell, 2007; Rejaul et al., 2015).
- viii. **Region of residence of the household.** Regions refer to the administrative divisions in Bangladesh, namely: Barisal, Chittagong, Dhaka, Khulna, Rajshahi, Rangpur and Sylhet.

[Table 1 about here]

4.4 HOI Approach

This section describes the necessary steps for the implementation of the Human Opportunity Index (HOI). The index comprises two main components: C the average coverage rate of the access to basic maternal and newborn healthcare services. The Dissimilarity Index (D-index) that measures the dissimilarity in access to basic maternal and newborn healthcare services for groups defined by circumstance characteristics (e.g. gender, wealth index, place of residence, etc.) compared with the overall coverage rate C of the population as a whole (de Barros et al., 2009). The D-index ranges from 0 to 1. A D-Index equal to 0 implies that access to basic maternal and newborn healthcare services is the same among the general population no matter one's particular circumstance; by contrast, a D-index of 1 indicates that a group is completely excluded from the access. When the access to basic maternal and newborn healthcare

services are equally distributed among the society the value of the D-index would be equal to 0 (Singh, 2011; Ju'arez, 2014).

Access to basic maternal and newborn healthcare services are defined as dichotomous outcome variables. Hence, for each type of care (birth taking place at a health facility, whether the birth was attended by a skilled professional, whether the child received any vaccination and postnatal checkup), we estimate the conditional likelihoods by specifying a binary function between access to care and circumstance variables using a logistic regression model. Then, we estimated the predicted probability of access to care (opportunity) that is explained by the circumstance variables:

$$\hat{p}_i = \text{Exp} \left(\hat{\beta}_0 + \sum_{k=1}^m \square_{x_{ki}} \hat{\beta}_k \right) / 1 + \text{Exp} \left(\hat{\beta}_0 + \sum_{k=1}^m \square_{x_{ki}} \hat{\beta}_k \right) \quad (1)$$

where here \hat{p}_i denotes the predicted probability for access to healthcare services, m denotes the number of criteria for the circumstances $x_{1i}, x_{2i}, x_{3i}, \dots, x_{mi}$, $\hat{\beta}_k$ are the parameters to be estimated. The coverage rate C for access to healthcare services could be calculated as follows:

$$C = \sum_{i=1}^n \square_{w_i} \hat{p}_i \quad (2)$$

where, w_i represents the weight, given by $\frac{1}{n}$, where n is the sample size.

The degree of inequality of opportunity that is explained by the individual's circumstances is measured by the D-index. Based on the approach of de Barros et al. (2009), D is given as follows:

$$D = \frac{1}{2C} \sum_{i=1}^n \square_{w_i} |p_i - C| \quad (3)$$

Thus, the human opportunity index HOI for access to care is shown in the equation (4):

$$\text{HOI} = C*(1-D) \quad (4)$$

HOI is a composite index of two factors: the level or coverage (C) and (1-D) that can be interpreted as equity of opportunity. The policymakers' objective should be to maximize HOI, which can be achieved either by enhancing the percentage of individuals who have access to the opportunities or by promoting a more equitable distribution of the opportunities or by increasing both coverage and equity. The HOI index ranges between 0 and 1: a higher value of the index means a higher coverage rate of opportunity, while lower inequality through the dissimilarity index.

4.4.1 Shapley Decomposition

After estimating the level of equality of opportunity proxied by the HOI, we assess the marginal contribution of each circumstance variable to inequality in maternal and child health healthcare access using the Shapley decomposition procedure proposed by Shorrocks (2013). The Shapley decomposition consists of estimating the marginal effect in the HOI of each inequality contributor (circumstance) in a specified sequence of elimination (Betti and Lemmi 2008; Shorrocks, 2013).⁴

Following de Barros et al. (2009), the dissimilarity index depends on the set of the circumstances and its value increases adding more circumstances. For example, if there are two circumstance variables A1 and A2, then D-index (A1, A2) > D-index (A1) and opposite for HOI. According to the Shapley decomposition method, from the set of circumstance variables, each circumstance variable is removed one after the other in a sequence, to measure the marginal effect of the removed variable on the dissimilarity index (Saidi and Hamdaoui, 2017). The new or changed value of the dissimilarity index provides the magnitude of the impact that a particular circumstance has over the overall value of the inequality index.

Let 'N' be denoted by the total number of circumstance variables that are present. Let 'n' represent the number of circumstance variables selected out of total circumstances N. Let 'S' represent the subset of N that does not include a particular circumstance, say 'T'. Then $D(S)$

⁴ When different categorical variables represent a single circumstance, we remove them simultaneously as a group. For instance, there are four dummy variables indicating the mother's education. In the regression analysis, we include three dummy variables as explanatory variables with secondary education as reference category. In various iterations for the decomposition analysis, we simultaneously include or remove all the educational levels from the regression. This process gives the contribution of the mother's education to total inequality of opportunity. We carry out the same process for the other circumstances that are represented by more than one binary variable.

denotes the subset without T circumstance, while $D(S \cup \{T\})$ denotes the subset that includes the circumstance T, where D represents the dissimilarity index for the opportunity of access to healthcare for the given circumstances. Thus, the inequality for a particular circumstance (T) is given as follows in equation (5).

$$D\text{-index}(T) = \sum_{S \subseteq N \setminus \{T\}} \left[\frac{|S|!(n-|S|-1)!}{n!} \right] [D(S \cup \{T\}) - D(S)] \quad (5)$$

The contribution of T is given as follows:

$$M_T = D\text{-index}(T) / D\text{-index}(N) \quad (6)$$

Where the total sum of contributions of all circumstance variables should add up to 100 percent or 1.

All estimations are carried out with STATA 14. For details on the computational issues (using STATA) we refer to Azevedo et al. (2011) and Suarez (2013).

5. Results

This section is divided into two sub-sections. In the first sub-section, we provide the descriptive statistics and estimates of the coverage rate, D-Index and HOI for maternal and child health services. We estimate the indices for all Bangladesh divisions and for rural and urban areas. In the second sub-section, we provide the Shapley decomposition of the D-Index that provides estimates of the contribution of each circumstance to overall inequality of opportunity.

5.1 Descriptive statistics, estimates of the Coverage rate, D-Index and HOI

Access to appropriate healthcare, especially hospital deliveries and skilled attendance at birth, is closely associated with substantial reductions in mortality and morbidity for both mothers and the newborn (Starrs, 2006). According to our descriptive statistics, included in Table 2, few women use health facilities for births. In our sample, 37% of women gave births with a skilled care provider and 40% of women reported having given births at a health institution. Our statistics show that, compared to skilled birthing and institutional delivery service utilization, the access to postnatal checkup and children immunization are relatively higher: 65% of respondents reported to have accessed postnatal checkup and 77% to children immunization.

[Table 2 about here]

The descriptive statistics for the circumstance variables are included in Table 3. It is worth noting that the percentage of women without any formal education or with primary education is quite high, while those with a higher level of education is relatively low (around 10% of the sample). In our sample, more than 75% of women are unemployed and live in a rural area.

[Table 3 about here]

Table 4 shows the level of coverage of healthcare services across circumstance variables. For both births taking place at a health facility and births attended by skilled professional indicators, the level of coverage is particularly low among women with no education and among those who belong to the lowest (first and second) wealth quintiles.

[Table 4 about here]

Table 5 shows the logit marginal effects for the basic maternal and newborn healthcare services.

[Table 5 about here]

A mother's education, the economic background of the family, the number of children in the household and living in an urban area, all appear to be the most important predictors for accessing maternal and newborn healthcare services.⁵

⁵ According to our results the economic background of the family, measured through the wealth index quintiles, does not affect the probability of accessing vaccinations. Actually, this is not surprising since the most important childhood vaccines, in Bangladesh, are made available by the government free of cost under the Expanded Program on Immunization (EPI). Sex of the child, sex of head of household, the mother's occupation, place of residence were found to be non-significant factors in determining whether or not a child had received full vaccination.

Based on the predicted probability from the logit model, we estimate inequality of opportunity. Table 6 shows Coverage, D-Index and HOI for the healthcare outcome variables. We also carried out an analysis for place of residence (urban vs. rural area) and for regions.

[Table 6 about here]

Starting from births taking place at a hospital, we find that the overall coverage rate for Bangladesh is 39.64 percent. The D- index for country is equal to 28.82 percent.

[Figure 1 about here]

The D- index is more than twice in urban areas as compared to rural areas. We also find that there is wide regional variation in terms of coverage and inequality of opportunity. Khulna has the highest coverage of 67.41 percent with the lowest inequality of 6.92 percent (see Figure 2). The region of Sylhet presents the lowest level of coverage, equal to 24 percent, accompanied by the highest level of inequality: D- index equal to 43.16 percent.

Despite the increase in rates of facility delivery, home birth is still the norm. Given that the health system in rural Bangladesh is not configured to provide skilled delivery care at home, there is a continued reliance on informal healthcare providers, such as traditional birth attendants (TBAs) especially in rural areas. Rural areas continue to be characterized by a shortage of healthcare professionals and healthcare facilities, thereby increasing their dependency on TBAs which ultimately result in lower access to institutional deliveries that remain relatively very low. In 2009, the government launched Revitalization of Community Healthcare initiatives to tackle the problem for the rural areas with a community engagement program focused on capacity building for the community clinics in rural areas and by raising awareness for utilization of primary healthcare in order to reduce maternal and neonatal mortality (Yaya, 2017).

[Figure 2 about here]

Concerning births attended by skilled professionals, our results show that the overall coverage rate for the country is 37.09 percent, while the D- index is equal to 27.89 percent with quite a large variation between rural and urban areas: D- index of 23.23 percent rural areas against a D-index of 14.79 percent in the urban areas. There is also a large variation across divisions within the country with Sylhet which presents the lowest coverage (equal to 23.2 percent) and the highest D- index (equal to 33.78 percent) (see Figure 3). Despite public information campaigns to raise awareness, training of traditional birth attendants, training of new community based skilled birth attendants and healthcare voucher programs to raise demands for utilization of healthcare services for delivery, the proportion of births attended by skilled professional in Bangladesh has remained relatively low again especially in rural areas and in some regions (Saha, 2017).

[Figure 3 about here]

Bangladesh has made significant gains in childhood vaccination coverage. Vaccination presents a lower level of access inequality compare to the other maternal and new born healthcare services. The overall coverage rate for children immunization is equal to 77.36 percent and the D-index is approximately 6.61 percent, the lowest among the healthcare services considered in our study. Despite the success, full immunization coverage varies across the country. For instance, the immunization coverage is the highest in Dhaka (85.62 percent) while the lowest coverage is observed in the Sylhet region (58.82 percent). Figure 4 shows the region wise ranking.

[Figure 4 about here]

Finally, we find that the overall coverage rate for postnatal checkup for child in Bangladesh is 65.22 percent. The inequality index for rural (4.18 percent) and urban areas (2.97 percent) are relatively low and slightly similar in contrast with other healthcare services. The region of Sylhet presents again the lowest coverage (50.8 percent) and also the highest inequality (D-index equal to 8.98 percent). Figure 5 shows the region-wise ranking.

[Figure 5 about here]

In 2007, the Ministry of Health and Family Welfare of the Government of Bangladesh implemented the Maternal Health Voucher Scheme, a specialized form of a demand-side financing program to reduce financial, geographical and institutional barriers to access maternal healthcare services for the poorest. Eligible women (identified based on household income and land ownership criterion) were provided with vouchers for various services along with the postnatal care visit within six weeks of delivery. The evaluation of the program resulted in improved postnatal visits among the poor. This success led the Maternal Health Voucher Scheme to be integrated in the government's main health program known as Health, Population and Nutrition Sector Development Program (HPNSDP) 2011-2016 (Ministry of Health and Family Welfare, 2015).

5.2 Decomposition Results

We also decompose inequality of opportunity using the Shapley value method to find the contribution of individual circumstances. The Shapley decomposition gives percentage contributions of various circumstances to the D-Index. Knowledge about relative contributions is particularly relevant as it enables policy makers to take appropriate measures, and concentrate on the largest contributors to reducing inequality of opportunity. The decomposition of the D-index by circumstances is shown in Table 7.

[Table 7 about here]

According to the previous literature, the Shapley's decomposition reveals that the family's welfare (measured through the wealth index) is the most significant contribution to inequality in accessing basic maternal and newborn healthcare services. We also find that the mother's educational level and place of residence (urban /rural) are among the most important contributors to inequality of opportunity. The empirical results show that regional differences contribute in particular to inequality of opportunity in vaccinations.

It is evident from Table 7 that the family's economic background accounts for the highest contribution to inequality of opportunity in maternal and newborn healthcare services except vaccination. For births taking place at a health facility, births being attended by a skilled professional and for postnatal checkup of child, wealth classes contribute to 39.69 percent, 39.81 percent and 39.18 percent of inequality of opportunity respectively. On the contrary, for vaccinations it is one of the lowest as it only explains 15.11 percent of the inequality.

The second important contributor to inequality of opportunity is the mothers' educational level. The percentage contribution of a mother's education to inequality of opportunity is relatively high for all the maternal and newborn healthcare services considered in this study. Looking at each healthcare services, the marginal contribution is higher for births taking place at a health facility and being attended by a skilled professional which account for 29.04 percent and 28.60 percent of the inequality respectively. For vaccinations, it shows a substantial contribution of 21.24 percent. A mother's education in postnatal checkup for the child also shows a contribution of 15.74 percent, although it is the lowest among the healthcare services. Concerning vaccinations, it can also be noted that the mother's education contributes more than family economic background. Table 7 shows that the contribution of wealth classes is 15.11 percent, whereas education of the mother contributes 21.24 percent to inequality of opportunity.

The place of residence too appears to be a significant contributors to explaining inequalities for all the healthcare opportunities. There exists a huge difference among inequality index for urban and rural areas with rural areas always having a higher inequality for all the healthcare opportunities. Rural areas tend to suffer from the challenge of availability of healthcare infrastructure. However, for vaccinations, the place of residence is not as high as compared to other healthcare opportunities with a contribution of 9.56 percent. For other healthcare opportunities, the place of residence explains between 18 and 20 percent of inequalities approximately.

Number of children in household (under five) also captures a significant contribution to explaining the inequality of opportunity. For a child receiving vaccination it is one of the major drivers with the largest proportion among the circumstance variable that explains the inequality with 27.48 percent. For the remaining healthcare opportunities, it explains between 7 and 8 percent of inequality approximately.

According to our decomposition results, mother's occupation is not one of the most important contributors to the inequality of opportunity with the exception of postnatal checkup for the child for which the mother's occupation accounts for 11.65% of the inequality.

The contribution of regions in explaining inequality for access to healthcare is relatively low. Interestingly, it is one of the significant drivers in explaining inequalities in vaccination with a contribution of 17.15 percent among the circumstance variables. For postnatal checkup of the child, region explains 4.11 percent inequality and contributes for less than 1% of the remaining healthcare opportunities inequality.

Gender of household head does not capture a significant contribution toward the inequality of opportunity. Specifically, it explains less than 1 percent of inequality for births taking place at a hospital and being attended by a skilled professional. Postnatal checkup for the child and the child receiving vaccination show a slightly higher contribution of 2.09 and 2.22 percent, respectively.

Finally, gender of child contribution is quite low among all healthcare opportunities except for vaccination where it explains 4.30 percent of inequality.

6. Concluding Remarks

The main aim of this study is to investigate the causes of inequality in accessing the basic maternal and newborn healthcare services in Bangladesh and underline the main drivers of inequality in accessing these services for the effective coverage and targeted interventions in the country.

Our results show that maternal education, family wealth and place of residence are the key identifiers responsible for the low healthcare access opportunity in the country. Coverage and opportunities are lower among the rural areas due to the lack of health infrastructure, health professionals and awareness. Specific efforts should be made to provide basic maternal healthcare services to the women of lower socio-economic status, especially those living in rural areas where poverty is more prevalent (Cummings et al., 2019). Education levels and wealth are positively associated with the utilization of basic maternal and newborn healthcare services and hence economic and educational improvement of the poor mothers would have a positive effect on reducing the prevalent inequalities.

The region-wise analysis of the index and decomposition helped identify the priority areas for interventions for each region. According to our results, Sylhet exhibits the lowest coverage and the highest D-Index rankings in comparison to other regions. The population in Sylhet is less literate, more conservative and faces sociocultural barriers in accessing healthcare services. Geographic barriers also affect the Sylhet division, which mostly covers a remote hilly and riverine area, and healthcare access tends to be more complex. The region is far below in terms of coverage of healthcare and level of inequality thus should be prioritized for interventions related to access to maternal and newborn healthcare services.

References

1. Amara, M., and H. Jemmali (2017). “On the Decomposition and Dynamics of Inequality of Opportunities: A Special Focus on Early Childhood Health and Nutrition in Tunisia”, *Economic Research Forum Working Paper 1093*. Giza, Egypt: Economic Research Forum.
2. Amin, R., Shah, N. M., Becker, S. (2010). “Socioeconomic factors differentiating maternal and child health-seeking behavior in rural Bangladesh: a cross-sectional analysis”. *International Journal for Equity in Health* 9, 9.
3. Anwar I., Nababan H.Y., Mostari S., Rahman A., Khan J.A.M. (2015). “Trends and Inequities in Use of Maternal Health Care Services in Bangladesh, 1991-2011”. *PLoS ONE*, 10: e0120309
4. Azevedo J. P. , Franco S. , Rubiano E., Hoyos A. (2010). "HOI: Stata module to compute Human Opportunity Index," *Statistical Software Components* S457191, Boston College Department of Economics.
5. Betti, G., Lemmi, A. (2008). *Advances on income inequality and concentration measures*. Routledge , Taylor & Francis Ltd.
6. Barros, R. P., Molinas Vega, J. R., Chanduvi, J., Giugale, M., & Hasan, A. (2012). “Do Our Children Have a Chance? A Human Opportunity Report for Latin America and the Caribbean” (World Bank, ed.). *The World Bank*.
7. Chowdhury, A.H.; Hanifi, S.M.A.; Mia, M.N.; Bhuiya, A. (2017). “Socioeconomic inequalities in under-five mortality in rural Bangladesh: Evidence from seven national surveys spreading over 20 years. *International Journal for Equity in Health*, 16, 197.
8. Collin, S. M., Anwar, I., Ronsmans, C. (2007). “A decade of inequality in maternity care: antenatal care , professional attendance at delivery and caesarean section in Bangladesh (1991 – 2004). *International Journal for Equity in Health*, 9, 1–9.
9. Cummings S., Seferiadis A. A., Maas J., Bunders J. F. G., Zweckhorst M.B. M. (2019) “Knowledge, Social Capital, and Grassroots Development: Insights from Rural Bangladesh”, *The Journal of Development Studies*, 55:161-176.
10. de Barros, P. R., Ferreira F. H. G., Molinas Vega J. R., Chanduvi J.S., (2009). “Measuring Inequality of Opportunities in Latin America and the Caribbean, Washington, DC: World Bank.

11. Gabriele, S. Cislighi, C., Costantini, F. (2006) Demographic Factors and Health Expenditure Profiles by Age: The Case of Italy. *ENEPRI Research Reports* No. 18.
12. Haider M.R., Rahman M.M., Islam F., Khan M.M. (2018). “Are trained delivery assistants better than non-trained personnel in practicing essential newborn care in home deliveries? Evidence from a nationally representative survey in Bangladesh”. *Int Health*. 10:302-309.
13. Hanmer, L., Lensink, R., White, H. (2003). “Infant and child mortality in developing countries: analysing the data for robust determinants”. *Journal of Development Studies*, 40(1), 101–118.
14. Hoyos, A. Narayan, A.(2011). “Inequality of Opportunities Among Children : How Much Does Gender Matter?” World Bank, Washington, DC. World Bank.
15. Islam, A., Biswas, T. (2014). “Health System in Bangladesh : Challenges and Opportunities Health system in Bangladesh : Challenges and opportunities”. *American Journal of Health Research*, 6,: 366-374.
16. Jensen, Eric R., and John F. Stewart (2003). “Health Facility Characteristics and the Decision to Seek Care.” *Journal of Development Studies*, 40: 79–100.
17. Ju’arez, F. W. C., Soloaga, I. (2014). “Estimating ex-ante inequality of opportunity”. *The Stata Journal*, 14: 830–846.
18. Liu L., Oza S., Hogan D., et al. (2015). “Global, regional, and national causes of child mortality in 2000-13, with projections to inform post-2015 priorities: an updated systematic analysis”. *Lancet*, 385: 430–40.
19. Mahmudur R. A. (2018) “A review on child and maternal health status of Bangladesh”. *CHRISMED J. Health Res.*, 5:1-7.
20. Nazmul, M., Tarana, H. Æ. (2008). “Maternal Education and Child Healthcare in Bangladesh”. *Maternal and Child Health Journal*, 12: 43–51.
21. National Institute of Population Research and Training (NIPORT), Mitra and Associates, and ICF International. 2016. Bangladesh Demographic and Health Survey 2014. Dhaka, Bangladesh, and Rockville, Maryland, USA: NIPORT, Mitra and Associates, and ICF International.
22. O’Donnell O. (2007) “Access to health care in developing countries: breaking down demand side barriers”. *Cad Saude Publica*, 23: 2820–34.

23. Rejaul K. Bakshi, Debdulal Mallick, Mehmet A. Ulubaşoğlu (2015). “Social Capital and Hygiene Practices among the Extreme Poor in Rural Bangladesh”. *The Journal of Development Studies*, 51:1603-1618.
24. Rubayet S., Shahidullah M., Hossain A., Corbett E., Moran A.C., Mannan I., Matin Z., Wall S.N., Pfitzer A., Mannan I., Syed U.; (2012) “Bangladesh Newborn Change and Future Analysis Group. Newborn survival in Bangladesh: a decade of change and future implications”. *Health Policy Plan*, 27 Suppl 3:iii 40-56.
25. Saha M., Odjidja E.N. (2017). “Access to a Skilled Birth Attendant in Bangladesh: What We Know and what Health System Framework can Teach Us”. *Health Syst Policy Res*, 4 No. 4:66
26. Saidi, A., Hamdaoui, M. (2017). “On measuring and decomposing inequality of opportunity in access to health services among Tunisian children : a new approach for public policy”. *Health and Quality of Life Outcomes*, 15, No. 213.
27. Sanoussi, Y. (2017). “Measurement and analysis of inequality of opportunity in access of maternal and child health care in Togo”. *BMC Health Services Research*, 17(Suppl 2).
28. SDG Tracker: Bangladesh (2020). Retrieved from <http://www.sdg.gov.bd/page/indicator-wise/5/428/3/0#1> accessed on May 22, 2020.
29. Shorrocks, A. F. (2013). Decomposition procedures for distributional analysis: a unified framework based on the Shapley value. *Journal of Economic Inequality*, 1-28.
30. Singh, A. (2011). “Inequality of Opportunity in Indian Children : The Case of Immunization and Nutrition”. *Population Research and Policy Review*, 30: 861–883
31. Singh K., Brodish P., Chowdhury M.E., Biswas T.K., Kim E.T. , Godwin C., Moran A. “Postnatal care for newborns in Bangladesh: The importance of health-related factors and location”. *J Glob Health.*, 7(2):020507.
32. Starrs A (2006). “Safe motherhood initiative: 20 years and counting”. *Lancet*, 368: 1130-1132.
33. Suarez A. H. (2013). "HOISHAPLEY: Stata module to perform Shapley Decomposition of the Human Opportunity Index”, *Statistical Software Components S457618*, Boston College Department of Economics.

34. Statista - The Statistics Portal. "Bangladesh: Urbanization from 2009 to 2019". Retrieved November, 17, 2020, from <https://www.statista.com/statistics/455782/urbanization-in-bangladesh/>
35. Tsawe M., Susuman A.S. (2020). "Examining inequality of opportunity in the use of maternal and reproductive health interventions in Sierra Leone". *J Public Health*, 26;42(2): 254-261.
36. Uddin M.J., Shamsuzzaman M., Horng L., et al. (2016). "Use of mobile phones for improving vaccination coverage among children living in rural hard-to-reach areas and urban streets of Bangladesh". *Vaccine*, 34.
37. UN Inter-agency Group for Child Mortality (UNIGME): Child Mortality Estimates 2018. New York: United Nations Children's Fund; 2018.
38. UN Inter-agency Group for Child Mortality (UNIGME): Child Mortality Estimates 2019. New York: United Nations Children's Fund; 2019.
39. Yaya, S., Bishwajit, G., & Ekholuenetale, M. (2017). "Factors associated with the utilization of institutional delivery services in Bangladesh". *PloS one*, 12(2), e0171573.
40. World Bank (2006): World Development Report: Equity and Development. Washington, DC: World Bank.
41. World Bank. (2017). Country Snapshot – Bangladesh, an overview of the World Bank group's work in Bangladesh, 2010 (October). Retrieved from <http://www.worldbank.org/en/country/bangladesh> accessed on 20 May, 2020.
42. World Health Statistics 2019: monitoring health for the SDGs, sustainable development goals. Geneva: World Health Organization; 2019. License: CC BY-NC-SA 3.0 IGO.

TABLES AND FIGURES

Table 1 - Independent Variables Description

<i>Variable</i>	<i>Description</i>
<i>Gender of child</i>	Dummy (1=male, 0=female)
<i>Gender of household head</i>	Dummy (1= male, 0= female)
<i>Number of children under 5 in the household</i>	Dummy (1= one child, 0 Two or more child)
<i>Wealth Index</i>	Dummy (1 = poorest, 0 otherwise; 1=poorer, 0 otherwise; 1=middle, 0 otherwise; 1 = richer, 0 otherwise; 1 = richest, 0 otherwise.
<i>Mother's' Occupation</i>	Dummy (employed =1; unemployed = 0;)
<i>Mother's education</i>	Dummy (1=no education, 0 otherwise; 1 = primary, 0 otherwise; 1 = secondary, 0 otherwise; 1 = higher, 0 otherwise.
<i>Place of residence</i>	Dummy (Urban=1, Rural=0)
<i>Regions</i>	Dummy (1=Barisal, 0 otherwise; 1=Chittagong, 0 otherwise; 1=Dhaka, 0 otherwise; 1=Khulna, 0 otherwise 1=Rajshahi, 0 otherwise; 1=Rangpur, 0 otherwise; 1=Sylhet, 0 otherwise.

Table 2 - Descriptive Statistics for Opportunities

<i>Outcome</i>	<i>Mean</i>	<i>Standard Deviation</i>
Birth taking place at a Health	0.40	0.49

Facility		
Birth attended by a Skilled Professional	0.37	0.48
Postnatal Checkup for Child (within 2 months after birth)	0.65	0.48
Whether Child received any Vaccination	0.77	0.42

Number of observations = 1294

Table 3 - Descriptive Statistics for Circumstance Variables

<i>Variables</i>	<i>Proportion (Percentage Composition)</i>	
Gender of Child	Male	51.33
	Female	48.67
Gender of Household Head	Male	90.98
	Female	9.015
Number of Children (under five)	One child	70.27
	Two or more	29.73
Wealth Index	Poorest	22.88
	Poorer	17.96
	Middle	19.61
	Richer	21.58
	Richest	17.96
Mother's Occupation	Unemployed	74.27
	Employed	25.73
Mother's Education	No Education	15.13
	Primary	27.4
	Secondary	46.83
	Higher	10.64
Place of Residence	Urban	25.25
	Rural	74.75
Region	Barisal	5.41
	Chittagong	23.64
	Dhaka	36.03
	Khulna	6.82
	Rajshahi	8.9
	Rangpur	7.08
	Sylhet	12.12

Table 4 - Coverage of healthcare services across circumstance variables

<i>Circumstance Variables</i>	<i>Birth taking place at a Health Facility</i>	<i>Birth attended by a Skilled Professional</i>	<i>Postnatal Checkup for Child (within 2 months after birth)</i>	<i>Whether Child received any Vaccination</i>
<i>Gender of Child</i>				
Male	39.14	36.94	65.91	78.73
Female	39.38	35.98	64.41	82.35
<i>Gender of Household Head</i>				
Male	39.2	36.41	64.73	80.13
Female	39.76	37.04	69.69	84.15
<i>Number of under- five Children</i>				
One Child	43.33	39.78	68.44	84.5
Two or more	29.62	28.65	57.74	71.01
<i>Wealth Index</i>				
Poorest	13.83	14.18	51.11	72.1
Poorer	30.74	27.45	60.8	74.47
Middle	34.69	30.84	64.21	84.19
Richer	48.01	44.96	68.27	84.05
Richest	74.62	69.84	84.83	88.89
<i>Mother's Occupation</i>				
Employed	39.98	36.43	61.82	80.28
Unemployed	37.17	36.6	74.88	81.1
<i>Mother's Education</i>				
No Education	12.13	12.76	48.6	67.94
Primary Education	27.74	25.65	63.89	76.5
Secondary Education	46.74	43.22	66.98	86.31
Higher Education	74.51	68.34	84.15	83.01
<i>Place of Residence</i>				
Urban	60.25	55.42	80.34	85.8
Rural	32.16	30.07	60.06	78.7
<i>Region</i>				
Barisal	33.11	28.97	56.29	78.07
Chittagong	31.18	28.66	65.87	80.6
Dhaka	45.94	42.73	69.15	87.54
Khulna	66.08	62.96	73.34	75.84
Rajshahi	39.71	33.9	69.69	79.49
Rangpur	44.99	44.22	69.34	77.19
Sylhet	19.07	18.9	45.63	65.79

Number of observations = 1294

Table 5 – Marginal effect from Logit Regression - * p<.1; ** p<.05; *** p<.01

Circumstance Variables	Birth taking place at a health facility		Birth attended by skilled professional		Postnatal Checkup for Child		Whether Child received any Vaccination	
	Marginal Effects	Std. Error	Marginal Effects	Std. Error	Marginal Effects	Std. Error	Marginal Effects	Std. Error
No education	-0.2277***	0.0393	-0.1910***	0.0390	-0.0597	0.0451	-0.1497***	0.0438
Primary	-0.1227**	0.0358	-0.1050**	0.0348	0.0297	0.0338	-0.0420**	0.0011
Higher	0.1580**	0.0560	0.1396**	0.0527	0.1095*	0.0451	0.0443**	0.0060
Women work	-0.0741*	0.0364	-0.0418	0.0354	0.1535***	0.0294	0.0283	0.0270
Male	0.0031	0.0318	0.0322	0.0302	-0.0197	0.0277	-0.0364	0.0228
Urban	0.1216**	0.0375	0.1083**	0.0359	0.0860*	0.0325	0.0452	0.0267
Male hh	-0.0927	0.0557	-0.0618	0.0530	-0.0549	0.0446	-0.0427	0.0357
Poorest	-0.1844***	0.0442	-0.1332**	0.0445	-0.1592***	0.0466	-0.0273	0.0380
Poover	-0.1101*	0.0451	-0.1000*	0.0440	-0.1206**	0.0477	-0.0536	0.0412
Richer	0.1070*	0.0489	0.1079*	0.0481	0.0380	0.0434	-0.0158	0.0385
Richest	0.3364***	0.0533	0.3065***	0.0537	0.1397**	0.0443	0.0661	0.0382
Bairisal	-0.2528***	0.0409	-0.2238***	0.0394	-0.1451*	0.0673	0.0691	0.0382
Chittagong	-0.3075***	0.0398	-0.2950***	0.0367	-0.0377	0.0563	0.0756	0.0353
Dhaka	-0.2226***	0.0448	-0.2223***	0.0402	-0.0311	0.0599	0.1201**	0.0321
Rajshahi	-0.1353*	0.0558	-0.1852***	0.0448	-0.0067	0.0644	0.0734	0.0384
Rangpur	-0.1196	0.0574	-0.1124	0.0534	-0.0570	0.0675	0.0781	0.0384
Sylhet	-0.2955***	0.0403	-0.2778***	0.0375	-0.1397*	0.0608	-0.0273	0.0439
One Child	0.1116**	0.0345	0.0756*	0.0333	0.0950**	0.0322	0.1310***	0.0281

Number of observations = 1294

Table 6- Coverage, Dissimilarity Index and HOI: Urban vs Rural Areas

Outcome	Coverage	Dissimilarity (D-Index)	HOI
<i>Birth taking place at a Hospital</i>	39.64	28.82	28.22
Urban	59.33	12.73	51.78
Rural	30.25	29.50	21.33
<i>Birth attended by a Skilled Professional</i>	37.09	27.89	26.75
Urban	55.50	14.79	47.29
Rural	28.31	23.23	21.73
<i>Ever had Vaccination</i>	77.36	6.61	72.24
Urban	83.25	2.47	81.19
Rural	74.54	1.68	73.29
<i>Postnatal checkup for child (within 2 months after birth)</i>	65.22	11.26	57.88
Urban	77.51	2.97	75.21
Rural	59.36	4.18	56.88

Table 7- Shapley value decomposition of D-Index – Percentage contributions of circumstances

Circumstance Variables	Birth taking place at a Health	Birth attended by a Skilled	Postnatal Checkup for	Whether Child received any
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	Facility	Professional	Child (within 2 months after birth)	Vaccination
<i>Gender of Child</i>	0.24	1.22	1.58	4.30
<i>Gender of Household Head</i>	0.93	0.71	2.09	2.22
<i>Number of under- five Children</i>	8.63	7.14	8.35	27.48
<i>Wealth Index</i>	39.69	39.81	39.18	15.11
<i>Mother's Occupation</i>	2.25	1.98	11.65	2.94
<i>Mother's Education</i>	29.04	28.60	15.47	21.24
<i>Place of Residence</i>	18.34	19.71	17.55	9.56
<i>Region</i>	0.88	0.83	4.11	17.15

Figure 1 – Coverage, Dissimilarity Index and HOI

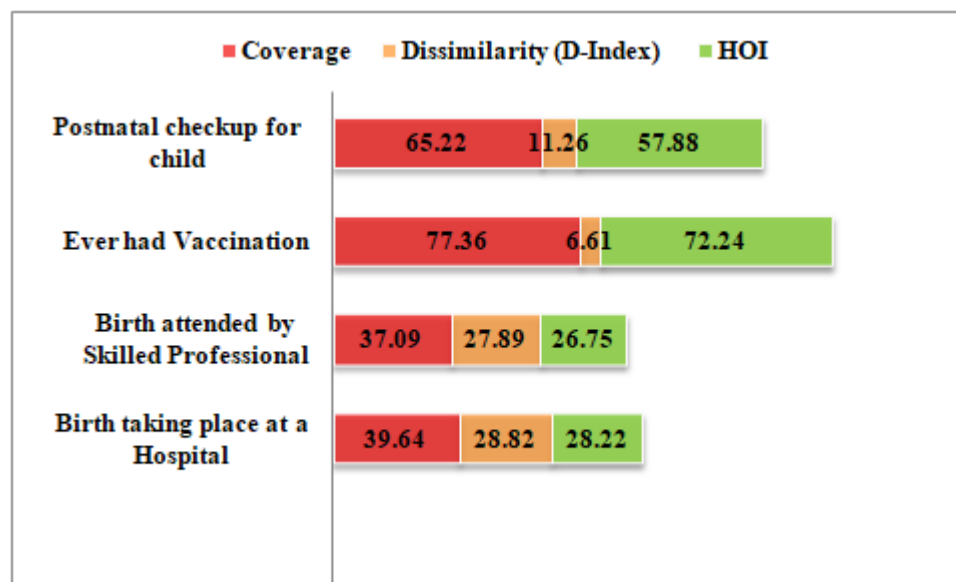


Figure 2- Coverage, Dissimilarity Index and HOI
Region-wise results for birth taking place at a health facility

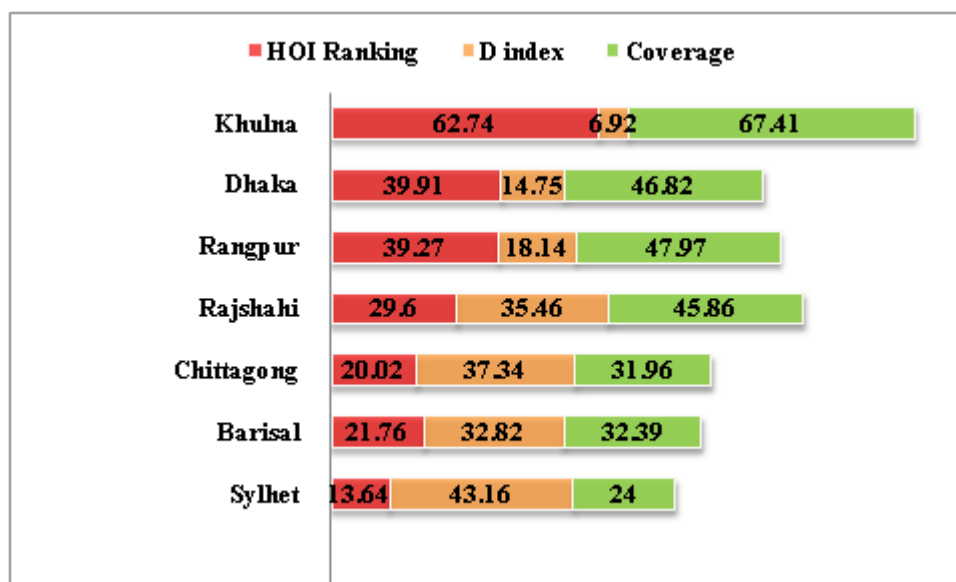


Figure 3 - Coverage, Dissimilarity Index and HOI
Region-wise ranking for birth being attended by a skilled professional

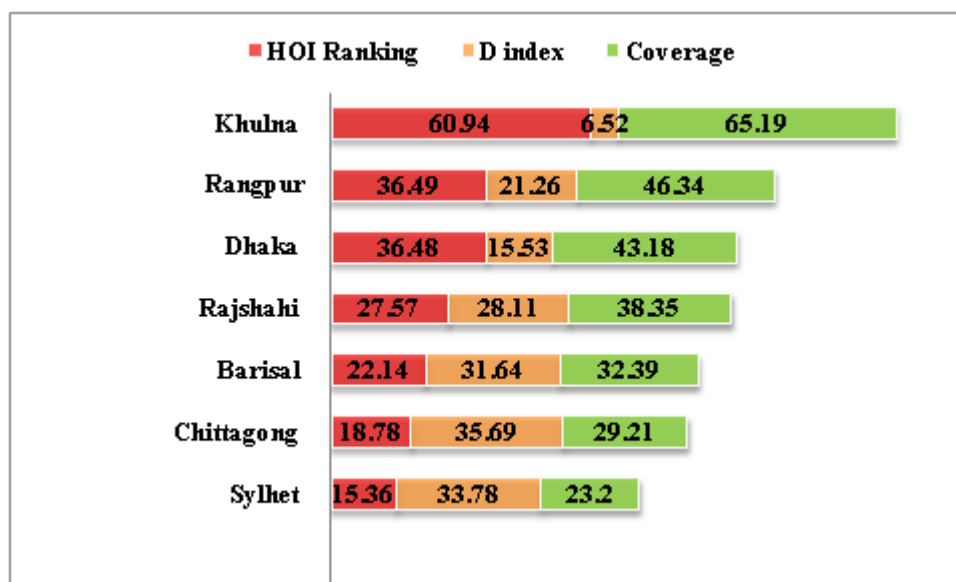


Figure 4 - Coverage, Dissimilarity Index and HOI
Region-wise ranking for ever had a vaccination

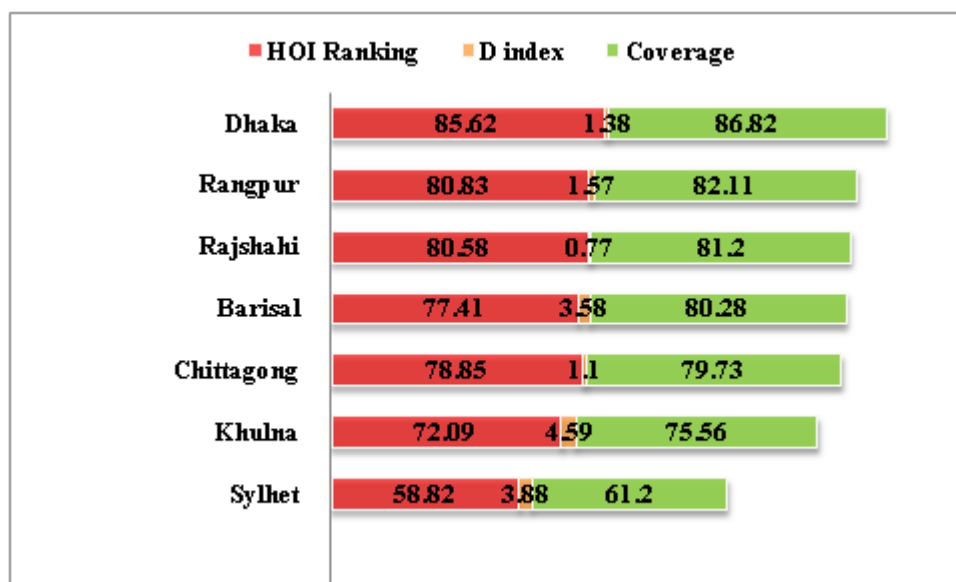


Figure 5 - Coverage, Dissimilarity Index and HOI
Region-wise ranking postnatal checkup for child

