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MASTER THESIS

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Inequality of Healthcare Access among Children in Bangladesh: An Opportunity Based Approach

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Declaration

I hereby declare that thesis titled “Inequality of Healthcare Access among Children in Bangladesh: An opportunity Based Approach” focusing on inequality in access to basic health services submitted to GLODEP consortium in 2020 is my original work. The literature review and the dataset used in the study for the analysis have been duly referenced and cited.

Harshita Thakare

May 27, 2020

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Theses guidelines:

Background The equality of opportunity can help in determining the equality in outcomes for individual. The basis for this equality is rooted in Rawls's (1971) work on equalitarian justice and Sen's (1980) concept of equality in capabilities. Roemer (1998) further reinforced this concept by analyzing the cause to inequality in opportunity. He argued that impact caused by the circumstances is the key determinant for this inequality as they are beyond an individual control while inequality arising from individuals' choices or degree of effort should be acceptable. Thus, inequality in children health outcome could be solely linked to the circumstances that are families' background, living conditions, parents' education, household income, etc. The Human Opportunity Index (HOI) proposed by Barroset al.(2008) was first applied in Latin America and Caribbean (2008) by World Bank, analyzed how children personal circumstances have an impact on accessing services that are eminent for their growth in future, finds a significant inequality in development opportunity. Aims – Drawing upon the HOI this study will try to analyze and understand the inequality of opportunity in access to basic healthcare for children in Bangladesh. Coverage and access to maternal and children healthcare remains one of the most significant challenge for Bangladesh coupled with poverty and high population density. The purpose of the study is to compute the opportunity index for access to basic healthcare for children in Bangladesh by analyzing the coverage and level of inequality. For these purposes we will compute a Human Opportunity Index for access to basic healthcare and contribution of different circumstances in inequality of opportunity for basic health care for children Data and Methodology – For these purposes, we will use data from the Bangladesh Demographic and Health Survey (BDHS) 2014. This survey was implemented under the authority of the National Institute of Population Research and Training (NIPORT) & Ministry of Health and Family Welfare, Bangladesh and funded by United States Agency for International Development (USAID). Firstly we will define proxies of health care access and circumstance that might influence the access to basic healthcare for children in Bangladesh. Then we will compute human opportunity index by computation of coverage rate for access to opportunity and the D-Index (Inequality Index). Finally, we will use the decomposition method to compute the marginal contribution of circumstances in inequality of opportunity.

Recommended resources:

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Dias, P. R., & Jones, A. M. (2007). Giving equality of opportunity a fair innings. *Health Economics*, 16(2), 109?112. <https://doi.org/10.1002/hec.1207>

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Amara, M., & Jemmali, H. (2017). On the decomposition and dynamics of inequality of opportunities: a special focus on early childhood health and nutrition in Tunisia.
Ebaidalla, E. M. (2019). WIDER Working Paper 2019 / 86 Inequality of opportunity in child health in Sudan Across-region study, (November).

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Abstract

In 2018, around 5.3 million children under the age of five died due to preventable causes, with majority of deaths taking place in developing countries. Timely and adequate access to basic healthcare services could have a substantial impact in child's survival. Healthcare access among children is a fundamental basic opportunity which is detrimental for achieving good child health status.

The objective of the study is to analyze the coverage, level of inequality and main drivers contributing to the inequality of access to basic healthcare among children in Bangladesh. The study computes Human Opportunity Index (HOI) for a composite indicator of access to healthcare for children comprising birth taking place at health facility, skilled birth attendance, receiving vaccination and postnatal care. Using shapley decomposition method, the study further analyzes the marginal contributions of circumstances of a child towards the inequality.

Findings from the study indicate that mother's education, wealth index, location and number of the children in the household are strongly associated with access to basic healthcare. Decomposition results further highlights that inequality arising in coverage of basic healthcare services in Bangladesh is largely explained by, first wealth of the household then mother's education and geographic location. The index entails new public policy implications for early on targeted interventions which could help in ensuring that a child receives early on healthcare which are imperative for their future growth.

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

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List of Abbreviations

BDHS	Bangladesh Demographic and Health Survey
DHS	Demographic and Health Survey
D-Index	Dissimilarity Index
EAs	Enumeration Areas
EPI	Expanded Program on Immunization
GNI	Gross National Income
HOI	Human Opportunity Index
LB	Live births
NIPORT	National Institute of Population Research and Training
UNDP	United Nations Development Program
UNICEF	United Nations Children's Fund
UNIGME	United Nations Inter-Agency Group for Child Mortality
USAID	United States Agency for International Development
WB	World Bank
WHO	World Health Organization

Chapter 1: Introduction

The chapter first explains the background for study followed by the country profile for Bangladesh. It then highlights the framework behind inequality of opportunity and the purpose of the study. It then describes the aim, objectives, scope and limitations of study, followed by the outline of the study.

1. Background

There has been a significant improvement worldwide for reducing the under-five mortality. Nonetheless, an estimated 15,000 children under the age of five die each day as compared to 34,000 in 1990 (World Health Statistics, 2018). As per WHO (2019) assessment, almost fifty percent of these under-five mortality are due diseases that are preventable and could be treated with simple and affordable health interventions. Thus, proper access to healthcare services among the children could help in saving a majority of young lives. Effective and efficient use of available health interventions could also significantly prevent the under five mortality. Jones et al. (2003) in a study highlighted that better use of just the available treatment could have saved an estimated 5.5 million child death which was around 63% of the child deaths that occurred in 2000. Emphasis on access to basic healthcare services among the child could help in achieving substantial positive health outcomes. Therefore, the study takes up access to healthcare services among children as one of the basic opportunities for child health outcomes and analyses the inequality of access of healthcare to address the gap and to improve the access. Especially, developing and low income countries tend to suffer more from challenge of poor child health outcomes. After the Sub Saharan Africa region, central and southern Asian region reports the highest under-five mortality rates (UNIGME, 2018).

1.2 Country Profile

Bangladesh is a developing country in the region of South Asia sharing its border 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 where the Gross National Income (GNI) per capita rose from \$100 to \$1,480 in 2017 (World Bank, 2017). The country is characterized by a fast urbanization rate over the decade with 36.63% of the population living in the urban centers of the country in 2018 (Plecher, 2019). Some key statistics for the country are highlighted as follows in table 1:

Table 1 - Country Profile: Bangladesh

Key Statistics: Bangladesh	
Population (2019)	168.1 millions
Population Density (2019)	1253 persons per sq. km
GDP, 2018 (US\$, billions)	274.02
GNI per capita (US\$, Atlas Method)	1750
Poverty Rate (2016)	24.3 %
Ranking of Human Development Index (2017)	136
Literacy Rate (2017)	72.3
Life Expectancy at birth (2017)	72
Human Capital Index (2018)	0.48 (Ranking: 106)
Climate Risk Index Ranking (2018)	7

Sources: (Bangladesh Bureau of Statistics, 2018; UNDP, 2018; UNFPA, 2019; World Bank, 2019; Eckstein, 2019)

Figure-1 shows the main administrative divisions of the countries. High population density coupled with high urbanization rates poses an impact over existing infrastructure capacities of urban centers to provide adequate living standards. The issue of Rohingya refugees from Myanmar further adds strain over the infrastructure services. The country is ranked 7th for the climate risk index in the world, which measures the climate change related calamities and fatalities caused by it (Eckstein, 2019). 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 decades related to maternal and child level health indicators. Between 1990 and 2018, the neonatal mortality reduced from 63 to 17 per 1000 live births (UNIGME, 2019). The under-five mortality rate dropped from 144 per 1000 live births (LB) in 1990 to 30 per 1000 LB in 2018 (UNIGME, 2019). Nevertheless, the proportion of the under-five mortality still remains high. The country has a very low per capita healthcare expenditure as a percent of GDP, which is 3.35% (Mahmudur, 2018). Socio-economic and geographic inequalities act as barrier for child and mother to receive adequate healthcare (Rubayet, 2012). Use of traditional healthcare practices like reliance on traditional birth attendant that may not be a skilled profession for delivery and other child healthcare services still dominates in the country. Another barrier that impedes the access to child healthcare or results in poor child status is the financial affordability of these services in the country.

The country still faces the challenge of utilization of existing healthcare services. Improving awareness and adequate access to healthcare services for mother and children remains a concrete issue in order to achieve the targets related to Sustainable Development Goal 3 (Good Health and Well-Being). SDG 3.2.2 for Bangladesh aims at reducing the neonatal mortality rate to 12 per 1000 LB and SDG 3.2.1 to reduce the under-five mortality rate to 25 per 1000 LB by 2030 (SDG Tracker, 2020).

The healthcare in Bangladesh is provided by both public and private organizations. Healthcare system follows a decentralized structure with three tier setup of primary healthcare services with Upzala Health Complexes at sub-district level, Union health and family welfare centers at union level and community clinics are rural level (Islam, 2014). The structure is followed by district hospitals providing secondary care services followed by hospitals in city areas covering all necessary healthcare provisions. The private facilities are usually concentrated in the urban area of the country where the treatment costs are generally higher and it could not be reached by all sections of the society. The government based facilities provide subsidized rates or free treatment for certain marginalized section of the society but majority of treatments are characterized by out of pocket expenditure. The government run facilities face the challenge of lack of infrastructure, lack of skilled professionals, poor service delivery and low quality care due to lack of adequate financing (Islam, 2014).

Although, with the economic progress, the country tends to suffer from numerous development challenges of high population pressure, poverty, climate change related disasters, unplanned urbanization and internal displacement. The socio-economically vulnerable population section of the society is at a continuous risk of being eliminated from the access of basic healthcare services



Figure I Administrative Divisions of Bangladesh

Source: (NIPORT, 2014). The administrative divisions refer to the year 2014 to reflect the dataset used in the study.

1.3 Conceptual Backdrop for Inequality of Opportunity

Rawls (1971) associated the idea of fairness with original position of an individual with the paradigm of *justice as fairness*. The original position exhibits conditions or values that are equally

distributed and are to everyone's benefit or advantage. Sen (1980) criticized Rawls theory on the grounds of practical application as original position relates to a hypothetical space for equality which idealizes the notion of perfect justice. He further opens the debate with the thought: *Equality of what?* He defines the space for equality as freedom of choice for an individual to achieve the desired set of functionings or capabilities that he/she values. The capabilities approach by Sen reinforced the notion of equality based on individual differences and the choices they make. Dworkin (1981) argued that equalizing welfare based on individual tastes or choices could lead to an unequal distribution of resources due to difference in what individual's desire. Arneson (1989) further advocated the concept of equality of opportunity of welfare. Cohen (1989) emphasized that the currency of egalitarian justice is an opportunity that is the equal chance for all the individuals to achieve the outcomes (Cohen, 1989). Roemer (1998) further analyzed the cause to inequality in opportunity by constructing components of circumstances and efforts. He argued that the impact caused by the circumstances is the key determinant for this inequality as they are beyond an individual control while inequality arising from individuals' choices or degree of effort should be acceptable.

Based on the inequality of opportunity principal, circumstances of a child are the only guiding determinants linked to inequality arising in child health outcomes. The accident of birth shall not determine the chance for a child to avail basic services that are crucial for their growth and development. The inequality of opportunity approach in developing countries could help in making targeted interventions in order to reduce the opportunity gaps. The study will thus focus on access of basic healthcare services in Bangladesh in relation to the circumstantial characteristics of a child.

1.4 Purpose of the study

The purpose of the study is to understand the coverage and causes of inequality for basic healthcare services among children in Bangladesh. The study focuses on four basic healthcare services based on availability in dataset and literature review, namely: birth taking place at a hospital facility; birth being attended by skilled professional; whether the child received any vaccination and postnatal checkup for the child (within 2 months after delivery). The study derives a composite variable of access to healthcare based on the four basic healthcare services and computes the Human Opportunity Index (HOI). It measures coverage and inequality for these services followed by the decomposition of inequality index. The purpose is to understand the coverage and cause for inequality of each individual healthcare opportunity along with the composite variable. The aim and objectives of the study are highlighted as follows:

Aim: To understand and analyze the inequality of access to basic healthcare among children in Bangladesh based on opportunity approach.

Objectives:

1. To compute the human opportunity index (HOI) for access to basic healthcare services among children in Bangladesh and analyze the coverage and the level of inequality.
2. To compute the marginal contribution of each circumstance variable to the inequality index and to identify main drivers for inequality in access of basic healthcare for children.

1.4.1 Scope & Limitation

The study uses the Demographic Health Survey dataset for Bangladesh for 2014, which represents the most recent dataset covering questions related child healthcare reported by the mother. Questions related to child health section are reported for the children under the age of five, thus the cross sectional study analyzes the inequality in access to healthcare for children under the age of five. The dataset maybe subjected to recall bias as mother's' reports questions preceding an interval up to five year to the survey year. The original idea was also to conduct a qualitative research through interviews for the least and the best performing regions in the country based on the index to better understand the situation on the ground, although due to travel restrictions imposed because of coronavirus further study could not be carried out.

1.5 Structure

The following chapters are outlined as follows. Chapter 2 discusses the literature review for access to healthcare among children based on empirical studies that adopted Human Opportunity Index (HOI) approach. Chapter 3 outlines the description of the data followed by the brief explanation of dependent variables and the circumstance variables. It further elaborates the methodology adopted for calculating the HOI and explains the shapley decomposition method used to compute the marginal contribution of circumstance variables. Chapter 4 presents the descriptive statistics followed by the results obtained from the computation of HOI and the decomposition of the inequality index. Chapter 5 presents the conclusion and recommendations based on the country context.

Chapter 2: Literature Review

The section highlights the most important contributions in access to healthcare and empirical review of the literature to create an understanding for existing literature on inequality in access of healthcare services among children. The review comprises of studies that have employed the use of HOI for child healthcare.

2.1 Access to healthcare for children

Access to healthcare as defined by Penchansky et al. (1981) is associated with four key dimensions: *availability*, *accessibility*, *affordability* and *acceptability*. These dimensions along with the supply side and demand side factors can contribute in achieving equitable access to healthcare for all. Access to healthcare services plays a pivotal role in achieving a good quality of life.

Healthcare access from early childhood is detrimental factor for overall human development. Improvement in quality and access to healthcare services for mother and child have an immense potential in decreasing the under five mortality (Rutherford, 2010). The first 1000 days of a child from the period he/she is born is considered as first window of opportunity which requires constant care as they are crucial for cognitive and physical development (Bellieni, 2016). It is thus eminent to receive appropriate health interventions as and when required in the early childhood period. In 2018, around 5.3 million of children under the age of five died from preventable causes with majority of deaths occurring in developing countries with poor population being at a higher risk of dying (World Health Statistics, 2018). For a child's proper growth and development access to the primary healthcare services should be a universal right as their future development depends on it. To ensure that the healthcare interventions are in reach of a child, one must focus on the four dimensions of access to healthcare. The infrastructure for the services should be available, should be in geographic proximity, should be affordable by all population groups and the practices should be well accepted among the society. To derive appropriate policy interventions it is important to understand the causes for a delayed attendance at a health facility or none at all in the usage of primary health services.

2.1.1. Inequality of access in healthcare for children

The framework as highlighted by Commission on Social Determinants of Health (CSDH) demonstrates that the structural determinants namely; income, education, occupation, social class, gender and race/ethnicity leads to the creation of an individual's socioeconomic position within the society that dictates the social determinants of health inequalities (Solar, 2007). The pathways for inequalities in child health status arises from these social determinants, for children, characteristics of parents and their behavior have a strong influence along with their household resources, occupation, wealth, living

conditions and socio-economic and political climate (Pearce, 2019). Based on the equality of opportunity, Roemer (1981) argued that the impact caused by the circumstances is the key determinant for inequality as they are beyond an individual's control rather than the efforts. Thus inequality in access of any basic services for children could be solely linked to the circumstances that are families' background, living conditions, parents' education, household income, etc (Barros, 2012).

In context to developing countries there exist various constraints for demand in healthcare services like income, price of the services, knowledge, education and quality of services (Donnell, 2007). Low income countries and lower middle income countries tend to have less access to healthcare services as compared to the developed or high income countries. All the determinants of healthcare access namely, geographic accessibility, availability, acceptability and financial accessibility lag in low income and lower middle income countries for provision of adequate care with poverty serving as the main barrier to access (Peters, 2008). Janicke et al. (2000) highlight the factor that access to healthcare is one of the key determinants in the effective utilization of primary healthcare among children and improving the child health status. The report on the state of inequality by WHO (2015) analyzed data for 86 low and middle income countries, showcases a significant inequality in newborn and child health interventions based on the education level of mother, place of residence, economic status and gender of child. Overall, the socio-economic positions of household and geographic location are key determinants for the inequality. They also found that the inequalities within the countries were also very pronounced. Access to healthcare services and appropriate health interventions for children should be independent of the accident of the birth rather should be accessible and available for all.

2.2 Review of Empirical Literature

Several studies have been carried to analyze inequalities in healthcare access in both developed and developing countries to identify appropriate policy interventions. A majority of these literatures focus on the supply side of healthcare like health systems, insurance policies, coverage, medical infrastructure, public financing in health, etc. From demand side, studies have been carried out to examine inequality in healthcare access through particular social and economic determinants like income, household wealth, education, gender etc. The study will help in further broadening and understanding of various demand side drivers related to circumstances for inequality in access of healthcare for children.

2.2.1. Opportunity Approach

There exists univariate or bivariate approaches to measure health inequalities to assess the difference in health outcomes or status in a given population or related to a particular characteristic like education, gender, income, etc (Spinakis, 2011; Sanoussi, 2017). The opportunity approach developed by

Roemer (1998) emphasizes on the cause of the inequality by analyzing circumstances and efforts. The use of opportunity approach to measure inequalities in health outcomes or health status remains relatively new in the field (Jones, 2018). The approach is better suited in the identification of targeted areas for policy interventions by examining the circumstances that are beyond an individual's control and efforts for which an individual could be held responsible (Roemer, 1998; Sanoussi, 2017). One of the tools developed to measure the inequality of opportunity for children is the Human Opportunity Index (HOI) by Barros et al. (2009) which quantifies how children's personal circumstances have an impact on accessing basic services that are necessary for their future growth. It comprises of two components; average coverage rate of specific opportunity and the degree to which the opportunity is attributed to the circumstances or the fairness of the distribution of the opportunity. (Barros et al. 2009). The Human Opportunity Index (HOI) proposed by Barros et al. (2009) was first applied in Latin America and Caribbean (2008) by World Bank, analyzed how circumstances have an impact on accessing services that are eminent for proper growth of children in future. They considered the education dimension (completion of sixth grade on time, school attendance at ages ten to fourteen) and housing conditions (access to safe water, sanitation and electricity) as the opportunity while parents' education, family per capita income, number of siblings, gender of child, gender of household head, location and presence of both the parents as circumstance variables (Barros, 2009). The study finds a significant inequality in accessing the basic opportunities in Latin America and Caribbean and it depicts one of the most unequal regions in the world.

The index has advantage over the other approaches, as it helps in identification of early on inequalities of opportunities for children which are more crucial factors for their development and cost effective from policy perspective rather than treating them later. Unjust and unequal distribution of basic opportunities at the early age of childhood could translate into huge civic cost into the future. The literature suggests that the index is more suited to reduce health inequalities which measures them early on and helps in taking targeted interventions (Singh, 2011). It also entails cyclic implication in terms of economic development of the country through the means of healthy human capital.

2.2.2 Human Opportunity Index and Healthcare access

The section comprises of the review of literature that employed the use of opportunity approach or HOI to measure inequality in health outcomes or status for children with a focus on healthcare access.

In developed countries, the studies on inequality in childhood health outcomes focus on the multi directional relationship between circumstance, efforts and health status mostly using the cohort data based on the opportunity approach (Sanoussi, 2017). Several studies have employed the use of concentration index or gini index to measure the inequality. The use of HOI, which includes the dissimilarity index has

been done to measure inequalities in various health outcomes or statuses for children like nutrition, immunization, stunting, wasting, access to maternal or child health care services, height and weight ratio, etc. Apart from measuring the inequalities in health outcomes, the index has been used by studies focusing on basic services like access to clean water, electricity and education which have an indirect outcome in achieving good health status.

In developing countries, the majority of the literature focuses on inequality in health statuses like malnutrition, stunting and immunization. Presence of substantial inequality in these outcomes is confirmed by studies in India (Kumar 2011) and Brazil (Monteiro et al., 2009). Several studies employing the use of HOI concluded that the indicators like parents' education, wealth and geography are key determinants in explaining the underlying inequality in health outcomes for children. These conclusions are confirmed by studies conducted by Assad et al. (2012) on child health outcomes in Egypt; Ersado (2014) & Barros et al. (2012) in Egypt for access to basic services; Singh (2011) on malnutrition and immunization in India; & Newman (2012) in Pakistan on access to basic services. Singh (2011) computed Human Opportunity Indices using the Indian National Health Family survey data for 1993 and 2006 for measuring inequality in immunization and nutrition among the Indian children. For immunization he used the indicators whether a child has received vaccine for namely, tuberculosis, diphtheria, whooping cough, tetanus, polio, and measles. For nutrition, he used the criteria of underweight by analyzing weight for age. The circumstance variables used in the study were cast of the household head, religion, gender of the child, place of residence, wealth quintiles, average parental education and number of siblings. The results indicate that there exist high levels of inequality for both immunization and nutrition with substantial geographic variations (Singh, 2011).

From the perspective of health access for children, studies have combined either the use of maternal care services or other health outcome like nutrition along with healthcare access. No study exclusively emphasizes the use or access to healthcare services for children with a focus on HOI. The following studies examine in detail the approach of HOI for healthcare access among children.

The study by Amara et al. (2017) examined inequality of opportunity in healthcare access and nutrition for children in Tunisia using Multiple Indicator Cluster Survey data for 2011-2012 by employing the use HOI. They considered two groups of outcome variables; one with access to basic healthcare during pregnancy, birth and early postnatal periods; and second one for nutrition. Access to basic healthcare comprised of the proxies lack of antenatal care, birth not taking place at health facilities, birth not being attended by skilled health professional, child not having a postnatal check-up (within two months after birth), health examination and regular immunizations within one year after birth, access to safe water and access to toilet. Nutrition comprised of indicators of stunting, wasting, underweight and whether the mother has had blood tests during her pregnancy. For circumstance variables the authors used

region, location (urban/rural), number of children under age of five, household composition, age of household head, gender of household head, father's education and mother's education. The study found low levels of inequality and with further decomposition authors found that parents' education, wealth and location of residence are key factors causing inequalities among the Tunisian children (Amara, 2017).

The study by Sanoussi et al. (2017) measured and analyzed the inequality of opportunities in access of 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 above 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. For the circumstance variables they considered mother's education, father's education, mother's occupation, father's occupation, household's socioeconomic status, gender of child, gender of household head, number of children in the household, region and location (urban/rural). They found that inequalities increased in access to adequate care (27.7% to 28.6%) during 1998 & 2013 among the children in Togo (Sanoussi et al., 2017).

Study by Saidi & Hamdaoui (2017) examined of inequality of opportunities among children in Tunisia on healthcare access and health status using 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 sample and postnatal care were considered. For nutritional status, indicators used 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 decomposition method, the study found that parents' education, wealth and geographic factors are the key factors in determining child development outcomes (Saidi & Hamdaoui, 2017).

Study by Tsawe et al. (2019) analyzed inequality in use and access of maternal and reproductive healthcare in Sierra Leone by computing HOI using DHS data for 2008 and 2013. The dependent variable comprised of four or more antenatal care visits, skilled antenatal care provider, births delivered in a facility, births assisted by a skilled birth attendant and use of any method of contraception. The circumstance variables used in the study were maternal age, marital status, maternal education, media saturation, household wealth, number of living children and number of household members, place of residence and region. The study concluded that between 2008 and 2013, the HOI index improved for the access of maternal and reproductive healthcare in Sierra Leone. Overall they found that inequalities declined over time and while employing shapley decomposition method they found that household wealth

status, maternal education and place of residence, are the most important factors contributing to the inequality.

2.2.3. Country Context

In Bangladesh, there has been a significant decline in the child mortality and neonatal mortality rates over the decade, although appropriate measures are required to meet the targets related to sustainable development goals (Rajia, 2019). Several studies have been carried out to measure inequality in child health outcomes using social and economic determinants. In the context of inequality in healthcare access, the prime focus has been on the issue of maternal healthcare access (Anwar, 2008; Collin, 2007). Study by Collin (2007) assessed the inequality in maternal healthcare based on the indicators of antenatal care, birth being attended by the skilled professional and caesarian section in Bangladesh between the period of 1991 and 2004. The study suggested that utilization of these services improved over the time among the socially disadvantaged women but on the other side the gap between different socio-economic groups is well pronounced affecting mostly the poor in rural areas (Collin, 2007).

Cross-sectional study by Amin et al. (2010) analyzed the socio-economic indicators that affect the maternal and child healthcare seeking behavior among the rural areas of Bangladesh using bivariate and multivariate analysis. The results from the study indicated that relative economic position of the household was the major determinant for healthcare seeking behavior among the rural areas for services like antenatal care, postnatal care, skilled birth attendance and child healthcare (Amin et al., 2010). The study by Anwar et al. (2011) examined trends, inequities and socio-demographic determinants in use of maternal health care services in Bangladesh between 1991 and 2011 using the DHS data. They employed the use of concentration index and found out that there has been a significant increase in the use of antenatal services, institutional delivery and C-section delivery rates in Bangladesh during the last two decades (Anwar et al., 2011).

Study by Chowdhury et al. (2017) analyzed the socio economic inequality in under five child mortality in rural Bangladesh between 1994 and 2014. The study analyzed the proximate determinants of child survival which were maternal education, environmental factors, nutrient intakes, illness control and injury. The study found that the socio-economic inequalities persisted for under-five mortality and proximate determinants of child survival with household economic position being the most important determinant. The study also explained that improvement in the status of under-five mortality and proximate determinants of child survival culminated due to economic development of the country which led to improved literacy among females and reduction of the poverty levels over the time period (Chowdhury et al., 2017).

Study by Nazmul (2007) analyzed the link between child healthcare and maternal education. The study found that maternal education is the most important determinant for child health status and utilization of child healthcare services in the country. Maternal education was also positively associated with the proportion of children receiving vaccination in the country. From the perspective of child healthcare, a majority of literature has examined inequalities in either the provision or utilization of postnatal service or skilled birth attendance by analyzing the socio-economic determinants in Bangladesh (Chakraborty, 2002; Anwar et al, 2008; Singh et al; 2017). Study by Singh et al. (2017) explained the importance of postnatal care for the new born in relation to antenatal care, place of delivery, the type of attendant performing the delivery (skilled/unskilled) and maternal complications using a logistic regression analysis for socio-economic characteristics in Bangladesh. The dataset analyzed was Bangladesh Maternal Mortality Survey for 2010. The study concluded that mother's who had delivery performed by the skilled professionals or experienced some complications were more likely to receive postnatal care for their new born. Nonetheless, the coverage of skilled professionals remains low in the country due to preference of home deliveries. The study proposed home based postnatal care visit as a transition strategy until the coverage for skilled birth attendance improves (Singh et al., 2017). Study conducted by Anwar et al. (2008) analyzed the inequalities in skilled birth attendance in Bangladesh. The study analyzed the areas with home based skilled birth attendant program for the data obtained from community survey in 2006. The study concluded that the coverage of skilled birth attendance is higher in the area than compared to national statistics. The study explained that there were substantial inequalities in use of skilled birth attendance based on asset quintile, area of residence, education and distance to hospital (Anwar et al., 2008).

Several studies have used the decomposition methods to identify the socio-economic contribution towards inequalities in child health like undernutrition, stunting, childhood morbidity by using regression based decomposition or decomposition of the concentration index (Sarker et al., 2020; Rabbani et al., 2017; Huda, 2016; Mahumud et al., 2019). One of the studies that used decomposition measured the marginal effect of social determinants towards inequalities in child undernutrition. Study found that the prevalence of the childhood nutrition declined over time but the inequalities increased between 2004 and 2014 with household economic status and maternal education being the key contributors towards the inequality (Sarker et al., 2020). Study by Mahumud et al. analyzed the socioeconomic inequality in child morbidity between 1993 and 2014 using regression based decomposition. Based on the decomposition results, the study concluded that low maternal education, lack of pre-delivery care, low immunization coverage and undernutrition among children shows a concrete association to the inequalities (Mahumud et al, 2019).

From the perspective of decomposition of inequalities related to access of maternal and child healthcare services, studies have not employed the use of shapley decomposition methods for measuring the relative contributions of socio-economic factors towards the inequality in Bangladesh.

Although the literature on inequality of healthcare access among children remains scarce, with none employing the use of the HOI to measure the inequality and contribution of socio-economic factors towards inequality. The study will address the existing gap in the literature by employing the use of HOI in Bangladesh to measure inequalities and contribution of circumstance variables for access to basic healthcare services among children and thus a new approach towards policy implications.

Chapter 3: Data & Methodology

This chapter comprises of the description of data, description of independent and dependent variables selected for the study, followed by the methodological approach adopted for computation of Human Opportunity Index (HOI) and for the decomposition of the inequality index for access to healthcare for children in Bangladesh.

3.1 Source of data and sample design

This study uses data from the Bangladesh Demographic and Health Survey (BDHS) 2014. The dataset represents the latest and the seventh DHS undertaken in Bangladesh. The BDHS includes information at household level covering health, population, family planning and nutrition sectors. The survey was jointly implemented by the National Institute of Population Research and Training (NIPORT) of Ministry of Health and Family Welfare, Bangladesh; ICF International, USA and Mitra & Associates, Bangladesh. The survey was funded by United States Agency for International Development (USAID), Bangladesh. The BDHS is one of the most comprehensive sources of data available at household level covering various indicators related to access and use of healthcare services with reported indicators for both mother and children along with demographic and household characteristics, thus, is best suited for this type of study.

The survey is representative of the entire population of the country covering all the seven administrative regions. The sampling frame used in the survey corresponds to the list of Enumeration Areas (EAs) from the country's Census Survey in 2011 provided by the Bureau of Statistics, Bangladesh with a two-stage stratified sampling. The divisions were stratified into urban and rural areas, first 600 EA were selected with a probability proportional to their size which resulted in the generation of household lists for the selected EA and 30 households per cluster were selected based on equal probability systematic selection (NIPORT, 2014).

The survey comprised of three questionnaires: household, women and community. Interviews were successfully conducted in 17,300 households and 18,245 eligible women were identified for interview. With a response rate of approximately 98 percent, 17,863 women were successfully interviewed (NIPORT, 2014). The section of the woman's questionnaire covers the topic of child health. The indicators used in this study were mainly taken from that section of the questionnaire.

3.2 Selection of dependent and independent variables

The selection of the variables is based on the literature review provided in the previous chapter. Specifically in this study the dependent variable is represented by the access to healthcare for children.

The dependent variable will be a composite variable which will comprise of the following variables: birth taking place at a health facility, whether the birth was attended by skilled professional, whether the child received any vaccination and postnatal checkup for child (within 2 months after the birth). Access to healthcare for children will be dummy variable which takes a value 1 if all the above conditions are met and 0 otherwise. Computation of HOI is also done for each individual healthcare outcomes considered for the composite indicator of access to healthcare. Table 2 presents the empirical evidence for the below variables based on access to healthcare and HOI.

1. Birth taking place at a health facility: Birth taking place in a hospital or at a health facility is considered to be one of the most effective measures to reduce the maternal mortality and thus improving upon on the chances for the child to survive and have a healthy life (Yesuf, 2014). The variable has been used in studies by Sanoussi et al. (2017) in Togo; Tsawe et al. (2019) in Sierra Leone and Amara et al. in Tunisia (2017) for access to healthcare among children. An institutional delivery could better handle complications during delivery and provides a safe environment in ensuring proper health of both mother and child. Essential newborn care (delayed bath until 72 hours of birth; breastfeeding in one hour of birth; drying and wrapping of newborn within 5 minutes of birth; application of antiseptic to cord, etc) is one of the most fundamental and crucial healthcare for neonatal survival (Singh, 2017). An institutionalized delivery has a higher probability for a child receiving all the recommended essential new born care in a proper manner. The responses were categorized as institutionalized deliveries or birth reported at a health facility against the birth taking place at respondent's home. The variable will be a dummy variable for birth of the children taking place at a hospital/health facility will be 1 and otherwise 0.

2. Birth Attended by Skilled Professional: Proportion of birth attended by skilled professional is one of the key indicators in the sustainable development goals to meet the target to reduce the global maternity ratio by 2030.¹ For access to healthcare among children, the variable has been used in studies by Sanoussi et al. (2017) in Togo and Tsawe et al. (2019) in Sierra Leone. Trained and an accredited professionals are better equipped to deal with the delivery and to better address the complexity involved related to both, mother's and child's health. Responses involving categories with qualifies doctors; nurse/midwife/paramedic; community skilled birth attendant; medical assistant; community healthcare provider and trained traditional birth attendant were considered as skilled professional for delivery. Whereas responses with family welfare visitor, untrained traditional birth attendant, unqualified doctors, friends/neighbors, relatives, no one and others were coded as unskilled birth attendance. The variable will be a dummy variable representing 1 for birth being attended by a skilled professional and otherwise 0. A child being delivered by a skilled professional has a higher probability of being born healthy and

¹<https://unstats.un.org/sdgs/indicators/indicators-list/> accessed on 26/03/2020

receiving appropriate care. The analysis from one of the study in Bangladesh found that unskilled birth attendants tends to perform less essential newborn care practices in comparison to the skilled birth attendance (Haider, 2018). It is thus imperative that birth attendants should have proper skills, education and knowledge for delivery that can play a pivotal role in child’s survival.

3. Whether the child received any vaccination: Vaccination represents one of the most important public health interventions to reduce deaths from preventable causes. Delivery and effective coverage of vaccination among the children in developing countries still remains one of the biggest challenges in health systems (Popova, 2016). Despite the high coverage of vaccination in the country, it remains to be one of the leading determinants for child mortality in the urban slums of capital Dhaka in Bangladesh (Hussain , 1999). With activities of internal displacement due to climate change issues and growing slum population, the children belonging to vulnerable population groups of the country are always at a risk of being excluded from the immunization programs. The variable will denote 1 as yes for child being ever vaccinated and 0 as no for not being vaccinated ever. The variable has been used in studies by Sanoussi et al. (2017) in Togo and Amara et al. in Tunisia (2017).

4. Postnatal checkup for the child (within 2 months after birth): Majority of neonatal deaths happen during childbirth or during the postnatal period (WHO, 2012). The postnatal period, as defined by World Health Organization is the first six weeks after the birth, which are considered as critical timeframe for survival and overall development of health indicators for the child. Postnatal care provides an opportunity to check for early on signs for illness. It can help in preventing complications in new born related to meningitis, diarrhea, sepsis and pneumonia (Singh, 2017). The variable will denote 1 as yes for being checked within 2 months and 0 as no for not being checked within the two months after birth. The variable has been used in studies by Saidi & Hamdaoui (2017) in Tunisia and Amara et al. in Tunisia (2017).

Table 2 - Variables used for Composite Indicator of Healthcare Access

Variables	Type	Empirical Evidence
Birth taking place at a health facility	Dummy (1 = Health facility, 0 = otherwise)	(Sanoussi et al., 2017; Tsawe et al.,2019; Amara et al., 2017).
Birth being attended by skilled professional	Dummy (1 = Yes, 0 = No)	(Sanoussi et al., 2017; Tsawe et al.,2019)
Whether the child received any vaccination	Dummy (1 = Yes, 0 = No)	(Sanoussi et al., 2017; Amara et al., 2017)
Postnatal checkup for the child (within 2 months after birth)	Dummy (1 = Yes, 0 = No)	(Saidi & Hamdaoui, 2017; Amara et al., 2017)

Based on the existing literature of HOI, set of circumstance variables were selected. Ten circumstance variables are selected which can have an impact on accessing healthcare services for a child. Table 3 represents the empirical evidence for selection of variables in regard to healthcare access based on the literature. The independent variables are grouped into five categories and are as follows:

1. Characteristic of Child: ‘Gender of child’ has been included as an independent variable for analyzing the child level characteristic. In developing countries, gender still tends to play a prominent role in access of basic services (Hoyos, 2012). It is a critical indicator in assessing the inequality of access to healthcare services for children among Bangladesh and is considered by majority of literature on HOI.

2. Demographic characteristics of household: ‘Gender of the household head’ and ‘number of children under 5’ in the household is included in the category. In developing countries, the head of the household is responsible for provision and access of 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. The number of children under the age of five in the household can have an impact over accessing healthcare services.

3. Economic Attributes: It comprises of the mother’s’ occupation, father’s’ occupation and the wealth index. These three variables represent the economic attributes related to a household. The occupation for both mother and father is divided into following categories: Not working; Professional/technical/managerial; sales; Agricultural - self employed; Agricultural - employee; Household and domestic; Services; Skilled manual and Unskilled manual. The wealth index is developed using 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) and serves as a proxy for household’s economic status (Filmer and Pritchett, 2001). Based on the scores generated by each household, the sample is divided in five quintiles comprising of equal number of households. The index comprises of five categories: i. Poorest, ii. Poorer, iii. Middle, iv. Richer and v. richest.

4. Parent’s Education: It captures both mother’s’ and father’s’ education level. Both the variables have been widely used in the literature based on opportunity approaches, mother’s’ education being the proxy for circumstance in almost all the literatures. Mother’s’ education has been divided into four categories: i. No Education, ii. Primary, iii. Secondary and iv. Higher. Father’s education follows the same categories where woman reported the educational attainment for their husbands.

5. Geographic Location: It includes the ‘location’ and the ‘region’ of the household. Location comprises of the urban and rural category. Both the variables have been largely used as the proxy for

circumstances as per the literature review. Location comprises of urban and rural category. To capture the variation within the country, region is included. There exist seven categories for the administrative divisions in Bangladesh: i. Barisal, ii. Chittagong, iii. Dhaka, iv. Khulna, v. Rajshahi, vi. Rangpur and vii. Sylhet.

Table 3 - Independent Variables

Variables	Type	Empirical Evidence
Characteristic of Child		
Gender of child	Categorical (1=Male, 2=Female)	(Singh, 2011); (Amara et al., 2017); (Saidi & Hamdaoui, 2017); (Sanoussi et al., 2017);
Demographic characteristics of household		
Gender of household head	Categorical (1= Male, 2=Female)	(Amara et al., 2017); (Sanoussi et al., 2017);
Number of children under 5 in the household	Discrete	(Singh, 2011); (Amara et al., 2017); (Sanoussi et al., 2017); (Tsawe et al., 2019);
Economic Attributes		
Wealth Index	Categorical (1 = poorest, 2=poorer, 3=middle, 4 = richer and 5 = richest)	(Singh, 2011)
Mother's' Occupation	Categorical (Not working = 0, professional/technical/managerial =1 , sales = 3, agricultural - self employed = 4, agricultural – employee =5 , household and domestic = 6, services =7 , skilled manual = 8 , unskilled manual = 9)	(Sanoussi et al., 2017)
Father's' Occupation	Categorical (Not working = 0, professional/technical/managerial =1 , sales = 3, agricultural - self employed = 4, agricultural – employee =5 , household and	(Sanoussi et al., 2017)

	domestic = 6, services =7 , skilled manual = 8 , unskilled manual = 9)	
Parent's Education		
Mother's education	Categorical (0 = No education , 1 = Primary, 2 = Secondary, 3 = higher)	(Singh, 2011); (Amara et al., 2017); (Saidi & Hamdaoui, 2017); (Sanoussi et al., 2017); (Tsawe et al., 2019);
Father's education	Categorical (0 = No education , 1 = Primary, 2 = Secondary, 3 = higher)	(Singh, 2011); (Amara et al., 2017); (Sanoussi et al., 2017)
Geographic Location		
Location	Categorical (Urban=1, Rural=2)	(Singh, 2011); (Amara et al., 2017); (Saidi & Hamdaoui, 2017) ; (Sanoussi et al., 2017); (Tsawe et al., 2019);
Region	Categorical (1=Barisal, 2=Chittagong, 3=Dhaka, 4=Khulna, 5=Rajshahi, 6=Rangpur, 7=Sylhet)	(Singh, 2011); (Amara et al., 2017); (Saidi & Hamdaoui, 2017); (Sanoussi et al., 2017); (Tsawe et al., 2019);

3.3 HOI Approach

This section describes the necessary steps for the implementation of the Human Opportunity Index (HOI) for access of healthcare among children in Bangladesh for DHS dataset 2014. The HOI proposed by Barros et al. (2009) was first applied in Latin America and Caribbean by World Bank (2008), that analyzed how children's personal circumstances have an impact on accessing services that are eminent for their growth in future. The index comprises of two main components:

1. The average coverage rate of specific opportunity (**C**).
2. The degree to which the opportunity is conditional to the circumstances or the fairness of the distribution of the opportunity (**D-Index**). (Barros et al., 2009)

The coverage represents the percentage of children in the sample that has access to healthcare services. The D index or dissimilarity index calculates the differences in the absolute coverage of access to health care services or how fairly healthcare services should have been distributed among the

population so that they are equal. It depicts the proportion of opportunities that are required to be redistributed within the society in order to make the inequality disappear. The value of D –index ranges from 0 to 1, when the opportunities are equally distributed among the society the value of the D-index would be 0 (Singh, 2011; Ju´arez, 2014).

The dependent variable, access to healthcare for children is defined as dichotomous outcome variable based on the approach by Barros et al. (p. 5, 2009). Let us suppose the binary outcome variable as (z_i), taking value 1 when i^{th} child has access to healthcare services and 0 otherwise. Firstly, to estimate the coverage, a logit model for composite indicator of access to healthcare services for children as a function of circumstances (gender of child, gender of household head, mother’s education, father’s education, mother’s occupation, wealth index, region and location) is estimated. Let us suppose (m) number of criteria for the circumstances (x) represented as $x_{1i}, x_{2i}, x_{3i}, \dots, x_{mi}$. The predicted probability for healthcare access for each child could be calculated based on the coefficient estimates obtained from the model. Let us denote the estimates of each parameter as $\{\hat{\beta}_k\}$. The predicted probability for each child for access to healthcare services could be calculated as follows in equation (1):

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

And thus, the average coverage rate for access to healthcare services could be calculated as follows:

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

Where, w_i represents the weight, given by $\frac{1}{n}$, where n represents the no. of sample.

The second step is to calculate the inequality through the D-Index, based on the approach of Barros et al. (2009) & modified by Soloaga & Ch´avez Ju´arez (2013b) it is given as follows:

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

Thus, the human opportunity index for access to healthcare is given as follows in equation (4):

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

The index range from 0 to 1, a higher value of the index is preferred as it signifies a higher coverage rate of opportunity while lower inequality through the dissimilarity index. The study will also compute the region wise index for individual and composite healthcare opportunities to better analyze the regional disparities within the country.

3.3.1 Shapley Decomposition

This study uses the Shapley decomposition method, in order to understand the contribution of each circumstance variable to the inequality in healthcare access. The method was introduced by Shorrocks (1999) which is based on shapley value on cooperatives games theory. The HOI gives us an impression of the extent of an opportunity that exists within the society. Although, the inequality index does not provide the root cause or main the determinants through which the inequalities are associated. Shapley inequality decomposition helps in the identification of these main drivers for the inequality by measuring the marginal contribution of each circumstance variable towards the inequality (Shorrocks, 1999).

Several studies based on HOI have applied this decomposition method. With reference to healthcare access and HOI, study by Amara et al. (2017) in Tunisia; Sanoussi (2017) in Togo; Saidi & Hamdaoui (2017) in Tunisia and Tsawe et al. (2019) in Sierra Leon have used this decomposition method to measure the marginal contribution of each circumstance towards inequality.

Following Barros et al. (2009), dissimilarity index is dependent on the set of the circumstances, adding more circumstances, increases the value of dissimilarity index. For example, if there are two circumstance variables A1 and A2, then D-index (A1, A2) > D-index (A1) and opposite for HOI. In Shapley decomposition method, from the set of circumstance variable, 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 & Hamdaoui, 2017). The new or changed value of the dissimilarity index, gives an idea about the magnitude of 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’ represents the number of circumstance variables selected out of total circumstances N. Let ‘S’ represents the subset of N that does not include a particular circumstance, say ‘T’. Then D(S) denotes the subset without T circumstance, while D (S ∪ {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.

The commands used in STATA are `hoi` and `hoishapley` to measure the inequality and to decompose the index based on circumstance variables. The STATA module to compute `hoi` was developed by Pedro et al. in 2010. The STATA module for `hoishapley` for the decomposition of inequality index was developed by Suarez in 2013. In this study, the decomposition is done for each individual healthcare opportunity and for the composite variable against the circumstance variable (gender of child; gender of household head; number of children in the household; region; location; parents' education, parents' occupations and wealth index) to better understand the socio-economic associations to the inequality.

Chapter 4: Results & Discussions

The chapter discusses the main findings obtained from the study. It presents the descriptive statistics, results generated from the regression and the human opportunity index, followed by the decomposition of the inequality index.

4.1 Descriptive Statistics

The starting sample comprised of 7,545 observations in the children dataset for health outcomes reported for under the age of five by the mother's'. Questions related to place of delivery and skilled professional attendance at birth were reported for birth taking place preceding three years of the survey for surviving children, thus the observation were reduced to 4541. Further, questions related to postnatal care for children were reported for the last live birth for the mother (NIPORT, 2016). The analysis eliminated the observations where children did not survive, responses with do not know values and the missing values from the dataset for the interest variables and the total number of observation achieved were 1287. To make the sample data representative of the entire population sample weights have been used and the command svyset is used for better estimation of sample characteristics for descriptive statistics. The command helps in accounting for the use sample weight, clustering and stratification (Tsawe, 2018). The sample weights used in the analysis are as provided in the BDHS dataset.

The table 5 represents the descriptive statistics for the dependent variables. Only 39.55% of the children out the sample reported birth being taking place at the institutional/hospital or a at health facility while the rest being institutionalized (at home). Only 36.99% of the birth is attended by the skilled professional while other by untrained health professionals or assistant or midwives. 65.11% of the sample accounts for access to postnatal checkup for children. Vaccination reports a comparatively high percentage of access with 77.23%. The composite indicator of access to healthcare accounts for a very low percentage of only 24.16% of the children.

Table 4 - Descriptive Statistics for Outcome Variables

Outcome	Mean	Standard Deviation	Coverage*
Birth taking place at a Health Facility	0.40	0.49	39.55
Birth attended by Skilled Professional	0.37	0.48	36.99
Postnatal Checkup for Child (within 2 months after birth)	0.65	0.48	65.11
Whether Child received any Vaccination	0.77	0.42	77.23

Access to healthcare	0.24	0.43	24.16
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**The coverage represents the percentage of access of each of the healthcare outcome among the children. Number of observations = 1287*

Appendix 1 details descriptive statistics for the sample for the circumstance variables. The Table-6 below represents the proportion of access of each healthcare outcome for each category based on the sample characteristics. The characteristics of the circumstance variables are represented as follows:

1. **Characteristic of Child:** The gender composition represents 51.47 % of male while 48.53% of female. Both of the categories represent almost equal access of 23% to healthcare services. The girls represent the lowest access of only 35.82% in birth being attended by the skilled professional and similarly for the boys with an access of 36.83%.

2. **Demographic characteristics of household:** 91.33% of the children are represented by a male household head. Access to healthcare represents a slightly high percentage access of 24.03% among male headed household than female, although vaccination represents comparatively a high percentage access among children being represented by female household head. 70.23% of the children are represented as one child while 29.48% with two to four siblings. Single child reports a higher access to all the healthcare components compared to more than one child in the household. With more than one child in the household the access for all the basic healthcare services decreases by almost 50.75% change. The rural areas represent a higher proportion of households with more than two children.

3. **Economic Attributes:** Children represented by poorest and poorer wealth index has the least access to healthcare with only 8.5% and 16.77% respectively, while the richest quintile has the highest access to healthcare services with 56.29%. A change from poorest to poorer quintile could almost double the chance for children for access to healthcare services. The poorest and the poorer quintile shows a greater difference in coverage for institutionalized deliveries and skilled birth attendance, on the other hand for vaccination and postnatal check up there exists only a slight difference. Major proportion (74.19%) of the sample is represented by not working/stay at home mother or either employed in agricultural activities (11.59%). Although the proportion of mother involved in technical/professional or managerial position is low but the category reports the highest access (61.82%) to healthcare services for children. Majority of the children are represented by father's' working in skilled manual works (34.91%) followed by sales (20.43%) and then being employed in agriculture (14.5%). Categories with father's' involved in household or domestic works followed by technical/professional or managerial works reports higher access to healthcare services for children.

4. **Parent's Education:** 'No education' among the parents indicates a prominent proportion with 15.17% among the mother's' while 23.79% among the father's' category. For both mother's' and father's' category, secondary education is reported the highest with 46.66% among mother and 31.25% among father. Access to healthcare services among children is reported the highest with mother (51.72%) and father (50.53%) having higher education.

5. **Geographic Location:** Bangladesh comprises of the seven regions with Dhaka representing the highest proportion with 36.01% of children. Within the regions, Khulna region has the lowest proportion of children belonging to the poorest quintile (13.4%) while the composition of wealth index in Sylhet region represents majority of the children belonging to poorest quintile which is 41.05% (Appendix 2). Khulna region reports the highest percentage of access (42.82%) to healthcare service among the regions for children. 25.12% are represented by urban areas while 74.88% by rural areas, while urban areas reports higher percentage (43.98%) for access to healthcare among children. There exists a difference of almost 26.08% for access of healthcare services among children in rural and urban areas.

Table 5 - Coverage of healthcare services based on circumstance variables

Characteristics	Birth taking place at a Health Facility	Birth attended by Skilled Professional	Postnatal Checkup for Child (within 2 months after birth)	Whether Child received any Vaccination	Access to healthcare
Gender of Child					
Male	39.03	36.83	65.85	86.83	23.86
Female	39.24	35.82	64.21	88.51	23.75
Gender of Household Head					
Male	39.25	36.46	64.7	80.09	24.03
Female	37.88	35.09	68.75	83.66	21.51
Number of Children in household (Under five)					
One Child	43.13	39.56	68.32	84.43	27.94
Two-Four	30	29.02	57.6	71.15	14.18
Five-Seven	0	0	30	46.67	0
Wealth Index					
Poorest	13.85	14.19	51.16	72.07	8.587
Poorer	30.78	27.48	60.75	74.44	16.77

Middle	34.63	30.78	64.17	84.17	17.07
Richer	48.05	44.98	68.02	83.92	25.17
Richest	74.33	69.5	84.66	88.77	56.29

Mother's Occupation					
Not working	39.85	36.28	61.64	80.17	23.28
Professional/technical/managerial	81.51	76.2	84.67	86.98	61.82
Sales	11.73	11.73	85.45	73.21	11.73
Agricultural - self employed	2.705	6.596	18.96	69.33	0
Agricultural – employee	25.68	33.1	70.58	82.19	20.93
Household and domestic	16.87	22.03	59.8	66.57	22.03
Services	24.58	37.76	77.69	72.83	15.46
Skilled manual	35.34	47.42	85.18	85.98	35.45
Unskilled manual	0	0	100	100	0

Father's Occupation					
Not working	63.49	55.26	29.23	81.33	5.321
Professional/technical/managerial	69.72	64.56	77.06	82.45	51.38
Sales	46.16	39.67	58.28	85.58	23.18
Agricultural - self employed	12.52	13.48	48.17	71.86	3.933
Agricultural – employee	23.69	22.01	60.07	67.01	10.77
Household and domestic	84.59	84.59	84.59	100	84.59
Services	41.08	37.27	69.56	80.42	23.11
Skilled manual	35.88	35.44	72.08	83.69	25.38
Unskilled manual	65.33	49.98	40.18	80.25	29.26

Mother's Education					
No Education	12.15	12.78	48.67	67.89	4.724
Primary	27.76	25.67	63.86	76.48	17.06
Secondary	46.53	42.98	66.72	86.2	27.6
Higher	74.46	68.28	84.12	82.98	51.72

Father's Education					
No Education	18.47	19.49	54.86	73.12	10.86
Primary	25.87	24.24	59.76	80.47	14.19
Secondary	48.85	42.74	72.42	81.57	28.24
Higher	73.19	69.19	74.84	88.56	50.53

Location					
Urban	59.96	55.08	80.15	85.66	43.34

Rural	32.15	30.05	59.99	78.64	17.26
Region					
Barisal	33.01	28.84	55.95	77.9	10.92
Chittagong	31.1	28.56	65.63	80.47	19.38
Dhaka	45.67	42.44	69	87.44	28.58
Khulna	65.99	62.87	73.28	75.78	42.82
Rajshahi	39.71	33.9	69.69	79.49	23.57
Rangpur	44.99	44.22	69.34	77.19	26.7
Sylhet	19.11	18.94	45.72	65.72	11.75

Number of observations = 1287

The table represents the proportion of access of each healthcare outcome for each category.

4.2 Human Opportunity Index

HOI STATA module developed by Pedro et al. (2010) was used to compute the index. Before running the regression, the test for correlation was performed among the circumstance variables. The correlation matrix (Appendix 3) indicates a moderate correlation among the father's education, mother's education and the wealth index. In order to reduce the correlation among the variables, separate model with father's socioeconomic components and mother's socioeconomic components were computed. Overall significance of both the model were statistically significant, although by adopting the model with mother's socioeconomic components, the correlation of 0.61 between father's education and mother's education and correlation of 0.5 between father's education and wealth index are eliminated and is also in favor of the literature. Furthermore, the model with father's socioeconomic components showed a higher mean variance inflation factor (VIF) value than the model with mother's socioeconomic components. (Appendix 4). Also, the linktest (Appendix 5) was performed to check for the specification error in the model. The linktest helps in identification of further predictors that may be statistically significant. If the test confirms that there are other predictors that are statistically significant then it indicates that the model specification is not good. The logit function should be a linear combination of the predictors. The linktest reconstructs the model using the linear predicted values (\hat{y}) and the square of linear predicted values (\hat{y}^2). The linear predicted values should be statistically significant for the model to be correctly specified while the square of the linear predicted values should not be statistically significant as they should not hold any explanatory power for model to be correctly specified. Appendix 5 highlights the results from linktest. The test does not hold any explanatory power as the p-value of the square of the linear predicted values (\hat{y}^2) was not statistically significant while the p-value for linear predicted values is statistically significant. Thus, the variables chosen for the analysis reflects towards a good model specification.

Computation of the HOI is done for each variable of the composite indicator along with the composite variable as each one of them represents a basic opportunity. The table 7 below represents the coefficients and the p value for each of the outcome variable.

Table 6 - Results from the logit regression

Circumstance Variables	Access to healthcare		Birth taking place at a health facility		Birth attended by skilled professional		Postnatal Checkup for Child (within 2 months after birth)		Whether Child received any Vaccination	
	Coef.	P> z	Coef.	P> z	Coef.	P> z	Coef.	P> z	Coef.	P> z
Mother's Education	0.6394	0.000	0.6614	0.000	0.5849	0.000	0.1716	0.028	0.2910	0.002
Mother's Occupation	0.0151	0.612	-0.0345	0.208	-0.0259	0.329	0.1284	0.000	0.0414	0.16
Wealth Index	0.4838	0.000	0.4915	0.000	0.4282	0.000	0.3415	0.000	0.0961	0.098
Number of children in household	-0.0033	0.000	-0.0030	0.000	-0.0023	0.000	-0.0019	0.000	-0.0031	0.000
Gender of household head	-0.0272	0.912	0.1909	0.38	0.1025	0.641	0.2765	0.213	0.2573	0.325
Gender of child	0.0816	0.583	0.0102	0.939	-0.1077	0.41	0.1143	0.36	0.2115	0.127
Region	0.0670	0.061	0.0594	0.064	0.0486	0.122	-0.0202	0.506	-0.1172	0.001
Location	-0.7440	0.000	-0.6210	0.000	-0.5926	0.000	-0.4052	0.009	-0.3075	0.07
_cons	-2.8291	0.000	-2.2012	0.000	-1.7958	0.001	-0.2882	0.57	1.1443	0.041
No. of observations	1287		1287		1287		1287		1287	
Prob > chi2	0.000		0.000		0.000		0.000		0.000	

With a significance level of 0.05, mother's education, wealth index, number of children in the household and location are statistically significant for access to healthcare services among the children. Mother's education and wealth index are positively associated with access to healthcare, while number of children in the household and location are negatively associated with the access to healthcare services. Location displays a strong negative relation towards access to healthcare.

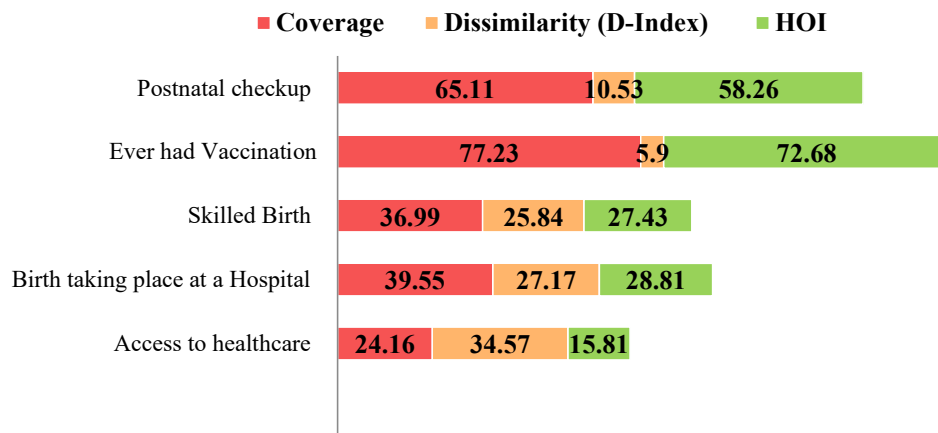
For birth taking place at a health facility and birth being attended by skilled professional, similar circumstance variables namely mother's education, wealth index, number of children in the household and location are statistically significant. Mother's education and wealth index has a positive impact for both the healthcare services. Although the association of mother's education and wealth index is strong for institutionalized delivery than skilled birth attendance, nonetheless, it is still quite strong for both. And it is negatively associated for number of children in the household and location.

For postnatal checkup of the child mother's education, mother's occupation, number of children in household, wealth index and location are statistically significant. The effect of mother's education is

least for postnatal checkup among other healthcare services. The association of postnatal checkup for mother's education and mother's occupation are close, with mother's education showing slightly higher association. For vaccination, mother's education, number of children in household and region are statistically significant, wealth index does not hold any relation. Association of mother's education with vaccination coverage is higher than postnatal checkup. Along with number of children in the household location, region also shows a negative effect for vaccination coverage.

Overall, mother's education is significant for all the healthcare service, improvement in mother's education will have a significant impact over improving the coverage for birth taking place at health facility. In comparison to other services, the impact of improving mother's education has less effect for postnatal care of child. Postnatal coverage is the only healthcare service which is related to improving the working status for women. Wealth index is statistically significant for all except access to vaccination, have a strong impact over birth taking place at health facility. Increase in number of children in the household tends to show a negative relation for all the healthcare services, although the effect is not that strong. Nonetheless, it is statistically significant for all the healthcare services. Circumstance variable region is only significant for child receiving vaccination with a negative relation. Location is statistically significant for all and negatively related for all the healthcare services, reflection of poor association of healthcare services with the rural areas.

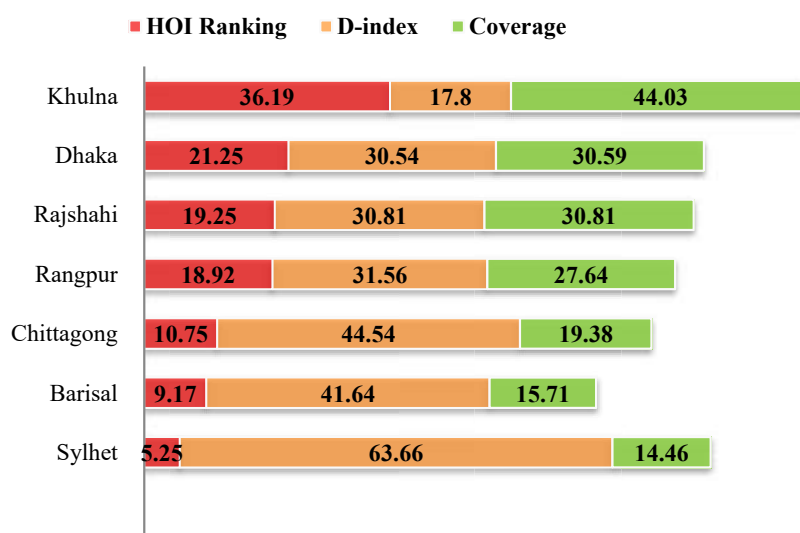
The graph 1 shows the results for coverage, D-Index and HOI for the healthcare outcome variable. Appendix 6 elaborates the results along with the locations (urban/rural).



Graph 1 - Index for the health outcome variables

Access to healthcare: The HOI for access to basic healthcare services is only 15.81%. A child born in Bangladesh has a very low access to opportunities related to basic healthcare services. The

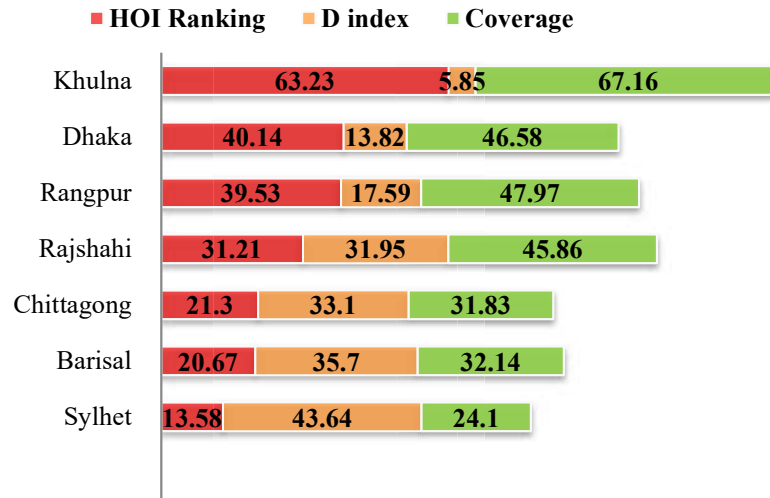
coverage is least for birth being attended by a skilled professional, with rural areas showing only 28.29 % of coverage. Rural areas show a greater inequality with a D-Index of 30.72% in access to these opportunities in comparison to urban areas with a D-Index of 18.76. The highest inequality in terms of healthcare outcomes exists in birth taking place at a health facility. Among the urban area, the inequality (10.75%) is high for birth being attended by skilled professional. Among the rural area, the inequality is highest for the institutionalized deliveries (24.46%). The opportunity of being vaccinated is the highest followed by postnatal checkup for a child. Graph shows the region wise ranking for the index. The region of Sylhet shows the greatest inequality with a D-index of 63.66% with a lowest opportunity index of 5.25. The graph 2 represents the results obtained from dissimilarity (D-Index) and HOI based on the region for access to healthcare.



Graph 2 - Region-wise results for Access to healthcare

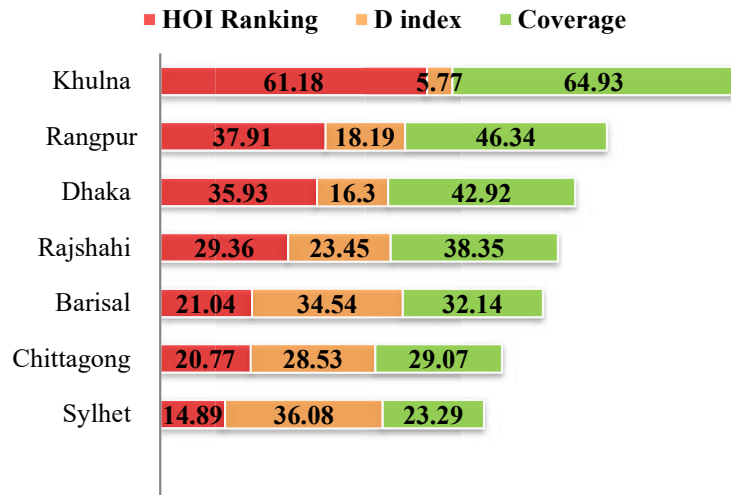
Birth taking place at a Hospital: The index for the opportunity in the country is 28.81. The opportunity for a child for birth taking place at a health facility is almost twice in urban areas as compared to rural areas (Appendix -6). As per the region wise ranking, the region of Khulna has the highest human opportunity index of 63.23 with the lowest inequality of 5.85%. The opportunity is the lowest in the region of Sylhet with 13.58 accompanied by the highest inequality 43.64%. Main reasons highlighted for place of delivery being at home are associated with low maternal healthcare education and affordability. Households in Bangladesh tend to rely on traditional birth attendants (TBAs) due to their cheaper availability. Also, there exists shortage of healthcare professionals and healthcare facilities especially in rural areas which increases their dependency on TBAs which ultimately results in lower access of the institutional deliveries is very low (Yaya, 2017). The government in 2009 launched Revitalization of

Community Healthcare initiatives to tackle the problem for the rural areas with 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). The graph 3 below represents the region wise ranking.



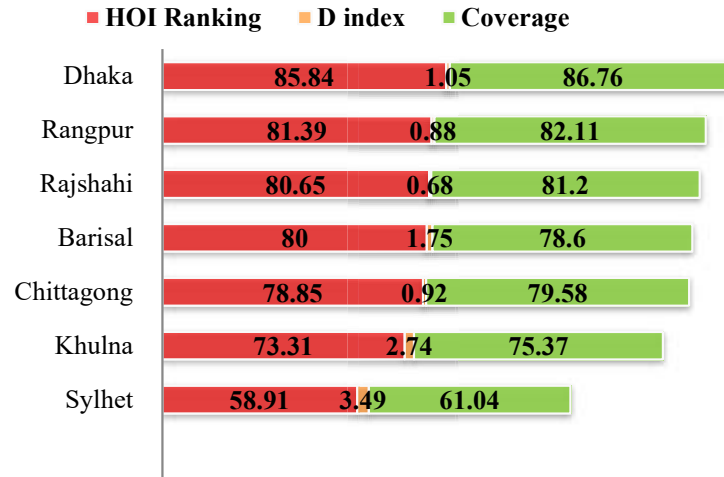
Graph 3 Region-wise results for birth taking place at a health facility

Birth attended by Skilled Professional: The index for the opportunity in the country is 27.43. There exists a higher inequality among the rural areas (24.46%). Again the region of Sylhet has the lowest opportunity of 14.89 also with highest inequality of 36.08%. Bangladesh achieved the MDG 5a to improve the proportion of births attended by skilled professional. Public information campaigns to raise awareness; training of traditional birth attendants; training of new community based skilled birth attendants; healthcare voucher programs to raise demands for utilization of healthcare services for delivery were among the effective strategies adopted to improve the proportions. (Chowdhury, 2011). Although, the proportion of birth not being attended by skilled professional is still quite high in the country which is attributed to the poor governance and monitoring by the government having a direct impact on the effectiveness of these strategies (Saha, 2017). The indicator is considered one of the most effective interventions to reduce maternal and neonatal mortality (WHO, 1999). This also highlights the fact that maternal and neonatal mortality still remains one of the most critical challenges for the Bangladesh. The graph 4 shows the region wise ranking.



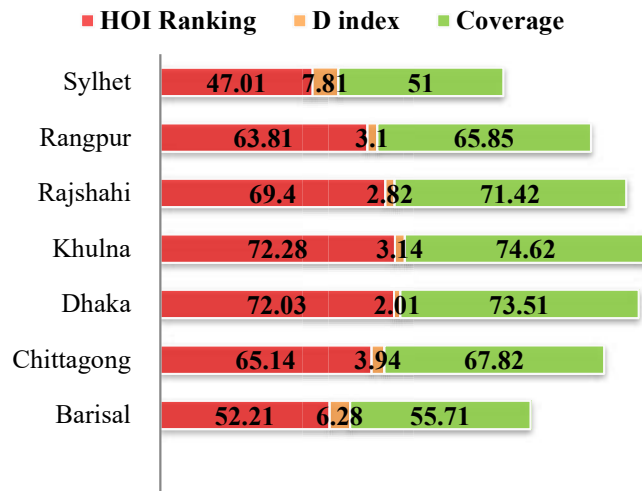
Graph 4 - Region wise ranking for birth being attended by skilled professional

Ever had Vaccination: The index for a child to ever had a vaccination is 72.68 and is among one of the highest opportunities for children being born in Bangladesh. The index is above 70% for all the regions except Sylhet which is at 58.91. The d-index is among the lowest for being vaccinated and thus signifies low inequality. Although, among the region Sylhet region followed by Khulna region shows a greater inequality. The expanded program on immunization (EPI) launched in 1979 was considered one most effective program to improve the coverage of vaccination in the country. The intervention helped the country to achieve a polio free status in 2001, eradication of neonatal tetanus in 2008 and the improved vaccination coverage rate in 2014 (Ministry of Health and Family Welfare, 2015). The implementation of the program was based on participatory approach with involvement from the community; private sector and local and international NGOs. The community outreach was achieved through mass awareness media campaigns coupled with focus on strategic service delivery of vaccines with the incorporation in primary healthcare system. Furthermore, to strengthen the vaccination coverage, strategic implementation of the program is required to address the inequalities arising within the regions of the country. The graph below shows the region wise ranking.



Graph 5 - Region wise ranking for child receiving vaccination

Postnatal checkup for child (within 2 months after birth): The overall opportunity index for postnatal checkup is 58.26. The inequality index for rural (2.63) and urban areas (2.85) are low and slightly similar. The opportunity is the lowest for region of Sylhet which is 47.02 also with the highest inequality of 7.82. In 2007, government launched a Maternal Health Voucher Scheme, targeting the poor women in order to improve the access to utilization of maternal healthcare services. Eligible women were provided with vouchers for various services along with the postnatal care visit with six weeks of delivery. The evaluation of the program resulted in an improved postnatal visits among the poor which also led to the integration of the program in the government's main health program know as Health, Population and Nutrition Sector Development Program (HPNSDP) 2011-2016 (Ministry of Health and Family Welfare, 2015). The graph 6 below shows the region wise ranking.



Graph 6 - Region wise ranking for postnatal checkup for child

4.3 Decomposition Results

The decomposition was carried out using the shapley method as explained in the literature review. The marginal contributions of each circumstance variables were calculated for each individual healthcare opportunity and for the composite variable of access to healthcare. The decomposition of individual healthcare opportunity helps in analyzing the impact of each circumstance variable in detail for the opportunity and thus in building the policy implications. The decomposition of the d-index or the inequality index by circumstance are represented in the table 14 below.

Table 7 - Results from shapley decomposition of d-index

Circumstance Variables	Access to healthcare	Birth taking place at a health facility	Birth attended by skilled professional	Postnatal Checkup for Child (within 2 months after birth)	Whether Child received any Vaccination
Mother's Education	26.44	28.97	28.55	15.33	21.43
Mother's Occupation	0.78	2.57	2.30	11.68	2.91
Wealth Index	38.86	39.74	39.86	39.23	15.19
Number of Children in household	9.56	8.79	7.33	8.93	27.08
Gender of household head	0.03	0.71	0.47	1.96	2.25
Gender of child	0.22	0.18	1.14	1.60	4.17
Region	0.53	0.81	0.75	3.88	17.53
Location	23.57	18.24	19.58	17.39	9.44

Mother's Education: It shows significant marginal contribution in the D-index in almost all the healthcare outcomes. 26.44% of the inequality is explained by mother's education for access to basic healthcare services for the children in the country. Looking at individual healthcare outcomes, the marginal contribution is higher for births taking place at a health facility and being attended by a skilled professional which 28.97% and 28.55% respectively. For vaccination, it shows a substantial contribution of 21.43%. Mother's education in postnatal checkup for child also shows a significant contribution of 15.33%, although is the lowest among the healthcare services. The HOI for access to healthcare among children becomes quite high from 15.81% to 44.83% if we consider mother's with higher education. Rural areas also reports high proportion of mother with no education as compared to urban.

Mother's Occupation: The circumstance variable is not one of the significant contributors towards explaining the inequality in all most all healthcare outcomes except postnatal checkup for the child. For the overall indicator of access to healthcare among children, it explains only 0.78% of the

inequality. Interestingly, for postnatal checkup, mother's occupation captures higher contribution towards the inequality which is 11.68%. This suggests that employed mothers' are better aware about the utilization and apply for certain programs like voucher scheme for postnatal care. For remaining healthcare services it explains only 2-3% of the inequality.

Wealth Index: The index represents a significant contribution in explaining the inequality in all the healthcare outcomes. 38.86% of the inequality arising in access to basic healthcare services is explained by wealth index. It denotes the largest proportion among the circumstance for explaining the inequality in access among every healthcare outcome, except vaccination. For birth taking place at a health facility, birth being attended by skilled professional and for postnatal checkup of child, wealth index explains 39% of inequality. On the contrary, for vaccination it is one of the lowest but significant, it only explains 15.19% of the inequality. As most of these interventions are provided free of cost.

Number of children in household (under five): The circumstance also captures a significant contribution in explaining the inequality. For the overall access to healthcare variable it shows 9.56% of the contribution. For a child receiving vaccination it is one of the major drivers with largest proportion among the circumstance variable that explains the inequality with 27.08%. For the remaining healthcare opportunities, it explains 7-8% of inequality approximately. Thus, household with more number of children tends to make some tradeoffs against availing basic healthcare services for children.

Gender of household head: It does not capture a significant contribution toward the inequality, explained by only 0.03% for the overall access to healthcare variable. It is under 1% for birth being taking place at a hospital and being attended by skilled professional. Postnatal checkup for child and child receiving vaccination shows a slightly higher contribution of 1.96% and 2.25%.

Gender of child: It does not hold explanatory power in terms of explaining the inequality. It contributes only 0.22% towards inequality in access to healthcare services. The contribution of the variable is quite low among all healthcare opportunities except a bit higher for vaccination, which explains 4.17% of inequality.

Region: The variable has a very low contribution for explaining inequality for access to healthcare with just 0.53%. Interestingly, it is one of the significant drivers in explaining inequalities in vaccination with a contribution of 17.53% among the circumstance variables. It implies at the implementation of the vaccination campaigns or at the region wise allocation. For postnatal checkup of child, region explains 3.88% inequality and is below 1% for the remaining healthcare opportunities.

Location: It is one of the significant contributors in explaining inequalities for all the healthcare opportunities. For the overall access to healthcare, it explains 23.57% of the inequality. As noted in the previous section that there exists a huge difference among inequality index for urban and rural areas with rural areas showcasing always a higher inequality for all the healthcare opportunities. The rural areas tend to suffer from the challenge of availability of healthcare infrastructure. Although for vaccination, location is not as high as compared to other healthcare opportunities with a contribution of 9.44%. For other healthcare opportunities, location explains between 17-19% of inequalities approximately.

4.4 Policy Implications

Results highlighted in the study could be very well integrated in the Health, Population and Nutrition Program (HPNSP) of Bangladesh. The program represents one of the main health policies of the country. Some of the key target areas of the program focuses to improve the access and utilization of maternal and child healthcare services and to improve the coverage of the vaccination in order to reduce the mortality through strategic investment in infrastructure and capacity building. Through the program it also aims at achieving the SDG targets related to reducing the child mortality.

The region wise analysis provides evidence for prioritizing the interventions to improve access to basic healthcare services. Strategic demand side financing based on drivers of inequality like community outreach initiatives, awareness campaign/programs on maternal and child healthcare education, etc could help in improving the coverage and ensuring equitable distribution of basic healthcare services for children. The recommendations based on the results are detailed in the following section.

The training program of community based skilled birth attendants (CSBA), first piloted by WHO in Bangladesh in 2003 to increase the capacity and access to skilled birth professionals has been since scaled up the government by increasing the district wise coverage. The program still functions along with some collaboration with the WHO. The program could prioritize the regions for allocation of human resources based on the results highlighted in the study along with awareness campaigns and community outreach in order to improve the coverage. The rural districts of the prioritized regions could be targeted to improve the coverage of the birth being attendant by the skilled professionals.

The government is in the process of planning an immunization act and the urban immunization strategy for strengthening the vaccination coverage (WHO, 2020). The vaccination program in the Bangladesh helped in eradicating the gender disparities (Ministry of Health and Family Welfare, 2015). Although, results from the study indicate that regional and wealth related disparities still exists. The government can prioritize interventions related to these disparities in order to ensure a complete coverage.

The government faces the challenge of poor governance and lack of monitoring in the execution of the programs under the health system (Saha, 2017). The health program should also give strong emphasis to proper management of interventions and anti-corruption measures in the health system for successful implementation.

Chapter 5: Recommendations & Conclusion

The importance of the study was to examine and analyze the access of the very basic healthcare services for children and to underline the main drivers of inequality in access to these services for the effective coverage and targeted interventions in Bangladesh to improve child health status.

The overarching result on access to healthcare indicates that HOI is well below the acceptable levels in order to ensure an adequate quality of life for children being born in Bangladesh. Maternal education, wealth in the household, number of children in the household and location are the key identifiers responsible for the low opportunity in the country. The coverage and the opportunity is the lowest among the rural areas due to lack of health infrastructure, health professionals and awareness. Among the rural areas, the poor population tends to be the most vulnerable group.

The region wise analysis of the index and decomposition helped in the identification of the priority areas for interventions for each region. Overall, in Bangladesh Sylhet region should be prioritized for interventions related to access to healthcare which exhibits the lowest HOI ranking in comparison to other regions. The region is far below in terms of coverage of healthcare and level of inequality. The table 9 below highlights the main priority area for each region along with the focus on demand side drivers of inequality. The focus areas for each region were identified based on the rankings for the HOI index and dissimilarity index for each healthcare category. The interventions could be highlighted as follows:

Long Term Goals: An integrated multi sector approach is necessary to improve the child health outcomes. Poverty reduction and improving the literacy rate among the female population could be highlighted as the long term goals for improving the coverage of very basic healthcare services and to reduce the child mortality.

Intermediate Goals: Capacity building for skilled birth attendance professional in order to improve their access among the rural population, also ensuring an affordable access. By training and certifying the traditional birth attendants in rural areas with a focus in the region of Sylhet, Chittagong and Barisal. Improving skilled birth attendance could also help in facilitating the coverage for vaccination and postnatal checkup for child by spreading knowledge about child healthcare. Mobilization of health professionals for home based postnatal care visits for the child and mother could also effective until the coverage for institutionalized deliveries is improved.

Short term Goals: To raise awareness through media, public participation platforms and exiting healthcare delivery mechanisms on importance and use of maternal and child healthcare and family

planning. The existing service delivery mechanism for vaccination is considered to be one of most effective intervention and a success story for the country over the past decades. The infrastructure and mechanism related to EPI program could be well utilized and integrated with other interventions and for awareness campaigns as an effective base. The micro credit groups especially in rural areas could also be used as effective channels for spreading awareness related to child and maternal healthcare and to raise awareness about government's existing policies and programs.

Table 8 - Region wise prioritized areas of interventions

Region	Area of Interventions	Focus
Barisal	Institutional deliveries; postnatal checkup for child	Poverty Reduction; Maternal healthcare education & female literacy
Chittagong	Skilled birth attendance	Poverty reduction; Maternal healthcare education; female literacy & awareness on family planning
Dhaka	Skilled birth attendance	Poverty Reduction: Maternal healthcare education; female literacy & awareness on family planning
Khulna	Vaccination	Maternal healthcare education & female literacy
Rajshahi	Skilled birth attendance	Poverty Reduction; Maternal healthcare education; female literacy & awareness on family planning
Rangpur	Postnatal checkup	Poverty reduction & female literacy
Sylhet	Institutional deliveries; Skilled birth attendance postnatal checkup for child & vaccination	Poverty reduction; Maternal healthcare education; female literacy & awareness on family planning

As per the policy implications explained in the previous section, community based skilled birth attendants (CSBA) program should target its resources towards rural areas in Sylhet followed by Chittagong as the priority so as to improve the overall access of birth being attended by skilled professional in the country. The priority area of intervention for the EPI program could be rural areas in Sylhet followed by the Khulna region. The Khulna region exhibits a significant inequality, thus the interventions should be targeted at poor households in the rural areas. The Health, Population and Nutrition Program (HPNSP) of the country should focus on the Sylhet region for improving coverage especially in rural areas for institutional deliveries, skilled birth attendance, postnatal checkup and vaccination also through prioritizing the funding for the region.

The government has improved the health status related to maternal and child healthcare over the past decades but that does not point at an adequate coverage of healthcare services among children. The

healthcare services represent the very least opportunities that every child should have a right to without being differentiated on the grounds of circumstances. Continuous and targeted interventions are required which demands collaboration from both public and private health providers along with effective community participation. Access to the basic healthcare services among children has potential impact on reducing the under-five mortality and improving child health status in Bangladesh. The difference between the vision and the implementation defines the current development. Eliminating the inequalities at the birth can help in achieving universal access to basic services and in improving the health status among the children. There exists a need to strike a true balance with knowledge building and collaboration among various development sectors to match the vision and implementation in health sector in Bangladesh in order to achieve progress.

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Appendices

Appendix 1: Descriptive Statistics for Circumstance Variables

Characteristics	Mean	Standard Deviation	No. of Observations	Proportion (Percentage Composition)	
Gender of Child	1.5	0.50	1287	Male (1)	51.47
				Female (2)	48.53
Gender of Household Head	1.09	0.29	1287	Male (1)	91.22
				Female (2)	8.781
Number of Children (under five)	1.18	0.88	1287	One child	70.23
				Two-Four	29.48
				Five-Seven	.2835
Wealth Index	2.93	1.44	1287	Poorest (1)	22.96
				Poorer (2)	18.02
				Middle (3)	19.68
				Richer (4)	21.51
				Richest (5)	17.84
Mother's Occupation	1.25	2.52	1287	Not working (0)	74.19
				professional/technical/managerial (1)	1.392
				sales (3)	1.842
				agricultural - self employed (4)	0.8478
				agricultural – employee (5)	11.59
				household and domestic (6)	1.039
				services (7)	2.037
				skilled manual (8)	7.019
				unskilled manual (9)	0.039
Father's Occupation	5.43	2.53	1287	Not working (0)	.7667
				professional/technical/managerial (1)	8.784
				sales (3)	20.43
				agricultural - self employed (4)	8.089
				agricultural – employee (5)	14.5
				household and domestic (6)	1.261
				services (7)	9.497

				skilled manual (8)	34.91
				unskilled manual (9)	1.764
Mother's Education	1.55	0.88	1287	No Education (0)	15.17
				Primary (1)	27.5
				Secondary (2)	46.66
				Higher (3)	10.67
Father's Education	1.40	1.03	1287	No Education (0)	23.79
				Primary (1)	28.39
				Secondary (2)	31.25
				Higher (3)	16.57
Location	1.68	0.47	1287	Urban (1)	25.12
				Rural (2)	74.88
Region	3.94	2.02	1287	Barisal (1)	5.392
				Chittagong (2)	23.57
				Dhaka (3)	36.01
				Khulna (4)	6.831
				Rajshahi (5)	8.938
				Rangpur (6)	7.115
				Sylhet (7)	12.14

Appendix 2: Region wise Wealth Index

Region	Poorest	Poorer	Middle	Richer	Richest	Total
Barisal	27.55	30.46	14.97	15.56	11.46	100
Chittagong	21.49	14.19	23.28	22.07	18.96	100
Dhaka	15.49	12.63	19.89	27.34	24.65	100
Khulna	13.4	24.58	17.72	23.45	20.85	100
Rajshahi	32.37	21.18	23.67	13.65	9.14	100
Rangpur	28.59	35.22	14.5	13.91	7.781	100
Sylhet	41.05	19.8	15.36	14.9	8.89	100
Total	22.96	18.02	19.68	21.51	17.84	100

Appendix 3: Correlation Matrix

	Father's Education	Mother's Education	Father's Occupation	Mother's occupation	Wealth Index	Siblings	Gender of household head	Gender	Region	Location
Father's Education	1									
Mother's Education	0.6152	1								
Father's Occupation	-0.2394	-0.2199	1							
Mother's Occupation	-0.0906	-0.0801	0.1042	1						
Wealth Index	0.5054	0.4452	-0.1082	-0.0377	1					
Siblings	-0.067	-0.1256	-0.0512	-0.0056	-0.0346	1				
Gender of Household Head	0.0136	0.0096	0.0647	0.0221	0.0186	-0.015	1			
Gender	-0.0445	-0.0007	-0.0043	0.0188	-0.0035	-0.0099	-0.0308	1		
Region	-0.1446	-0.1152	-0.0169	-0.066	-0.1203	0.0447	-0.0669	-0.0092	1	
Location	-0.2051	-0.1385	-0.0174	0.0092	-0.438	0.0333	0.0032	-0.0062	0.0263	1

Appendix 4: VIF Values for the circumstance variables

Variable	VIF	SQRT VIF	Tolerance	R-Squared
Mother's Education	1.29	1.13	0.7778	0.2222
Mother's Occupation	1.01	1.01	0.9869	0.0131
Wealth Index	1.53	1.24	0.6520	0.3480
Number of children in household	1.02	1.01	0.9813	0.0187
Gender of child	1.00	1.00	0.9984	0.0016
Gender of household head	1.01	1.00	0.9938	0.0062
Region	1.03	1.02	0.9695	0.0305
Location	1.25	1.12	0.8028	0.1972
Mean VIF	1.14			

Appendix 5: Linktest for the model

Access_healthcare	Coef.	Std. Err.	z	P> z 	[95% Conf.	Interval]
_hat	0.997718	0.125323	7.96	0.000	0.75209	1.243346
_hatsq	-0.00113	0.051714	-0.02	0.983	-0.10249	0.100228
_cons	0.000161	0.095084	0.00	0.999	-0.1862	0.186521
No. of observations	1287					
Prob > chi2	0.000					
Pseudo R2	0.2029					

Appendix 6: Results for Coverage, D-Index and HOI

Outcome	Coverage	Dissimilarity (D-Index)	HOI
Access to healthcare	24.16	34.57	15.81
Urban	41.78	18.76	33.95
Rural	15.80	30.72	10.95
Birth taking place at a Hospital	39.55	27.17	28.81
Urban	59.18	9.78	53.39
Rural	30.24	24.46	22.84
Birth attended by Skilled Professional	36.99	25.84	27.43
Urban	55.31	10.75	49.37
Rural	28.29	18.25	23.13
Ever had Vaccination	77.23	5.90	72.68
Urban	83.09	1.25	82.05
Rural	74.46	1.41	73.40
Postnatal checkup for child (within 2 months after birth)	65.11	10.53	58.26
Urban	76.29	2.63	75.26
Rural	59.34	2.85	57.64