ESSAYS ON HEALTH INEQUALITIES AND UTILIZATION OF HEALTH SERVICE IN LOW-AND MIDDLE-INCOME COUNTRIES

By

Lkhagvasuren Khorolsuren

DISSERTATION

Submitted to
KDI School of Public Policy and Management in
partial fulfillment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY
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ABSTRACTS

ESSAYS ON HEALTH INEQUALITIES AND UTILIZATION OF HEALTH SERVICE IN LOW-INCOME AND MIDDLE-INCOME COUNTRIES

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Abstract

CHAPTER ONE: SOCIOECONOMIC DETERMINANTS OF HEALTH INEQUALITIES AND THE IMPACT OF INTERVENTIONS: OVERVIEW OF THE EVIDENCE

Objectives: The main objectives of this study were to identify key socioeconomic determinants of health inequality and evaluate the likely effectiveness of different types of interventions aimed at reducing socio-economic health inequalities available from the literature and highlight appropriate types of interventions to tackle health inequalities for future evidence-based policy. **Methods:** This study systematically reviews 73 articles on the determinants of health inequality and 26 studies on impact evaluation of interventions and policies to tackle health inequality. Key databases were searched including EBSCO, PubMed, JSTOR, Cochrane library of databases and DHS database. **Results:** Income and income inequality, education and place of living were associated with health outcomes of the population. Interventions targeting healthy behaviors and prevention were most effective at reducing health inequalities compared to other type of interventions. Interventions based on education and accesses to health care services were mostly successful in reducing health inequality. Interventions on poverty reduction and housing showed inconclusive mixed results, but were mainly unsuccessful. **Conclusion:** Programs based on healthy lifestyle and behaviors and access to health care, specifically improving distribution of health professionals in remote disadvantaged areas are effective to tackle health inequalities.

Keywords: Health Equity, Program Effectiveness, Disadvantaged Population, Health Policy, Socioeconomic Factors

Abstract

CHAPTER TWO: CHILD HEALTH AND HEALTH INTERVENTION COVERAGE IN LOW- AND MIDDLE- INCOME COUNTRIES: AN PANEL ANALYSIS ON HEALTH INEQUITY

Objectives: This paper examines the effect of expansion of essential maternal and child health intervention coverage on reducing level and inequity in child mortality.

Methods: Using 167 nationally representative Demographic and Health Surveys and Multiple Indicator Cluster Surveys of 54 low income and middle income countries during 1993 to 2014, we estimated a panel random effects model of health intervention coverage and the child mortality rate. A composite coverage index is constructed as a weighted average of eight maternal and child health intervention coverage. Inequalities in the child mortality and health intervention coverage were measured by the Concentration Index by household wealth quantiles. **Results:** The descriptive analysis shows substantial inequalities in intervention coverage and child mortality were present by household wealth and across countries. The result of panel data analysis showed that a one percent increase in composite coverage index results in 1.4 fewer deaths per 1000 live births and equity in child mortality improve by 0.17 point. On the other hand, inequality in coverage has a harmful effect on level and equity in child mortality. Results suggested that one point increase in inequality of intervention coverage increase under-five mortality per 1000 live births by three more deaths and increase inequality in child mortality rate by 0.5 percent, holding other factors constant.

Conclusion: Results of this study suggest that persistent efforts must continue to be made to expand coverage of essential maternal and child health interventions for the poorest mothers and children as fast as possible, in order to save lives of children and reduce inequality in both health care and health outcome.

Key words: Health inequality, Vulnerable population, Child Health, Universal Health Coverage, Access to Health Care, Low and Middle Income Countries

Abstract

CHAPTER THREE: THE EFFECT OF ACCESS BARRIERS ON SERVICE USE IN MATERNAL HEALTH CARE: EVIDENCE FROM CAMEROON

Objective: This study aimed to examine the effect of demand-side access barriers on the utilization of maternal health care services in Cameroon. **Methods:** Repeated cross-sectional data of 2004 and 2011 Demographic and Health Survey from Cameroon were employed. Information about the mothers of 71767 live-born children age under five years in the five years preceding the survey was included in this study. Multiple logistic regression models were used to examine the effects of demand-side barriers on the utilization of skilled antenatal care and delivery care. **Results:** The adjusted odds ratios of both utilization of antenatal care and delivery care were significantly lower if women reported that they have big financial, cultural and geographical problems accessing health care than who reported they have less difficulties. Mothers residing in the urban area, mothers with higher levels of education, and those in the highest wealth quintiles were most likely to receive professional antenatal care and delivery care. The important barriers to access antenatal care and delivery care in Cameroon was getting money to get medical treatment, distance, and transport to a health facility.

Conclusion: Women who have barriers to seeking health care for themselves were least likely to receive professional antenatal care and delivery care. The result of this study implies that policies to reduce demand-side barriers, such as lowering or exempting user fees for essential maternal care especially for the poorest and most vulnerable mothers, bringing healthcare closer to the people, improving infrastructure and organization of transport networks will significantly increase utilization of effective maternal care in the country.

Keywords: Antenatal care, Delivery care, Barriers to access health care, Inequality, Cameroon

Dedicated to

My beloved family

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INTRODUCTION

Globally, health status of the children has been significantly improved during last two decades (WHO, 2017). Millennium Development Goal (MDGs)'s target-4 to reduce under-five mortality rate (U5MR) by two-thirds, between 1990-2015 is achieved in some developing countries and on average global U5MR reduced by half between 1990 and 2015.

Until recent, governments of low and middle income countries tend to trade of inequality in health for average health at the national level in order to achieve their development goals. But health situation of disadvantaged population and some subgroups may have lagging behind or even worsened since implementation of MDGs (Barros et al., 2012). It received attention from international organizations and next global Sustainable Development Goals (SDGs) set a target to achieve Universal Health Coverage (UHC) by 2030 at the end of 2015, which is the key strategy to improve health of the population by ensuring access to health care for everyone without putting them into financial hardship.

As a result coverage of essential maternal and child health interventions significantly increased in low and middle income countries. It is important to study effect of UHC on child survival and equity in those interventions as well as equity of health outcomes. Number of recent studies showed that scaling up interventions to leave no-one behind contributed to decrease child mortality (Bhutta et al., 2010; Kuruvilla et al., 2014; Victora et al., 2016) and improve equity in those interventions (De La Torre, Nikoloski, & Mossialos, 2018; França, Restrepo-Méndez, Maia, Victora, & Barros, 2016; Quayyum et al., 2013). However evidence of how expansion of health interventions contributed to reduced inequalities in child health outcomes in low and middle income countries is still rare. To fill this gap, we aimed at assessing impact of expansion of key maternal and child health interventions on inequality of child health outcome in low- and middle-income countries.

This dissertation is organized into three independent chapters. The first chapter summarized empirical evidences of determinants of health inequality and the impact of public policy or public health interventions aimed at reducing health inequalities for future evidence-based policy in developing countries by reviewing recent literature.

The second chapter provides empirical evidences of how expansions of health interventions contributed to decrease the level and the income inequality of child mortality in the low- and middle-income countries.

Despite making efforts to expand health care coverage, it is also important to assess factors influencing utilization of health care services, which deepens health inequality in developing world. Financial difficulty, cultural problems, distance and transportation to health faculty are the documented (Dairo & Owoyokun, 2010; Delvaux, Buekens, Godin, & Boutsen, 2001; Gage, 2007; Houweling, Ronsmans, Campbell, & Kunst, 2007; York, Grant, Gibeau, Beecham, & Kessler, 1996) examples of barriers that prevents woman to use health care, even its available. The reason we noticed the highest inequality of professionally assisted delivery care, followed by antenatal care, among maternal and child health care interventions in studied countries in chapter two might have been not only due to the limited availability of health care, but also women's barrier to access health care. The third chapter presents in-depth analysis of factors influencing access to health care services using micro data from Cameroon, where inequality in delivery care and antenatal care was the highest among studied countries when health service is widely available. This chapter examined the effect of access barriers on use of service in maternal care in Cameroon.

CHAPTER ONE: SOCIOECONOMIC DETERMINANTS OF HEALTH INEQUALITIES AND ITS IMPACT: OVERVIEW OF THE EVIDENCE

1.1. BACKGROUND

There is a growing literature in this area exploring the cause of health inequality and differences in health at individual, community, population level. Health inequality is determined by set of complex socioeconomic, individual and biological factors, such as income, education and literacy, employment and working environment, geographical area, age, gender and ethnicity (Adler, 2002). Among these complex factors income may be the strongest variable that explains variations in health in empirical literature. Income determines the living condition such as housing, food consumption, access to quality education and health service, which are the all positively associated with health. Therefore policies and interventions aimed at improving income of the population may be one of the most efficient and effective among interventions aimed at reducing health inequalities. Therefore in this session we mainly focused on association between income and health, especially the link between household income and child health.

It has been documented in the literature that the fundamental factors affecting health depend on one's income and its relatively even distribution among members of the population (Ettner, 1996; Kelly, Bonnefoy, Morgan, & Florenzano, 2006; Pickett & Wilkinson, 2015; Uphoff, Pickett, Cabieses, Small, & Wright, 2013). Evidence from studies supports that one of the most successful ways of improving health of disadvantaged groups is to increase their income (Akee, Copeland, Keeler, Angold, & Costello, 2010; Arno, House, Viola, & Schechter, 2011; Herd, Schoeni, & House, 2008; Hoynes, Schanzenbach, & Almond, 2016; Kruk, Prescott, de Pinho, & Galea, 2010); Pickett and Wilkinson (2015); (Strully, Rehkopf, & Xuan, 2010). However exploring the casual relationship is challenging, because of reverse causality of income and health (Jason & Barbara, 2013). It is not a clear cut that low income leads to poor health or

poor health leads to low income. To examine the pure casual effect of income and health, recent papers tend to use child health status as a health outcome variable because income-health reverse causality is less likely the case during childhood (William Evans, 2013).

After identifying key socioeconomic factors of health inequalities, we used them as a ground of interventions tackling health inequalities in the search strategy of second section of this chapter. Throughout the world there has growing socioeconomic inequalities in health, and in health status and these differences in health care services exist in Organization for Economic Cooperation and Development (OECD) member countries (Braveman & Tarimo, 2002; d'Uva, Jones, & Van Doorslaer, 2009; Delvaux et al., 2001). These inequalities are even larger in less developed countries for many reasons (OECD/EU, 2016). There are large inequalities in self-reported health across different income groups in all OECD countries (Bleich, Jarlenski, Bell, & LaVeist, 2012). Governments of OECD countries have developed and implemented various interventions and policies tackling health inequalities for more than three decades (Lambert, 2014; Regidor, 2004a, 2004b). These countries are on widely different phases of awareness of and willingness to take action on health inequalities. From late 1980s, OECD countries intensified their focus on health inequality, while most developing countries have mainly centered their efforts on measuring health inequality levels.

Evidence for the effects of interventions on health inequality in the literature is richer for OECD countries. Developing countries may learn several lessons from OECD countries as they try to achieve greater progress in reducing health inequality.

How does one tackle health inequality? What could be the most effective and efficient way to reduce health inequalities? These are the key questions that need answers, but there is no single solution for the problem as health inequality is determined by set of complex socioeconomic, individual and biological factors, such as income, education and literacy, employment and

working environment, geographical area, age, gender and ethnicity etc. In order to answer these questions, it is important to study the success and failure of past interventions in developed countries. There is substantial literature over the span of decades in these countries exploring causes of health inequality, explaining how to measure it and attempting to answer what reduces the health differences between socio-economic groups (Ferrie, Shipley, Smith, Stansfeld, & Marmot, 2002; Kunst et al., 1999; Mackenbach et al., 1997; Smith et al., 1998; Wagstaff, 2000; Wagstaff, Paci, & Van Doorslaer, 1991). However, very limited literature can be found regarding the effectiveness of programs, interventions and policies attacking health inequality (Bambra et al., 2009). It is important to learn from the past what has really worked while highlighting areas for future improvement.

Aim of this chapter is to find evidences of association between socioeconomic situation (SES) and health, and evaluate studies in OECD countries that have evaluated the impact of public policy or public health interventions aimed at reducing health inequalities and highlight the interventions that have been effective for future evidence-based policy in developing countries by systematically reviewing the recent literature.

1.2. METHODS

1.2.1. Search strategy

Key databases were searched including EBSCO, PubMed, JSTOR, Cochrane library of databases and DHS database. The search was limited to articles in the English language, published from 1980 to recent. The following key words were searched under three main headings: socioeconomic inequalities in health (disparities in health status, socioeconomic health inequality, differences in health status), socioeconomic determinants of health inequality (income, household income, rural/urban, education, place of living, etc.), and effects of

interventions aimed at reducing health inequalities (policy/intervention on health inequality, impact of policy/interventions, effectiveness of policy/interventions, etc.).

1.2.2. Inclusion and exclusion criteria

The search identified 218 articles about determenants of health. Title screening was done from the whole list of identified articles and duplications were removed. Papers were excluded on the basis of three criteria in general: a descriptive or theoretical discussion, papers with only abstract and no specific focus on health inequality. As a result, total of 73 full text articles on determinants of health inequality were reviewed thoroughly in detail.

For the studies of effects of public policy or intervention on health inequality, the search identified 78 articles and a total of 26 articles were reviewed in detail. A study was included if it met the following seven key inclusion criteria:

- Evaluated impact of public policies and interventions on health inequality.
- Compared populations affected by two or more groups impacted by a policy or intervention.
- Measured change in health outcomes, access to health care and healthy behavior of the study populations.
- Published between 1980 and 2017.
- Conducted in an OECD country.
- Published in peer reviewed international academic journal.
- Published in English language.
- Complete peer reviewed manuscript was available, not just an abstract.

1.3. RESULTS

1.3.1. Difinition of health inequality

Health inequality is determined by various socioeconomic factors, such as age, sex, race and ethnicity, education, income, social status, unemployment, place of residence of the population and many more. Socioeconomic inequality in health exists regardless of countries development status and advances of health system.

In order to clarify our terminology used throughout this paper, it is important to distinguish between health inequality and health inequity. Sometimes these two terms are mixed or incorrectly used in the literature. WHO defined health inequality as "differences in health status or in the distribution of health determinants between different population groups". It can be health differences between elder and young, man and woman or poor and rich. Some health inequalities are attributable to gens, environmental conditions or lifestyle choices that are mainly beyond the control of health policies. This type of health inequalities is unavoidable (Whitehead, 1985). In contrast health inequalities can be avoidable. For example, higher maternal and child mortality rate among disadvantaged social groups may be prevented by the basic health services. More children is dying in rural area because of no proper sanitation is avoidable by simple public health interventions. These are the examples of health inequity, which has an ethical dimension.

However WHO definition of health inequality also includes health inequity concept. Therefore recent literatures used inequality in health as a term to indicate systematic and avoidable health differences. To avoid confusion, term of health inequality will be used in this paper.

Policy for reducing health inequalities does not mean that everyone has the same health status and completely eliminates differences in health. It means reduce or eradicate health differences caused by unjust and avoidable factors.

1.3.2. Importance of reducing socioeconomic health inequalities in health

Socioeconomic health inequalities are unfair. Although the meaning of "unfair" varies person to person, culture to culture and country to country, it has a common meaning. For example, every mother and child must have a same chance of survival regardless of their wealth, education or place of leaving. 6.3 million children died before age of five in 2013 (WHO report, 2014), less than one percent of child death occurred in high income countries and remaining 99 percent occurred in low and middle income countries. It is unfair that the child is dying just because of they are born into poor family.

Second, socioeconomic health inequality is avoidable. On humanitarian grounds, it is not acceptable for children suffer from ill-health caused by hunger and starvation, or dying because of born into the poor family which may be eliminated completely.

Third, inequalities in health impede economic growth. A cross country study (Michael, 2011) showed that a 1 percent increase in health inequality decreases income per capita by 0.1%. Another analytical study covering 38 Sub-Saharan African countries also found out that GDP per capita is negatively associated with inequalities in health interventions (Subramanian and Daniel, 2014).

1.3.3. Key determinants of health inequalities

1.3.3.1. Income and income distribution

Income and its distribution are believed to be one of the most important factors of health of the population. On average, health status of the richest group is tends to be higher than the poorest group. People living in more equal society live longer that those live in unequal societies. Enormous number of studies can be found from the literature concerning link between income, income inequality and health.

Since 1980's income inequality is rising sharply in both developing and developed countries. One of pioneering main papers in this area was published in 1992 showing connection between income inequality and life expectancy among nine developed countries (Wilkinson, 1992). Since then to present dozens of papers discussed about the link between income distribution and health status. Mixed or opposite results can be found among papers exploring correlation between income inequality and health. We can find papers that support relative income hypothesis or papers arguing that increased inequality leads to worse health in future (Zheng, 2012), or some papers says there is no relationship.

There are various hypothesis are made such as absolute and relative income hypothesis, deprivation hypothesis, relative position hypothesis and tested in individual level, within country and between countries.

Individual level studies clearly support the income and health hypothesis. Also, individual level studies suggest that there is a nonlinear relationship between income and health. (Mackenbach et al. 2004) found that the increase in household income results increase in self-reported health status. But less improvement is observed when household income gets higher. The shape of relationship between household income and self-reported health status is found to be curvilinear using survey data from seven European countries.

The level of income also determines inequalities in access to health care. A recent paper, published in International Journal of Equity in Health by Wilunda, measured equity in utilization of emergency obstetric care at Wolisso Hospital in Oromiya, Ethiopia. They surveyed 760 women and found out that 70% of women utilizing emergency obstetric care belonged to top wealth quintile with only 4% belongs to the poorest two quintiles in Ethiopia (Wilunda, 2013). Another study confirms that access to health care of poor woman is limited.

Carine et al found out that access to live saving Caesarean section were extremely low among the poorest using Demographic and Health Surveys (DHS) data (Carine et al., 2006).

Household income and parent's income is the strongest predictor of the children's health as well (Amy et al. 2013; Zhu et al. 2012; Devaux, M. and M. de Looper, 2012). Studies examining the relationship between household income and child health status consistently find that there is a highly significant relationship between these two variables.

There is increasing number of literature exploring relationship between income inequality and health status of the population within and between countries. Studies on health inequalities within the country are usually in line with individual studies that confirms curvilinear relationship between income and health. However researchers who use aggregate level data for testing income inequality and health hypothesis strongly argue that aggregate level study is preferable over individual level studies, because by definition income inequality is a property of the population and not of individual.

Therefore, the most important findings testing income inequality and health hypothesis can be found from cross country studies. Some showed that income inequality matters but some show income inequality does not matter.

A famous study by Robert Waldmann found a significant correlation between income inequality and infant mortality rate using population level study. He used cross sectional data including 57 developing and developed countries. Main result from this study was infant mortality rates among the poor increase when the rich get richer (Waldmann, 1992).

Another study (Mikko, 2011) recently used panel data including 21 developed countries for over 30 years assessed impact of income inequality and population health showed that income inequality has an strong and significant impact on mortality up to age 15 for both genders. After age 15 the link disappears for female mortality, but the association is still present up to age 50

for male mortality suggesting that the policies tackling health inequalities may improve health status of the population.

In contrast to above studies, some argue that there is no direct link between income inequality and poor health. Because correlations come from more important factors other than income inequality itself (Deaton, 2003). For example, Jeffrey and Jennifer examined the association between income inequality and health using data from 47 developing and developed countries in 1990. They concluded that positive correlation between the GINI and infant mortality became insignificant once education is controlled for, while negative correlation between income inequality and life expectancy is removed by controlling for income per capita (Jennifer and Jeffrey, 2001). But others (Kawachi and Tony Blakely 2001) criticized their control variable, which is secondary school enrolment rate. Including education in their model causes a multicollinearity issue and produced biased estimation. Because income inequality and education has a causal relationship. Poor education can be a production of high income inequality.

In conclusion, income and income inequality matters, but it is just a part of the story, so we have to investigate other important factors which have influence on health such as education and place of living.

1.3.3.2. Education

Education plays a major role in socioeconomic gradient in health status. Less educated people tend to be sicker than well-educated counterparts. Recently Arroyave et al. (2014) studied the contribution of specific causes to disparities in adult premature mortality (ages 25-64) by educational level from 1998 to 2007 in Colombia. They found that people with only primary education had greater premature mortality than people with post-secondary education.

Mortality declines as level of education increases, declines are larger for higher-educated people.

Education is closely related with income and rural-urban health disparities. Less education means less opportunity to earn high income and also low social class. A study (George, 1998) determined the association between education and occupational social class using data from a cohort of men recruited from 27 workplaces in Glasgow, Grangemouth, and Clydebank (all in the west of Scotland) between 1970 and 1973. Prospective observational study design was used. 5749 men aged 35–64 who completed questionnaires and were examined. Over 21 years of follow up, total 1639 of the men died. The result showed that men in manual social classes and men who dismissed full time education at a young age had greater death rates. Deaths caused by cardiovascular disease were most strongly associated with education. The non-cardiovascular non-cancer category was the cause of death group most strongly associated with adulthood social class.

Also education is an important determinant of health care utilization. Simon et al. (2007) examined the relationship between antenatal care with skilled health professionals and live births delivered by caesarean section, according to SES, including education using data from four DHS conducted between 1993 and 2004 in Bangladesh. Utilization antenatal care service is significantly low among the women without formal education (18%) comparing to woman with secondary or higher education (99%). Kunst and Houweling (2001) conducted a cross country study among developing countries using also DHS datasets that lower utilization of delivery care by poor mothers is partly due to their lower level of education.

1.3.3.3. Place of living

Socioeconomic status (SES) of population can be judged by where the person lives. Especially it is true for developing countries where people belong to lower socioeconomic group live in

rural and remote areas. And their health status is worse than those who live in urban settings because of so many reasons including accessibility to health care service and ability to pay. Efforts have been made to explain variations in health between regions and neighborhoods, because of its importance in public policy. Whether public policy that attempt to reduce health inequality should concentrate individual based initiatives or area based initiatives is very important question to answer. Evidences from industrialized countries mostly concentrate on what features of neighborhoods might promote or damage health, which is not really interest of this paper. Therefore we will concentrate on only rural and urban health disparities here. Health status of the population in rural area may be disadvantaged by poorer availability of health care service, higher level of unemployment, more hazardous environmental, occupational and transportation conditions.

A study in United States (Mansfield et al., 1999) examined premature mortality by county in the United States and measured its relationship with metropolitan, urban and rural geographic location. They found that premature mortality was highest in rural counties in Southeast and Southwest. Evidence from Canada (Raymond, 2009) confirmed that rural Canadians tended to have poorer health status than their urban settings. Another study from Canada (Mikiko, 2014) examined rural-urban disparities in terms of life expectancy. As a result life expectancy at birth was lower for both genders in rural areas. James et al. (2010) examined whether the use of basic health services and incidence of unmet health care needs experienced by Canadians aged 55 years or older vary across urban and rural areas of Canada, and analyzes possible reasons for any observed differences. They used data from The Statistics in Canada Master file of Cycle 2.1 of the Canadian Community Health Survey (CCHS) from 2002–2003. They found significant differences between rural and urban in terms of health care utilization.

Based on analysis on Demographic and Health Survey data from 35 developing countries, Fox et al (2013) found that rural children have a considerably higher risk of poor nutrition.

But results from studies concerning rural-urban health differences are not consistent. For example, a recent study (Srinivasan, 2013) attempted to explore rural/urban differences in child nutrition outcomes using DHS of Bangladesh and Nepal. They found insignificant differences in HAZ urban and rural settings.

As the country develops, rural-urban health disparities disappear. World Health Report and MDGs reports highlights that mortality and morbidities heavily concentrated in poor rural areas of developing countries.

1.3.4. What Has Worked? Lessons from OECD Countries to Tackle Health Inequalities: A Review of the Literature

1.3.4.1. Classification of interventions targeted to reduce health inequality

Interventions tackling health inequalities appear in many different forms. They involve macro-economic policies, social policies, public policies and poverty eradication interventions, participation of disadvantaged groups in labor market, upgrading housing and environment and improving access to health service, etc.

The classification of interventions aimed at reducing health inequality based on socioeconomic status of targeted population (income, education or place of residence) was challenging for a very simple reason. Most interventions simultaneously targeted multiple aspects of inequality such as low-income, less educated population, ethnic minority, rural and remote populations of the various disadvantaged groups. In this study, the various interventions were classified based on how they reduced health inequality. These categories are summarized in Table 1.1.

Table 1.1. Classification of interventions aimed at reducing health inequality

Type of intervention	Description
Poverty reduction and labor participation	
Non-cash subsidy programs	Food support programs for disadvantaged groups.
Labor participation	Improving labor participation of disadvantaged groups.
Interventions on healthy behaviors and prevention	
Social marketing	Raising public awareness and behavior change.
Prevention	Screening, individual risk factor assessment and immunization.
Health education	Improving knowledge, attitudes and life style.
Housing and supportive environment	
Improving environment	Neighborhood improvements and moving to better areas.
Structural change	Improving living environment such as street layout and green space, better housing, etc.
Access to health service	
Access to health service	Improving access to health care of disadvantaged groups.
Education	
Education	Education policies and interventions aimed at reducing health inequality.
Mixed strategies	
Integrated strategies	Combination of at least two strategies to tackle health inequalities.

[1]*Classification was done based on the only the articles included .*

1.3.4.2. Effectiveness of poverty reduction interventions

Income is one of the most important factors of health. Rich people tend to be healthier than poor people. Several numbers of studies can be found in the literature concerning the link between income and health inequality (Ettner, 1996; Lynch, Smith, Kaplan, & House, 2000; Mackenbach et al., 2004; Mellor & Milyo, 2001; Smith, 1996; Swain; Van Doorslaer et al., 1997; Waldmann, 1992; Zheng, 2012).

Conceptually, reducing health inequality means improving health of poorest population as fast as possible while health of higher social classes continues to improve (Kelly, Bonnefoy, Morgan, & Florenzano, 2006). In order to achieve this significant policy goal, it is important to deal with the most basic pre-existing condition affecting health which is income and its distribution. It has been documented in the literature that the fundamental factors affecting health depend on one's income and its relatively even distribution among members of the population (Pickett & Wilkinson, 2015; Uphoff, Pickett, Cabieses, Small, & Wright, 2013). Evidence from studies supports that one of the most successful ways of improving health of disadvantaged groups is to increase their income (Akee, Copeland, Keeler, Angold, & Costello, 2010; Almond, Hoynes, & Schanzenbach, 2011; Arno, House, Viola, & Schechter, 2011; Herd, Schoeni, & House, 2008; Hoynes, Schanzenbach, & Almond, 2016; Kruk, Prescott, de Pinho, & Galea, 2010; Strully, Rehkopf, & Xuan, 2010). Evidence for the impact of interventions on income comes in different forms. A total of three interventions were identified targeting socioeconomic disadvantages, including poverty reduction policies, social benefit schemes and increasing labor participation for disadvantaged population. Summary details of poverty reduction and labor participation interventions are provided in Table 1.2.

Table 1.2. Summary of poverty reduction and labor participation interventions.

Citation (year) Country of study	Intervention	Targeted population/Health outcome measurement if applicable	Learnings from Study
UK (McFadden et al., 2014)	"Healthy Start" (HS), Food subsidy program that gives vouchers for fruit, vegetables, milk, and infant formula.	Low income mothers and young children/improvement of nutrition for pregnant women and young children	This program improved quantity and quality of food of low income pregnant and breast-feeding mothers and children.
UK (Ford, Mouratidou, Wademan, & Fraser, 2008)	Giving "Healthy start" vouchers for fresh fruit, vegetables, milk and infant formula.	Low-income, Caucasian, pregnant and postpartum women living in Sheffield.	Pregnant and postpartum women participated in this program significantly increased their daily intakes of energy, Fe, Ca, folate and vitamin C compared with the Welfare Food Scheme women (similar program as HS).
USA and UK (Crowther, Marshall, Bond, & Huxley, 2001)	Prevocational training and supported employment program for people with severe mental illness.	People with severe mental illness	Supported employment was an effective tool to help people with mental illness to be employed.

Nutrition is a critically important factor of human health and it is true especially for pregnant and postpartum mothers and their children (Clark, Sydenstricker, & Collins, 1924). For low-income families, it is often difficult to give priority to spending for healthy food such as fruits, vegetables, milk and vitamin supplements because of their cost (Maslen, Raffle, Marriott, Smith, & Council, 2013). Elimination of food poverty has always been a top priority of anti-poverty policies and food subsidy programs are important component of it. "Healthy Start" is an example of food subsidy programs which provided food vouchers to low-income mothers

and young children in United Kingdom and was launched in 2006 (Ford et al., 2008; McFadden et al., 2014). Impact of "Healthy Start" was evaluated empirically by McFadden et al and Ford FA et al (Ford et al., 2008; McFadden et al., 2014). Results from these studies provided evidences that food subsidy programs can improve nutrition of low-income mothers and children, but there is a lack of evidence that it improved health outcomes or reduced health inequality.

When we talk about income, we tend to omit non-cash income and its distribution. It is also an important determinant of health and health inequality as same as cash income because significant quantities of economic resources are received in a non-cash form such as health service, education, food, transportation, etc.

Crowther et al systematically reviewed studies comparing supported employment, prevocational training and basic care for people with severe mental illness as ways to improve their labor participation (Crowther et al., 2001). This study suggested that supported employment was a more effective tool to help people with mental illness to be employed than prevocational training.

1.3.4.3. Interventions on healthy behaviors and prevention

Interventions on healthy lifestyle, behavior change and prevention of disease are one of the most common types of interventions aimed at reducing health inequalities in practice because of their nature (Kumar & Preetha, 2012). Generally, health promotion interventions are easier to measure and evaluate, because most of their effects can be seen within shorter period of time as opposed to other socio-economic interventions such as poverty reduction and expansion of education. On the other hand, health related behavior, which is usually the main target of most health promotion interventions, is itself heavily dependent on one's income, education, culture

and other factors (Short & Mollborn, 2015). Therefore, it is important to understand and modify the health behaviors of disadvantaged groups in order to tackle health inequalities.

A total of seven healthy behavior and prevention interventions were identified targeting reducing health inequality. Table 1.3 summarizes healthy behavior and prevention interventions and how these interventions impacted on health inequalities. These studies targeted disease prevention, changing health behavior and reducing health inequality by commonly applying different types of research methods including quasi-experimental trials, randomized controlled trials, before and after studies, time series analysis, etc.

Table 1.3. Summary of interventions on healthy behaviors and prevention

Citation (year) Country of study	Intervention	Targeted population/Health outcome measurement if applicable	Learnings from Study
Canada, (Bastian, Maximova, McGavock, & Veugelers, 2015)	School Health program	School children/Body weight status	School health promotion was effective in increasing physical activity and prevent obesity, especially for the children from disadvantaged population.
Netherlands (De Walle & Van der Pal, 1998)	Mass media campaign on the use of folic acid to reduce the risk of fetal neural tube defects.	Pregnant woman in the Netherlands	Although, low educated woman was benefited from the program, differences in awareness and use of folic acid by level of woman's education remained the same.
Netherlands (Crone et al., 2003)	Antismoking	Adolescents with lower education/ smoking status	This intervention was successful in preventing smoking among adolescents with low education for a short term.
USA, (Pinto, 2010)	Preschool education to low-IQ, disadvantaged African-American children.	Disadvantaged African-American Population/Addictive behavior	Preschool education to disadvantaged children was an effective tool to reduce unhealthy behavior in later-life such as drug and alcohol usage.
Ireland, (O'Neill, McGilloway, Donnelly, Bywater, & Kelly, 2013)	Incredible Years program, improving the skills and parenting strategies of parents of children with conduct problems.	Children between the ages of 3 and 7 years from disadvantaged area/ Mental health	Incredible Years program offered a cost-effective policy option for reducing behavioral problems of children from economically disadvantaged areas.
UK, (Baker & Middleton, 2003)	Cervical cancer screening	Woman aged 35-64 from disadvantaged areas/Screening coverage and cervical cancer incidence and mortality	Increasing coverage of cervical screening in disadvantaged areas reduced incidence and mortality from cervical cancer.
Spain, (Daban et al., 2007)	Preventive practices, such as anti-smoking advice, blood pressure measurement and flu vaccination.	Non-institutionalized residents of the city of Barcelona over 15 years old in the year 2000/Increase in the public health services	Increase in the public health services eliminated inequalities in prevalence of receiving the preventive practices between social class or gender.

Bastian et al. studied impact of health promotion programs on health inequalities (Bastian et al., 2015). This study compared the change in body weight status and physical activity level of school children with and without health promotion programs. Their findings demonstrate that comprehensive school health programs in disadvantaged groups can reduce inequalities in physical activity and prevent obesity. They concluded that investments in school-based health promotion programs have a potential to reduce health inequality. A school based anti-smoking intervention was evaluated by Crone et al. (Crone et al., 2003). They found that education programs leading to healthy lifestyle behavioral changes were effective in the short run. However positive impacts disappeared over time. Therefore, there was no significant effect on reducing health inequality in long run. Daban et al. suggested that increasing public health services reduces the inequalities in receiving the preventive practices, such as anti-smoking advice, blood pressure measurement, and flu vaccination between the social classes or genders (Daban et al., 2007). Baker et al. also found preventive practices such as cervical cancer screening, reduced health inequality gap between wealthiest and poorest groups over time (Baker & Middleton, 2003).

An interesting study by Walle et al. evaluated impact of mass media campaign aimed to promote folic acid among pregnant woman with different education levels (De Walle & Van der Pal, 1998). Results showed that overall usage of folic acid to prevent fetal neural tube defects reduced the incidence of neural tube defects in babies of both low and highly educated woman. However, they did not achieve their main goal of reducing gap between awareness and use of folic acid of low and high educated woman. After the intervention, they found out that the socioeconomic differences still remained.

1.3.4.4. Housing and supportive environment

Shelter and safe living environment are accepted to be one of the main determinants of health (Krieger & Higgins, 2002; Saegert, Klitzman, Freudenberg, Cooperman-Mroczek, & Nassar, 2003; Schmit & Lorant, 2009). Income, education and place of residence and other socioeconomic factors determine one's living conditions such as their housing and environment. Therefore, interventions aimed at improving housing and living environment of disadvantaged populations likely have the potential to reduce health inequalities (Chang et al., 2004; Chaudhuri, 2004; Sanbonmatsu et al., 2011). Intuitively, providing standard housing for the poor takes less time and costs less money than reducing income inequality or expanding educational level of general population. Five studies were identified that evaluated the impact of housing interventions and one that considered the environment, specifically green space, and these are listed in Table 1.4.

Table 1.4. Summary of housing and supportive environment interventions.

Citation (year) Country of study	Intervention	Targeted population/Health outcome measurement if applicable	Learnings from Study
New Zealand, (Howden-Chapman et al., 2007)	Installation of a standard retrofit insulation package.	Seven low income communities in New Zealand/Self-reported health and access to health care	Insulating existing houses resulted healthier indoor environment and it improves self-rated health. This intervention reduced self-reported wheezing, days off school and work, and visits to general practitioners.
UK, (Mitchell & Popham, 2008)	Green space	Population of England at younger than retirement age/ All-cause mortality and mortality from circulatory diseases	Populations that were exposed to the greenest environments had lowest levels of income related health inequality. Physical environments that promote good health might be important to reduce socioeconomic health inequalities.
USA, (Leventhal & Brooks-Gunn, 2003)	Moving to Opportunity for Fair Housing Demonstration program	Families from public housing in high-poverty neighborhoods/Mental health	Moving to low-poverty neighborhood resulted significantly less distress. Also mental health of boys in the intervention significantly improved.
UK, (Gibson, Thomson, Kearns, & Petticrew, 2011)	Scotland's Housing and Regeneration Project (SHARP) for regeneration and relocation to new-build social housing.	Low income groups/Well-being, mental health	Housing and street design had positive impact on mental health and quality of life by altering key psychosocial processes such as control, privacy and sociability.
Scotland (a), (Kearns, Petticrew, Mason, & Whitley) (2006)	SHARP	Low income groups/Well-being, mental health, self-rated health	Self-rated health improved from 26 % to 32 % as tenants reported their general health as 'excellent' or 'very good' after moving to social housing.
Scotland (b), (Ade Kearns, M Petticrew, P Mason, & E Whitley, 2008)	SHARP	Low income groups/Physical health, health behavior	Physical health outcomes and healthy behaviors did not significantly improve for the Intervention Group over time.
Scotland (c), (A Kearns, M Petticrew, P Mason, & E Whitley, 2008)	SHARP	Low income groups/Well-being, mental health	With numbers available, no difference in mental health and well-being was observed between the intervention group and control group.

Howden-Chapman and collegues conducted a cluster-randomized study to evaluate effect of improvement of housing quality on health inequality (Howden-Chapman et al., 2007). The program targeted low-income people with old and poor housing conditions in areas with cold weather and the impact of insulating their houses. Warmer houses led to better health outcomes, such as self-reported wheezing, days off school and work, and visits to general practitioners and fewer hospital admissions for respiratory conditions for disadvantaged group. The authors suggested that the intervention of upgrading insulation in existing homes had the potential to diminish health inequality.

"Moving to Opportunity (MTO) for Fair Housing Demonstration" is a famous program among economists and public health specialists. It was a program of moving low income families with children under 18 years old from public housing in poor neighborhoods to private housing in better neighborhoods. It was launched by the U.S. Department of Housing and Urban Development in Baltimore, Boston, Chicago, Los Angeles, and New York City between 1994-1998 (Sanbonmatsu et al., 2012). The study hypothesis was that moving to better housing and neighborhoods would improve mental and physical health of the disadvantaged population. Leventall et al. tested the hypothesis regarding mental health and found significantly less distress among adults in experimental group than control group (Leventhal & Brooks-Gunn, 2003). They also found a significant reduction of anxiety and depression among boys who moved to private housing compared to the boys in control group. Scotland's Housing and Regeneration Project (SHARP) also showed that better housing had an impact on health and well-being. The program aimed to improve the health and wellbeing of tenants by moving them into social housing to improve their housing and surrounding environment. SHARP provided social houses in 60 sites across Scotland between 2002 and 2008. Several evaluations of the impact of SHARP on health outcomes and well-being of the tenants have been done in different stages of program from 2006 to 2011 using different research methodologies. An impact

evaluation completed by Kearns et al. found significant improvement in self-rated health status but no significant difference in mental health status of experimental groups (Kearns et al.). Their next series of impact evaluation studies were conducted in 2008 and determined the impact of social housing on different health outcomes like mental and physical health, behavior and wellbeing (A Kearns et al., 2008; Ade Kearns et al., 2008). They found that better infrastructure, quality housing and well-planned streets have a significant positive impact on people's mental health but no or little impact on their physical health and health behaviors. In an observational population study Mitchell et al., again from UK, suggested that healthy environments have great potential to reduce health inequalities (Mitchell & Popham, 2008).

1.3.4.5. Access to health care

Inequalities in access to health service and uneven service distribution exist in every country harming the health of disadvantaged populations (Andrulis, 1998; Lasser, Himmelstein, & Woolhandler, 2006). Therefore, equal distribution of health services and equal access to health care are major challenges of public health policy (Fein, 2005). Inequality in access to health care exists for many reasons such as the distance to health care facilities, level of infrastructure, distribution of health care personnel, health care costs and availability of quality and effective treatments, etc. (Mayberry, Nicewander, Qin, & Ballard, 2006; O'Donnell, 2007). Interventions aimed at improving access to health care focused on the above-mentioned factors and were designed to increase access to quality primary care, ensure more even distribution of general practitioners and improve transportation and communication, and many more. The details of these types of interventions are summarized in Table 1.5.

Table 1.5. Summary of access to health care interventions

Citation (year) Country of study	Intervention	Targeted population/Health outcome measurement if applicable	Learnings from Study
Australia, (Korda, Butler, Clements, & Kunitz, 2007)	Universal health care system	Whole population/Non-avoidable mortality rates	Universal health care contributed to decreased absolute socioeconomic non-avoidable mortality but increased relative health inequalities.
21 European countries, (Ozegowski, 2013)	Policy mechanisms in achieving a more equitable geographical distribution of general practitioners including (1) interventions during medical training; (2) financial incentives; (3) quotas to allocate GPs to regions and (4) capitation-based remuneration.	Rural or socially deprived areas /Country-specific equity in the geographic GP distribution served	Quotas based on health care needs to allocate GPs to regions significantly reduced inequality in access to health care. Financial bonuses to GPs working in disadvantaged areas and interventions during medical training had little or no impact.
UK, (Rabinowitz, 1993)	Physician Shortage Area Program (PSAP) in 1974, initiated by the Jefferson Medical College. It combines a selective medical school admissions policy with a special educational program	Rural and underserved areas/ The geographic and specialty choices of more recent graduates	PSAP graduates were 10 times more likely to work in rural or under-served areas.
Australia, (Morell, Kiem, Millsteed, & Pollice, 2014)	Rural health professional program: A case managed recruitment program to improve distribution of health professionals.	Rural and underserved areas/Recruits in rural area	Financial support played an important role for equitable distribution of health professionals. Being domestically trained, having previously lived in a rural or remote area, being a nurse and older age were the variables linked with recruitment in remote area.

Continued

Citation (year) Country of study	Intervention	Targeted population/Health outcome measurement if applicable	Learnings from Study
USA, (Pathman, Konrad, King, Taylor Jr, & Koch, 2004)	Financial support to medical students, residents, and practicing physicians in exchange for a period of service in underserved areas.	Rural and underserved areas/Socioeconomic need of communities and patients served by physicians, programs' participant service completion and retention rates, and physicians' satisfaction levels	Loan repayment and direct financial incentive programs were successful in promoting health professionals to work in underserved location.
USA, (Weinberger, Oddone, & Henderson, 1996)	Increase access to primary care for veterans after discharge from the hospital.	Chronically ill hospitalized patients (veterans)/Hospital readmission, Quality-of-life scores and patient satisfaction	Increase access to primary care for veterans after discharge from the hospital increased rather than decreased the rate of hospital readmission. No effect on quality-of-life scores. However, patient satisfaction increased.

Weinberger et al. studied effects of increasing access to primary care for chronically ill hospitalized patients after discharge on their quality-of-life scores and patient satisfaction outcomes (Weinberger et al., 1996). They found that patient satisfaction improved significantly, but quality-of-life scores did not change after the intervention. Another study from Australia evaluated the impact of universal health care system on health inequality (Korda et al., 2007). It showed that advantaged and disadvantaged groups both benefited from universal health care system, but the health inequality gap between them widened even more.

The remaining studies in this review aimed at improving access to health care by focusing on how to achieve more uniform geographical distribution of general practitioners (Morell et al., 2014; Ozegowski, 2013; Pathman et al., 2004; Rabinowitz, 1993). They used different types of strategies such as selective medical school admissions policy to select more students from rural or disadvantaged areas, training focused on providing care to disadvantaged populations during medical school, financial incentive strategies, quotas to allocate general practitioners to regions and capitation-based compensation. Rabinowitz and Morell found that admitting people to medical school who came from rural areas or had trained in rural areas previously or who had previously worked as a nurse in rural remote area were the most effective strategies. On the other hand, Ozegowski found that these interventions had no impact on increasing general practitioners in remote rural areas (Morell et al., 2014; Ozegowski, 2013; Rabinowitz, 1993). In Ozegowski's study quotas determining the number of general practitioners per region were an effective tool to achieve equitable general practitioner distribution. These studies agreed that remunerating general practitioners through capitation payments was an effective policy mechanism.

1.3.4.6. Education and mixed strategies interventions aimed at reducing health inequalities

Education plays a major role in socioeconomic gradient in health status (Adams, 2002). Less educated people tend to be unhealthier than well-educated counterparts (Arendt, 2005; Statistics, 2012).

Recently Arroyave et al. studied the contribution of specific causes of disparities in adult premature mortality (ages 25-64) by educational level from 1998 to 2007 in Colombia. They found that adults with primary education had higher premature mortality rates than adults with post-secondary education. Over the 9-year study period mortality rates declined in all educational groups but decreases in mortality were significantly greater for higher-educated men and women (Arroyave, Burdorf, Cardona, & Avendano, 2014).

Less education means fewer opportunities to earn a high income and being in a low social class (Damaske & Frech, 2016; McGinn & Oh, 2017). One study showed that young men belonging to a low social class with no education during have greater risk of dying prematurely (Arendt, 2005). Among causes of death, death from cardiovascular disease the strongest relationship with level of education. Therefore, an important component of interventions aimed at reducing health inequalities was health education of the targeted disadvantaged population (Jayasinghe, 2015). Two articles on effectiveness of health education interventions on health were identified and both of them were found to be effective. Table 1.6 summarizes education and mixed strategy interventions

Table 1.6. Summary of education and mixed strategies interventions

Citation (year) Country of study	Intervention	Targeted population/Health outcome measurement if applicable	Learnings from Study
France, (Etilé, 2014)	Educational expansion policies	Less educated population/BMI	Educational expansion intervention significantly reduced inequality in BMI.
18 European countries, (Östergren et al., 2017)	Educational expansion	General population/ Mortality	Level of education was associated with mortality inequality.
USA, (Fryer Jr & Katz, 2013)	The Moving to Opportunity and investments in school quality	Low-income students growing up in high-poverty neighborhoods/Reducing risky behaviors and mental health	Investments in school quality were effective for reducing risky behaviors. MTO program reduced mental and physical health inequalities.

Etile et al. examined the contribution of changes in education to BMI reduction in low-income French adults between 1981 and 2003 (Etilé, 2014). They found that expansion of educational opportunities reduced the body mass index of those with low income.

A recent study by Östergren et al. suggested that education expansion widened educational inequalities in mortality rate because the disadvantaged populations utilized the expanded educational opportunities proportionately less (Östergren et al., 2017). One intervention that used a mixed strategy was called "Moving to Opportunity" in which a group was moved to improved housing with better educational opportunities (Fryer Jr & Katz, 2013). It was a randomized controlled trial targeting students from poor families raised in poor neighborhoods. Its results suggest that investments to improve school quality are a very effective way to promote healthy lifestyle and reduce socioeconomic inequalities.

1.3.4.7. Overall success of the interventions

Table 1.7 summarizes the overall success of interventions on health inequalities based on their strategies. Most interventions (19 out of 26) were successful in achieving their goal of reducing health inequalities.

Table 0.7. Summary of overall success of the interventions by its type

Type of intervention	Number of identified interventions	Impact on health inequality	Overall success (yes/partly/no)
Healthy behaviors and prevention	7	Yes – 6 Partly - 1	Yes
Access to health care	6	Yes – 4 Partly – 1 No - 1	Yes
Housing	7	Yes – 4 Partly – 1 No - 2	Yes
Education	2	Yes - 2	Yes
Mixed strategies	1	Yes - 1	Yes
Poverty reduction and labor participation interventions	3	Yes -1 Unclear - 2	Unclear
Total	26	Yes – 19 Partly – 3 No – 3 Unclear-2	

1.4. DISCUSSION AND CONCLUSIONS

The purpose of this literature review was to evaluate the effectiveness of different types of interventions aimed at reducing socioeconomic health inequalities. The main challenge of this literature review was the scarcity of evidence of effectiveness of interventions targeted at reducing health inequalities published in peer reviewed scientific journals. Articles related to impact of public policies and interventions mainly concentrated on evaluating the impact on health outcomes of the general population, not how the interventions impacted on different socioeconomic groups and health inequalities.

This lack of evidence limits the ability to achieve the initial purpose of this study, which was to suggest appropriate evidence-based policy interventions to tackle health inequalities in developing countries. This lack of evidence is the main weakness of this study. The evidence for the effectiveness of a certain type of intervention and policy based was often nonexistent or inadequate. For instance, the overall success of poverty reduction and labor participation interventions was based on only 3 interventions available in the literature.

Evidence of impact of public policies and interventions aimed at reducing health inequalities comes in many different forms, often overlapping, making them difficult to isolate and categorize. Whitehead suggested four main types of actions to reduce health inequalities, such as strengthening individuals and communities, improving living and working conditions and promoting healthy macro-policies. Pons-Vigués et al. divided interventions into certain types, including promotion health behaviors, healthy settings, SES context, physical context and combined approach (Pons-Vigués et al., 2014; Whitehead, 2007). Similar to Pons-Vigués et al. approach, but in a more focused way, interventions in this study were classified into six types including poverty reduction and labor participation, healthy behavior and prevention, housing

and supportive environment, and access to health care, education and mixed strategy interventions.

In terms of success, most interventions achieved their initial goal of reducing health inequalities. Although many believe that income and housing are among key determinants of health, interventions based on these two determinants are not always successful in reducing of health inequality. Food subsidy non-cash programs significantly improve quantity and quality of food of targeted disadvantaged population. Intuitively these types of programs will improve health outcome of disadvantaged groups and reduce health inequalities. However, none of the included studies provided clear evidence that they reduced socio-economic health inequalities. Further studies should focus not only how poverty reduction interventions improve access to quantity and quality of food, but also their measurable impact on health outcomes. The true impact of such social policy interventions may only be demonstrated in the long run.

Interventions based on education are one of the main approaches to tackle inequalities in health. This study suggests that improvement and equal distribution of education decreases health inequality.

Effectiveness of interventions to reduce inequality in access to health care is of major interest to researchers and policy makers. Interventions to improve access to health care showed that universal health care system and increased access to primary health care have no impact on reduction of health inequality or were inconclusive. This result is line with findings of Bambra et al. (Bambra et al., 2009). On the other hand, policy interventions to achieve more even geographical distribution of health professionals showed promising results. Quotas to allocate, financial support and specifically train and incentivize medical students, residents, and practicing physicians to work in disadvantaged areas significantly improved the distribution of

health professionals (Morell et al., 2014; Ozegowski, 2013; Pathman et al., 2004; Rabinowitz, 1993).

Studies promoting healthy behaviors and prevention, such as school-based health education teaching socially disadvantaged children to change their health-related behavior, showed the most positive results. Preschool and school health programs targeted at disadvantaged groups increased their physical activity and prevented obesity (Mayberry et al., 2006). It also reduced unhealthy behavior in later-life such as drug and alcohol usage and behavioral problems (Pinto, 2010). Prevention strategies and mass media health campaigns elevated awareness and reduced incidence and mortality in disadvantaged areas (De Walle & Van der Pal, 1998).

These results indicate that when policy-makers and local stakeholders intervene to overcome health inequalities, they should develop programs based on healthy lifestyle and behaviors, better housing and safe environment, and to evenly distribute access to health care.

Future studies of public policy interventions to reduce inequality in food, housing, and education should also focus on the direct impact of these inventions on health and their impact on tackling health inequalities. For instance, it is not only important to examine how food subsidy programs improve quantity and quality of food of low income pregnant and breast-feeding mothers and children, but also it is important to study if the improved nutrition measurably improved the recipient's health. Further health-related impact evaluation studies are also needed, particularly on the long-term effect of poverty reduction and housing interventions.

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CHAPTER TWO: CHILD HEALTH AND HEALTH INTERVENTION COVERAGE IN LOW- AND MIDDLE- INCOME COUNTRIES: AN PANEL ANALYSIS ON HEALTH INEQUITY

2.1. BACKGROUND

Globally 15 000 children die every day before their fifth birthday in 2016 (WHO, 2016). More than half of these child deaths in developing countries are due to conditions that could be prevented or treated with access to simple and affordable interventions (WHO, 2018).

Almost 99 percent of child death occur in low income and middle income countries (Andrews, Brouillette, & Brouillette, 2008). Therefore, one of the ambitious health-related targets of Millennium Development Goal (MDG) was to reduce under-five mortality rate (U5MR) by two-thirds between 1990 and 2015. Later in 2005, fifteen years after initiation of MDG, World Health Assembly called for "countries to plan for the transition to universal health coverage (UHC)" (WHO, 2005). After the MDG era, sustainable development goals (SDGs) defined UHC as one of its main targets (WHO, 2015).

Since signing up the MGD in 1990, countries made an enormous effort to scale-up maternal and child health intervention coverage to eliminate preventable child deaths and improve health equity. As a result, skilled birth attendants in deliveries rose by 12 percent, antenatal care visits during pregnancy increased by 15 percent, measles vaccination coverage rose by 12 percent between 1990 and 2012, globally (Lomazzi, Borisch, & Laaser, 2014). Child mortality fell by 53 % during the MDG era, but this achievement was not enough to meet the MGD target to reduce child mortality by two thirds. Moreover, inequality in child mortality remains high, child mortality among the poor is 1.5–2.5 times higher than the rich (WHO, 2010).

After taking global actions to achieve health related MDGs and SDGs, there is a rising interest in the recent literature to explore the effect of scaling-up the maternal and child health intervention coverage towards UHC in reducing child mortality and improving health equity.

However, surprisingly little attention has received about effect of inequality in intervention coverage on inequality in health outcome.

To fill the gap, this chapter aims to examine the effect of expansion of essential maternal and child health intervention coverage on reducing child mortality and improving health equity, using longitudinal cross-country data from the low and middle income countries.

To our knowledge, this is the first attempt to examine relationship between inequality in intervention coverage and inequality in child health outcome over time and accross low and middle countries.

This chapter consists of six main sections. The first section presents an overview of the evidence of effectiveness of maternal and child health interventions in reducing child mortality and improving health equity in resource poor settings. The second section discuses data and methodology used in this study, the third section presents the descriptive analysis of level and trends of health inequalities in health care coverage and inequalities of child mortality in included countries. The fourth section examines the link between child mortality rate and inequality in child health intervention coverage. The fifth section discusses the effect of inequalities in intervention coverage on level and equity of child mortality. The last section concludes the result of this study.

2.2. LITERATURE REVIEW: EFFECT OF MATERNAL AND CHILD HEALTH INTERVENTIONS ON CHILD MORTALITY AND HEALTH EQUITY IN RESOURCE POOR SETTINGS

Backgraound

Low- and middle income countries failed to achieve MGD4 to reduce child mortality by two thirds in 2015. And inequality in intervention coverage and health outcome remained high (WHO, 2015).

As we discussed in the first chapter, child health and health inequality determined by a set of complex socioeconomic, individual and biological factors, such as income, education and literacy, employment and working environment, geographical area and ethnicity (Adler & Newman, 2002). Before the MDGs and SDGs, literature in this area mainly focused on above-mentioned factors. But after taking global actions to achieve MDG4 and transaction to UHC, there is a rising interest in the recent literature to explore the effect of scaling-up the maternal and child health intervention coverage towards UHC in reducing child mortality and improving health equity.

"No one must be left behind" (Olaiya, 2016) is the main target of UHC and one of the main outcomes of UHC is equitable health outcomes and wellbeing (WHO, 2015). Therefore, researchers and stakeholders are increasingly interested in whether the disadvantaged population of the poorest countries benefiting from the expansion of effective interventions.

We aimed to summarize the evidence of effects of the scaling-up maternal and child health interventions on child mortality and inequality in child mortality by reviewing recent literature in low- and middle income countries.

Search strategy

Key databases were searched including EBSCO, PubMed, JSTOR, Cochrane library of databases and DHS publications and CountDown to 2015 and 2030 publications. The search was limited to articles in the English language, published from 2000 to recent. The following keywords were searched under two main headings: maternal and child health intervention coverage (expansion or scale-up coverage, effect/impact of coverage, inequality in coverage, SES, income, wealth) and inequality in health outcome (infant mortality, neonatal mortality, child mortality, inequality in child mortality, rate ratio, rate difference, slope index of inequality, concentration index).

Inclusion and exclusion criteria

A study was included, if it evaluated the impact of maternal and child health interventions on child health outcome or inequality in child health outcome or both, published in the peer-reviewed international academic journal in the English language.

Papers measured magnitude and trends of inequality in coverage or health outcome, descriptive or theoretical discussions, papers with only abstract available and no specific focus on health inequality in coverage or health outcome were excluded from this review.

Results

The search identified 3700 articles about maternal and child health intervention coverage, child health outcome and health inequality. Title screening was done from the whole list of identified articles and duplications were removed. After applying the inclusion and exclusion criteria, we reviewed 22 peer-reviewed and published articles in detail.

Effect of intervention coverage on child health outcome

The primary interest of researchers and policymakers about the UHC would be whether the actions and affords towards UCH help to improve health outcomes. We reviewed studies evaluated the effect of scale-up maternal and child health interventions on child health outcomes (Summary of included articles is available in Appendix 2.9).

We identified six cross country studies evaluated the effect of maternal and child health interventions on child health outcomes. From 35 to 98 low- and middle-income countries in Latin America, Asia, and Africa were studied. Intervention types in these studies range from eight to eighteen maternal, neonatal, child health interventions, environmental and nutritional interventions. Two studies summarized overall intervention coverage by composite coverage index. We have found four country-specific studies from Guinea, Madagascar, Brazil, and Cuba in this area.

The results of cross-country studies suggest that there is a strong negative relationship between coverage and child mortality. Corsi & Subramanian studied the association between maternal and child health intervention coverage and child mortality using data from 81 Demographic and Health Surveys from 35 sub-Saharan African countries. Results of ecological time-series and child-level regression model indicated that a unit increase in CCI was associated with an odds ratio of 0.86 for child mortality (95% CI: 0.82-0.90) (Corsi & Subramanian, 2014). Another cross-country

analysis covered sub-Saharan and South Asian region provided more evidence that an expansion of 16 maternal and child health intervention to 90 % could save 0.59-1.08 million lives in South Asia and 0.45-0.80 million lives in sub-Saharan Africa annually.

Aquino and colleague estimated the impact of the family health program to improve delivery of maternal and child health care services on infant and child mortality rate. They found a significant negative relationship between family health program and infant mortality rate. The results suggested that infant mortality rate reduces by 13-22 % if coverage reaches to certain levels. Moreover, the effect was stronger in lower human development index group (Aquino, de Oliveira, & Barreto, 2009). More evidence provided by a Cuban study (Mercer, Khan, Daulatuzzaman, & Reid, 2004) on family health care also suggested that improvement of family health care contributed to reducing infant mortality rate by 40 percent.

A contradictory result to the above-mentioned study is found from a country-specific analysis of Guinea (Greenwell & Winner, 2014), which showed that delivery care did not contribute to the reduction of neonatal survival, also prenatal care has no effect on infant survival. However, delivery care and postnatal care was related to better survival outcomes for infants. The authors concluded that infant survival improves in the later months of the first year of life.

A set of studies can be found in the recent literature using the Lives Saved Tool (LiST) to examine the impact of inequality in health coverage on child mortality. The LiST is a computer-based software developed by the Johns Hopkins Bloomberg School of Public Health to estimate the number of deaths that can be averted as a result of the expansion of effective maternal and child health interventions in low- and middle-income countries (Winfrey, McKinnon, & Stover, 2011).

A study (Clermont, 2017) evaluated the impact of within-country inequality in health care coverage on child mortality using data from 98 developing countries. The result showed that

expanding essential health interventions to the level of the top wealth quintile averts 24–32% of child deaths. Another study used LiST (Friberg et al., 2010), estimated that if intervention coverage scaled-up to the global goal of 90 %, lives of four million woman and children would be saved per year in 42 sub-Saharan Africa.

A longitudinal cohort study in Madagascar (Garchitorena et al., 2018), estimated the effect of both maternal, newborn and child health (MNCH) coverage, healthcare inequalities on child mortality rate. CCI increased by 30.1 % and this improvement resulted in the reduction of under-five and neonatal mortality 19.1% and 36.4%, respectively. Generally, SII of coverage reduced, but both SSI and CIX for care-seeking behaviors for ARI or ANC (4+ visits) were increased. Although the authors reported the inequalities in coverage in intervention and other areas, we didn't find specific results related to inequality in coverage and child mortality.

Results of both country level and multi-country studies indicated that the improvement of maternal and child health intervention coverage significantly contributed to the reduction of child mortality.

Effect of intervention coverage on inequality in child health outcome

The next group of studies (appendix 2.10) provides evidence of the effectiveness of scaling-up maternal and child health intervention coverage on inequality in child mortality rate.

Previous studies evaluated the effect of coverage on child mortality consentaneously pointed out that maternal and child health intervention coverage increased in all studied countries and it resulted in improvement in child health outcome. However, inequality in coverage remains high (Barros et al., 2012; Barros & Victora, 2013; Victora et al., 2012) in developing countries, and it may have a harmful effect on child health and health equity.

A cross-country evidence (Bhutta et al., 2013) suggested that if coverage increases at present rate in all studied countries, it could save 54% of diarrhea and 51% of pneumonia deaths by 2025 by

using LiST. Effect of the interventions was greatest in the poorest quintiles, which reduces inequality in child mortality. However, the authors did not discuss how much reduction in inequality in child mortality in detail.

Another study also used LiST to estimate the effect of the expansion of coverage on child mortality rate and life expectancy at birth. This Ethiopian study proposed three scenarios of scaling-up interventions, such as government target levels, 90% coverage and 90% coverage of the five interventions (institutional delivery care, ORS, seeking treatment for ARS, breastfeeding, case management of severe neonatal infection) with the highest impact. The results showed that U5MR reduces from 101.0 in 2011 to 68.8, 42.1 and 56.7 per 1000 live births under these three scenarios and reduce inequality in the age of death (Onarheim et al., 2012). The result suggested that prioritizing high impact interventions promotes improving child health.

Bishaia and colleagues evaluated the impact of measles vaccination coverage on inequality in U5MR using data from Bangladesh (Bishai, Suzuki, McQuestion, Chakraborty, & Koenig, 2002). The authors concluded that measles vaccination lowers child mortality and reduces inequality in child mortality. A case-control study also from Bangladesh showed that improved antenatal care and family planning contribute to reduce neonatal mortality, and poor benefits more from the intervention.

More evidences from China (Zeng, Yan, Cheng, & Dibley, 2011), Tanzania (Ruhago, Ngalesoni, & Norheim, 2012), Afghanistan (Akseer et al., 2016), Colombia (Mosquera et al., 2012) and Bangladesh (Mercer et al., 2004) suggested that improvement of various maternal and child health interventions significantly reduce child mortality and improve equity in health outcome.

Evidence from Brazil (Victora, Vaughan, Barros, Silva, & Tomasi, 2000) and Thailand (Limwattananon, Tangcharoensathien, & Prakongsai, 2010) showed that equitable intervention

coverage improves child health, but equitable coverage has no effect on inequality in child health outcome.

In conclusion, the transaction to universal health coverage positively impacted on child health outcome and equity in child health in low- and middle-income countries. Countries must continue to make efforts to scale-up the essential maternal and child health interventions in order to achieve greater health outcomes and health equity.

Limitation of the review and suggestions for future studies

The main limitation of this review is it focused only on maternal and child health interventions and child health outcome, while there are many types of interventions implemented to improve child health in developing countries, such as cash transfer for the poor, expansion of community and traditional health workers to the villages, woman improvement interventions and many more.

The main interest of this study was to document evidence of the effect of inequality in coverage on inequality in child health outcome. However, the majority of included studies that evaluated the impact of the expansion of maternal and child health intervention coverage on child mortality did not use proper inequality measurements to quantify the effects. Conclusions that coverage or equity in coverage contributed to reducing inequality in child health outcome was drawn from the results that indicated the poor or disadvantaged populations benefited more from the interventions and child mortality is reduced more in poorest population.

To fill this gap, future studies should measure both inequalities in coverage and inequality in health outcome, using appropriate measurements of inequality, that captures true differences between different groups of the society. Moreover, we have identified that the evidence base on the effect of inequality in intervention coverage on inequality in health outcome is rare in the resource-poor

settings. Future studies in this area will greatly contribute to shaping effective health policies to improve health and health equity in low- and middle-income countries.

2.3. DATA AND METHODOLOGY

2.3.1. Data sources and panel constriction

This study used data from Demographic and Health Surveys (DHS) Program (USAID), Multiple Indicator Cluster Survey (MICS) (UNISEF), WHO equity database (WHO), Countdown to 2015 and 2030 data (International Center for Equity in Health, Pelotas, Brazil) and the DataBank from the World Bank (WB), which are all publicly available databases. In many developing countries, their health information and registration system may not be well developed, therefore data is often considered not reliable and accurate. Well-designed household survey could generate reliable data source in developing world. DHS and MICS are the most accurate, nationally representative and internationally comparable databases of the developing world, which contains more than 600 surveys in over 100 countries in total. Indicators of these databases DHS and MICS collects data on fertility, reproductive health, maternal and child health, mortality, nutrition and anthropometry measures of children and mothers, since 1984 (DHS) and 1996 (MICS).

DHS and MICS provide disaggregated information on access to health care and health status by socioeconomic situation of the woman and children that allows deeper equity analysis of the data. Also its repeated cross-sectional designs in countries with multiple survey waves allow examining complex causal relationships between socioeconomic variables and health across countries and over time. The weakness of DHS and MICS is it's conducted independently within each countries, which means observations of most of the countries conducting DHS and MICS are not measured at the same time, limiting the concurrent cross-country comparisons. Overcoming this weakness is discussed in later in this section in detail.

Information on eight health interventions those scientifically proven to have significant impact on children's health, such as various vaccinations, treatment of sick child and interventions during

pregnancy and at delivery coverage, disaggregated by five household wealth quintiles are used in this study. Under-five mortality rate and concentration index of U5MR are chosen for key health outcomes of child health interventions. Data for some of the control variables, such as woman with secondary or higher level of education is also collected from the DHS database.

For the other control variables, GDP per capita and Health Expenditure per capita, Out of Pocket Payments (OOPs) as a percentage of countries total health expenditure, unemployment rate and the percentage of urban population is collected from DataDank dataset.

Absolute health inequality measures, based on distribution of household wealth are calculated for key maternal and child health interventions as well as health outcome variable. Composite Coverage Index (CCI), a summary measure of overall coverage and its CIX were available in WHO equity database. Computation of CIX and CCI is discussed in in detail in Methodology part of this chapter.

We aimed at constructing a survey-round specific panel. The lowest unit of our analysis is a survey-rounds nested in the countries. The advantage of having an panel data structure for this study is first, it enables to examine the trend and impact of change in inequality in intervention coverage on change on inequality in child health outcome over time. Second, it provides more information, lager sample size that will result more reliable estimations than cross-sectional data. Third, panel data set allows to apply "more sophisticated behavioral models with less restrictive assumptions" (Baltagi 2006). We followed Boerma's approach to include countries with two or more survyes in this study (Boerma, 2008).

As a result, total of 54 countries identified having more than two survey-rounds, covering 167 surveys (164 nationally representative surveys from DHS and 3 MICS surveys) since 1993 (See Appendix 1). The surveys conducted before 1993 are excluded from this analysis, due to

availability of disaggregated data qualified for CIX calculation or missing information of variable of interest. On average, the time difference between two surveys was 12.3 years and maximum time difference between first and the last survey was 20 years and minimum was 3 years respectively. The time of panel is in years (survey-rounds) nested in countries, from 1993 to 2014, but with gaps. Time periods of the DHS and MICS are not consistent within and between countries. For example, Philippines have 5 DHS waves; the first DHS is conducted in 1993 and the other 4 surveys are done in every five years in 1998, 2003, 2008 and 2013 respectively. And Jordan also has five DHS from 1990, but did not maintain the five year gap between surveys all the time. For instance the second survey is done after 7 years in 1997; the last survey is conducted only after two years of the fourth round in 2009. Because each country conducted their DHS independently in different years with irregular waves depending on countries need, as a result the time dimension of the panel become specific to each country. Therefore group sizes differ across each group. The minimum observation for a country is two and maximum was six in our panel. Total of 18 countries absorbed for two times, 19 countries absorbed for three times, 13 countries observed for four times, three countries for five times and one country observed for six times respectively.

Having 2-6 observations per country in different time periods makes panel data largely unbalanced. In unbalanced panel T (time) differs among countries and is replaced by Ti (Kunst 2010). This type of unbalanced panels can occur frequently specially in economic empirical settings. Empirical strategies to deal with unbalanced panel data and their treatment issues are discussed in several econometrics books and literature (Greene 2003), (Baltagi 2006), (Erik, 1999), (Kwak 2011), (Bontempi 2015) and (Andrew, 2015), they suggest that the having an unbalanced panel does not necessarily a limitation, since empirical strategies to deal with unbalance data are developed.

There are several approaches to deal with unbalanced panel. We refer to W.H.Greene's fixed effects approach for unbalanced panel (Greene 2003), p.293).

Let's consider the general form of following fixed effects model.

$$\boldsymbol{y_{it} = \alpha \quad + X_{it}\beta + u_{it}\ , i = 1, \dots, n} \text{ and t=1,..,Ti}$$

Where:

y_{it}-Outcome variable

X_{it}-Repressor

u_{it}-Error term, $u_{it} = \alpha_i + \varepsilon_{it}$, where α_i-is unobservable time-invariant country specific effect, and ε_{it} –remainder disturbance which is assumed to be IDD $(0, \delta_v^2)$. Both of them are assumed to be independent of each other and among themselves.

The proceeding analysis of this model assumed equal group sizes and a modification to allow unequal group sizes is simple. The full sample size is nT in balanced panel, in unbalanced panel case it is $\Sigma_{i=1}^{n} T_i$. It requires following modifications:

In unbalanced panel Ti is different for each group; therefore group means must be based on Ti. The overall means for the independent variables in unbalanced panel are:

$$\bar{\bar{x}} = \frac{\sum_{i=1}^{n}\sum_{t=1}^{T_i} x_{it}}{\sum_{i=1}^{n} T_i} = \frac{\sum_{t=1}^{n} T_i \bar{x}_i}{\sum_{i=1}^{n} T_i} = \sum_{i=1}^{n} f_i \bar{x}_i$$

Where $f_i = T_i/(\sum_{t=1}^{n} T_i)$. For the balanced panel case $f_i = (1/n)$.

Within groups moments are computed using following formula's for unbalanced data.

$S_{xx}^{within} = \sum_{i=1}^{n}(\sum_{i=1}^{T}(x_{it} - \bar{x}_{i.})(x_{it} - \bar{x}_{i.})')$ where $S_{xx}^{within} = \sum_{i=1}^{n}\sum_{i=1}^{T}(x_{it} - \bar{x}_{i.})(x_{it} - \bar{x}_{i.})'$ in balanced panel. For other moments are modified likewise as follows:

$$S_{xy}^{within} = \sum_{i=1}^{n}\left(\sum_{i=1}^{T}(x_{it} - \bar{x}_{i.})(y_{it} - \bar{y}_{i.})\right)$$

$$S_{yy}^{within} = \sum_{i=1}^{n} \left(\sum_{i=1}^{T} (y_{it} - \bar{y}_{i.})(y_{it} - \bar{y}_{i.})' \right)$$

No other modifications are necessary for one way LSDV estimator (Greene, 2003). Further the within group estimator is computed as:

$$b^{within} = \left[S_{xx}^{within} \right]^{-1} S_{xy}^{within}$$

b is BLUE, if the variance component δ_{μ}^{2} is equal to zero. If it is positive, OLS is still unbiased and consistent, but its standard errors are biased (Baltagi 2005).

Kwak (Kwak 2011) discussed an important assumption about source of missing data, proposed empirical techniques to deal with unbalanced panel with non-randomly missing.

To deal with unbalanced data, it is important to distinguish source of missing data. We can apply standard panel methods on unbalanced data when Missing Completely at Random (MCAR) assumption is satisfied. Under MCAR panel methods is valid and the resulting estimation is consistent and unbiased. MCAR means that missing is not correlated with any other variables. MCAR assumption is violated if there is differential missing (i.e. systematically different counterfactual response variable across covariates for missing units) in the data, which bias of estimates. The strategies to eliminate bias from differential missing are discussed in detail elsewhere (Kwak 2011).

In our case MCAT is not violated. As discussed earlier countries included in this study conducted their DHS and MICS independently within the country, therefore absence of missing observations in this panel can be considered as missing completely at random, which means “missing is not correlated with any other variables” (Kwak 2011).

2.3.2. The measurement of health inequality

Many health inequality measurements developed and used to explore disparities in health care and health outcome of the population for decades. Trends of using particular measures changed time to time, from simple and straightforward measures to more advanced and complex measures. Generally, simple measurements compare utilization of health carer or health outcomes between two groups and complex measures assess health inequality in multiple groups. Each of the health inequality measurements has their own strengths and weaknesses in terms of capturing true differences between different groups of the society. Therefore it's important to choose appropriate methods of measurement for the specific study depending on its purpose, since selection of measurements substantially impact on magnitude of health inequalities.

There are number of critical reviews, comparisons and evaluations of health inequality measurements in the literature (Atkinson 1970; Sen, 1973; Cowell, 1977; Wagstaff, Paci et al. 1991; Gakidou and King 2002; Mackenbach, Kunst et al., 1997; Gakidou, Murray et al. 2000; Carr-Hill, Chalmers-Dixon et al. 2005, Kjellsson, Gerdtham et al. 2015; Harper and Lynch 2006; De Maio, 2007; Spinakis, Anastasiou et al., 2011; Bartley, 2016). Based on the literature we demonstrated the basic techniques to calculate the main measurements of health inequalities used in this study and explored its advantage and disadvantages in certain circumstances.

In general, health inequality measurements may categorized into three main groups, which are simple, regression based and complex measurements.

Simple measurements are relatively easy and straightforward to calculate and interpret. It includes commonly used measures in the analysis of health inequality such as rate difference and rate (Wagstaff, 1991) ratio. It makes pairwise comparisons of health indicators between two socioeconomic groups.

Regression based health inequality measures are used to analyze the association between socioeconomic status and health indicators. Slope index of inequality and relative index of inequality are the most commonly used regression based measures in health inequality analysis.

Concentration Index (CIX), Atkinson's Index, Thiel Index and Mean Log Deviation are the examples of complex health inequality measures that reflects socioeconomic dimension to health inequalities.

Each measurement of health inequality has its advantage and disadvantages. For example, simple measures are easy to calculate, easy to interperet, and it disctribes the main differences in health indicators instanly. However, simple measurements ignore the information about other socioeconomic groups, as it calculates difference between only two social groups, such as rich and poor, educated and uneducated etc. While the Lorenz curve and Gini coeffiecent measures health inequality using data from all groups, but fails to reflect the socioeconomic dimention to disparities in health (Wagstaff, 1991).

We used following criterias to select a valid and reliable health inequality measure for our analysis:

Simplicity: It does not mean that a health inequality measure should be easy to calculate or does not require a complex dataset. Simplicity means that a health inequality measure should be easy to interpret and readily understood by non-technical audiences such as policy makers and other stakeholders.

Use of all socioeconomic groups: A health inequality measure should consider all socioeconomic groups. Some health inequality measures only take into account to top or bottom groups and ignore middle groups. This case there is no way to know whether inequality is reduced or increased over time from bottom group to middle group.

Visaulation: Visuaization of a measure is one of the main ways to present the presence of health inequality to the audience.

Decomposability: It would be a great advantage that if a health inequality index measures magnitude of health inequality as well as decompose them into their sources, such as income and education etc.

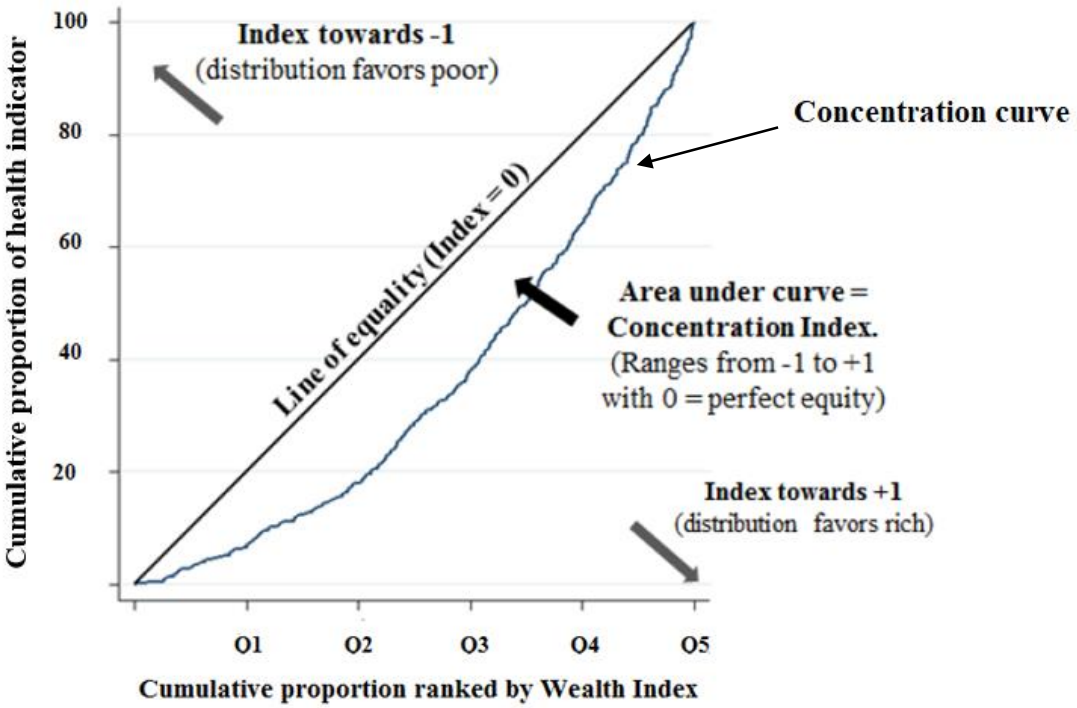
Independency: Change in income or size of population should not affect the health inequality measure (Dalton, 1920; Litchfield, 1999; Wagstaff, 1991).

Based on above properties and comparing advantages and disadvantages of health inequality measurements, we selected Concentration Index (CIX) as a absolute measure of health inequality among the complex measures. Also its used widely in the international literature, which allows us to compare and cross validate our results with other studies.

CIX is a measure of the covariance between of ranked income groups and coverage, and is derived by plotting the cumulative share of the population, ranked by income, against the cumulative amount of the mean level of intervention coverage. DHS and MICS constructed Wealth Index as proxy for income of households. It is difficult to measure income in developing world as source of income comes in different forms such as agriculture product etc. The wealth index is computed using easy-to-collect data on current household assets and access to electricity and sanitation facilities. After constructing the wealth index, survied households are grouped into five wealth quintiles, from poorest to the richest. Data on child mortality and intervention coverage are disaggregated by the five wealth quintiles to capture income dimension to inequalities in health.

CIX could be visualized by the following graphical analogy (Figure 2.1.) to illustrate the presence of inequality in maternal and child intervention coverage, as well as inequality in child mortality.

Figure 2.1. Graphical illustration of Concentration Index



Note: Q1-the poorest wealth quentie, Q2-poorer, Q3-middle, Q4 richer and Q5 is the richest wealth quintile.

Source: www.worldbank.org/analyzinghealthequity

Population is ranked by their wealth index, beginning with the poorest (Q1) and ending with the richest in the figure 2.1. Concentration curve plots the cumalitive portpotion of the population against cumulitaive proportion of the health indicator. Health indictor on the vertical axes could be illness, mortality, access to health care and many more. In our case, it is the child mortality rate and health intervention coverage. On the line of inequality everyone enjoys the same health care coverage or child mortality rate is the same for everyone with different weath. If health care coverage favors more the rich, the concentration curve lies below the line of equality. If child mortality is more concentrated in the poorer wealth qeuntiles, the concentration curve lies above the line of inequality. Wider the area between line of equality and concentration curve, greater the health inequality.

The Concentarion Index denoted as CIX is simply twice the area between line of equality and concentration curve, computed by the following formula:

$$CI = \frac{2}{\mu}\left[\sum_{j-1}^{J} p_j \mu_j R_j\right] - 1$$

where $p_j$is the group's population share, μ_j is the group's mean coverage, and R_j is the relative rank of the $_j$ th wealth quintile which is defined as:

$$R_j = \sum_{j-1}^{J} p_y - \frac{1}{2} P_j$$

where p_y is the cumulative share of the population up to and including wealth quintile j and p_j is the share of the population in quintile j. R_j indicates the cumulative share of the population up to the midpoint of each group interval. One of the reasons the CIX is favored by researchers is that it reflects the socioeconomic dimension to inequalities in health, a downward health gradient results in a positive CIX, whereas an upward health gradient results in a negative CIX as shown in the Figure 2.1. The reason we choose the CIX is that it is sensitive to the direction of the socioeconomic gradient, uses information on all wealth quintiles. It is also decomposable into between group disparities and within group differences. In addition to these advantages it has a strong graphical analogue to visualize the health inequalities among wealth quintiles and over time as we mentioned earlier. The disadvantage of CIX is it may report no differences when populations in middle wealth quintiles are disproportionally affected.

Choice of health inequality measurement depends on type of inequalities, data, research hypothesis and many more. In general CIX appears to be the most appropriate measurement of health inequalities for our analysis of low- and middle income countries, since large and comparable household databases available such as DHS and MICS.

2.3.3. Methodology

This is a longitudinal cross study including 54 low and middle income countries and 167 survey-rounds. List of low-, lower middle income, and middle income countries by World Bank income classification included in this study can be found in Appendix 2.

A national representative sample size was achieved in each country using two-stage cluster sampling design. DHS and MISC uses standardized model questionnaires, which are comparable with one another, manuals (sampling, household listing, survey organization, interviewer's manual etc.) and field procedures under supervision of USAID and UNISEF, which makes DHS and MICS comparable within and between countries over time.

Wealth index is used as a proxy of the household income in included countries, where income and household expenditure data is not readily available and reliable, also difficult to estimate. DHS and MICS constructed wealth index with collaboration with World Bank in purpose of identifying poor households and evaluate how poor have access to globally recommended interventions. The wealth index is constructed based on household owned durable assets, materials used for root, floor and walls of the house and access to electricity, water and sanitation facilities. Interviewed households are assigned a standardized score for each asset and scores are summed by household. Then survey respondents are ranked by the asset score of their household and equally divided into five quintiles, such aspoorest, second, third, fourth and the highest.

CIX of U5MR and and CIX of various health intervention coverage is computed based on the wealth quintiles, as we discussed earlier in the choice of inequality measurement.

2.3.3.1. Model specification

The following general model is employed for assessing the relationship between child mortality and inequality of access to maternal and child health interventions.

$$U5MR_{it} = \beta_0 + \beta_1 CIX_{cov_{it}} + \beta_2 X_{it} + \alpha_i + \varepsilon_{it} \quad (1)$$

Where $U5MR_{it}$ - is the child mortality rate of country i at survey-round t. $CIX_{cov_{it}}$ - is Concentration Index of Composite Coverage Index. X_{it}- is a vector of confounding socioeconomic factors. α_i-is unobservable time-invariant country specific effect, and ε_{it} –is an time-varying error term. The coefficient β_1 captures the effect of inequality in intervention coverage on inequality in child mortality over time.

The relationship between inequality of access to health interventions and inequality of health outcomes is estimated using the below model:

$$CI_{U5MR_{it}} = \beta_0 + \beta_1 CIX_{cov_{it}} + \beta_2 X_{it} + \alpha_i + \varepsilon_{it} \quad (2)$$

The dependent variable in this model is inequality in child mortality rate denoted by $CI_{U5MR_{it}}$, which is the concentration index of under-five mortality rate. $CIX_{cov_{it}}$ Concentration Index of Composite Coverage Index. β_1 in this model captures the relationship between inequality of access to health interventions and inequality of child health outcome.

Varibales used in the estimations

Dependent variable

The dependent variable in this study is under-five mortality rate (U5MR) known as child mortality rate for model (1). U5MR is the number of child death per 1000 live births, age between 0-59 months. U5MR is one of the most powerful indicator of child health status as well as a good indicator of development of health system of the country.

The outcome variable in the second model is Concentration Index of U5MR, which measures inequality of child mortality. It ranges from -1 to 1, where 0 indicates perfect equality. The value towards -1 indicates the distribution of U5MR is more concentrated among poor, if the value towards +1 it is the sign that U5MR is more concentrated among richer population. We took the

absolute value of CIX of U5MR, and multiplied by 100 to show the magnitude of inequality more understandable for the audence.

Key explanatory variable

The key variable of interest is $CIX_{cov_{it}}$ in above models, which is inequality in coverage or concentration index of of composite coverafe index (CIX of CCI). CCI is a summary measure for monitoring universal coverage in maternal and child health care to have a broader picture of how maternal and child health interventions distributed among different socioeconomic groups in the society.

Composite coverage index (CCI) combines eight key maternal and child health interventions calculated as an equally weighted average of four different continuum of care (Barros et al., 2012; Boerma, Bryce, Kinfu, Axelson, & Victora, 2008). CCI is computed by the following formula (Wehrmeister, 2016):

$$CCI = 0.25\left(DFPS + \frac{SBA + ANC1 +}{2} + \frac{2DPT3 + Measles + BCG}{4} + \frac{ORT + ARS}{2}\right)$$

where FPNS is family planning need satisfied, SBA is skilled birth attendant, ANC1 is antenatal care visits (at least one) with skilled provider, DPT3 is three doses of diphtheria pertussis tetanus vaccine, Measles is measles vaccination, BCG is vaccination for tuberculosis, ORT is oral rehydration therapy for children with diarrhea, and ARS is care seeking for pneumonia. The standard CCI can be modified including or excluding the type of interventions according to the research interest. We used the standard CII in this study because the standard CCI covers preventive and curative maternal and child health interventions, proven to have a significant impact on child health outcomes.

The eight interventions in standard CCI is categorized by four different stages of care, such as pre-pregnancy interventions, during pregnancies and intervention at birth, child immunization, and treatment of the sick child.

The pre-pregnancy intervention included in CCI is family planning. Family planning avoids or reduces risk to the health and lives of children (Maine, 1981). Effective family planning in low- and middle-income countries, especially improvement of modern contraceptive methods used by women at reproductive age helps women to control birth spacing, prevents unwanted pregnancies, and births in very young or old ages and high parity, which will have an adverse effect on child survival (Trussell, 1984).

The next stage of care includes at least one visit to the health facility for antennal care (ANC) and births attended by trained health professional SBA. ANC is a proxy for many healthcare facilities during pregnancy, such as tetanus toxoid vaccination, intermittent preventive treatment of malaria in pregnancy, syphilis detection and treatment, iron supplementation in pregnancy, hypertensive disorder case management and MgSO4 management of pre-eclampsia to ensure healthy pregnancy Clermont, 2017). A cross-country study (Jones, 2003) estimated the effect of scaling-up of each maternal and child health interventions on child mortality. The result suggested that, if coverage scaled-up to 90 %, care for antenatal steroids alone could save 2.46 million lives of under-five children (5 % of all averted deaths) and clean delivery could prevent 4.11 million (4 %) in a year in developing countries. Another study also confirms that delivery care was related to better survival outcomes for infants (Greenwell & Winner, 2014).

The third and fourth stage of care is related to interventions that have a direct effect on child health, such as child immunization and treatment of the sick child. CCI includes three types of vaccinations that prevent the leading causes of child death in developing the world, such as

diphtheria pertussis tetanus vaccine, measles vaccination, and tuberculosis. These vaccination coverage are associated with the reduction of child mortality (Kristensen, 2000; Trunz, 2006) as well as reduction of inequality in child mortality (Bishaia, Koenig, & Khan, 2003; Roberts, 2003; Spence, 1993).

The last continuum of care included in CCI is the oral rehydration therapy for children with diarrhea and care seeking for pneumonia. These two child health interventions are the curative interventions for the sick child. Diarrhea and pneumonia are among the major killers of the children especially in resource scare settings (WHO, 2015) and ORS and case seeking for ARS are closely associated with child mortality rate in developing countries (Nguyen, 2006; Jones, 2003).

Overall, the composite coverage index correlated more strongly with child mortality, comparing to another coverage index (co-coverage, includes only preventive interventions) (Wehrmeister, 2016). The expansion of coverage of effective interventions for child health could have a great potential to improve child health and equity in health, and CCI allows us to summarize and track the changes in coverage with one potentially representative number. Therefore, CCI is increasingly used in studies in the recent literature (Akseer, 2016; Barros, 2012; Boerma, 2008; Corsi, 2014).

Other explanatory variables

Health and health inequality are determined by a set of complex socioeconomic, individual and biological factors, such as income, education and literacy, employment and working environment, geographical area, age, gender and ethnicity (Adler, 2002). Among these complex factors, we selected following a set of variables based on the literature.

As we discussed in Chapter 1, income and its distribution commonly used to explains variations in health in empirical literature (Zheng, 2012; Wilunda, 2013; Amy et al. 2013; Zhu et al. 2012; Devaux, M. and M. de Looper, 2012). To capture the effect of income and its distribution on child

mortality we included GDP per capita and GINI as confounding factors in our model. Income determines the living condition such as housing, food consumption, access to quality education and health service, which are the all associated with health. Moreover, empirical studies suggest that there is a nonlinear relationship between income and health. Increase in income results improvement in health status (Mackenbach et al. 2004). But less improvement is observed when income gets higher. To capture this non-linear relationship we included a log of GDP per capita along with GDP per capita squired. Effect of income and income inequality on health is discussed in detail in chapter one.

Education plays a major role in socioeconomic gradient in health status (Arroyave et al., 2014). Mortality declines as the level of education increases and declines are larger for higher-educated people (Montez, 2011; Montez, 2013). Children born to more educated mother would more likely to survive because educated mothers are able to get health-related information such as where and when to go for the antenatal check-ups, the importance of immunization for the children, what to when the child experience diarrhea etc.

Expenditure of healthcare is significantly associated with a large reduction in infant mortality (Nixon, 2006). Increase in health expenditure improves the availability of medicine and vaccinations, improves quality of services, which has a direct effect on child health.

Health status of the rural population is worse, compared to the urban population because of so many reasons including long distance and poor transportation to health facilities and rural and urban differences in health is long been documented (Mansfield et al., 1999; Raymond, 2009; Mikiko, 2014).

A sufficient number of physicians are a critical factor to provide timely and quality health service. There is a positive relationship between a number of doctors and health status (Morell et al., 2014; Ozegowski, 2013; Pathman et al., 2004; Rabinowitz, 1993).

Table 2.1 provides the definition of dependent and independent variables of the specified models.

Table 2.1. Variable Definitions

Variables	Source	Scale	Definition
Dependent variables			
Under-five mortality rate (U5MR)	DHS and MICS database	Number of deaths per 1,000 live births	Number of children dying before reaching age five per 1,000 live births.
Concentration Index of U5MR (CI of U5MR)	WHO Health Equity Monitor database	0 to 100	Concentration index of under-five child mortality rate
Composite coverage index (CCI)	WHO Health Equity Monitor database	Percent	Weighted average of eight (FPNS, ANC1+, SBA; BCG, Measles, DPT;ORT, ARI) coverage indicators.
Concentration Index of CCI (CIX of CCI)	WHO Health Equity Monitor database	0 to 100	Concentration index of CCI.
GDP per capita	World Bank database	GDP per capita (current US$), log scale	Gross domestic product per capita using purchasing power parity rates, constant at 2011 international dollars.
GINI	World Bank database	0-100	Gini index for income
Woman with secondary or higher education (% of total)	DHS and MICS database	Percent	Percentage of women with secondary or higher education.
Health expenditure per capita	World Bank database	Health expenditure per capita (current US$), log scale	The sum of public and private health expenditures as a ratio of total population.
Unemployment rate (%)	World Bank database	Percent	Share of the labor force that is without work but available for and seeking employment.
Urbanization (%)	World Bank database	Percent	Percentage of people living in urban areas.

2.4. RESULTS

2.4.1. Results of descriptive analysis

2.4.1.1. Summary of variables

Table 2.2. Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
U5MR	167	95.40	54.60	16	274
CIX of U5MR	167	10.05	6.27	0.2	33.4
CCI	167	62.90	13.53	22	84
CIX of CCI	167	8.25	6.04	0.3	30.9
Log of GDP per capita	167	6.66	0.93	4.79	9.18
GINI	167	42.59	8.02	27.4	65.8
Log of health expenditure per capita	167	3.70	0.99	1.7	6.2
Physicians (per 1,000 people)	167	0.56	0.82	0.01	3.7
Urban population (% of total)	167	38.95	18.23	11.4	86.4
Woman with secondary or higher education (% of total)	167	40.23	26.36	3.8	99.6
Unemployment, total (% of total labor force)	167	7.92	6.06	0.4	31.6

Above table presents the summary statistics of included variables from 167 nationally representative Demographic and Health Surveys and Multiple Indicator Cluster Survyes of 54 low income and middle income countries during 1993 to 2014.

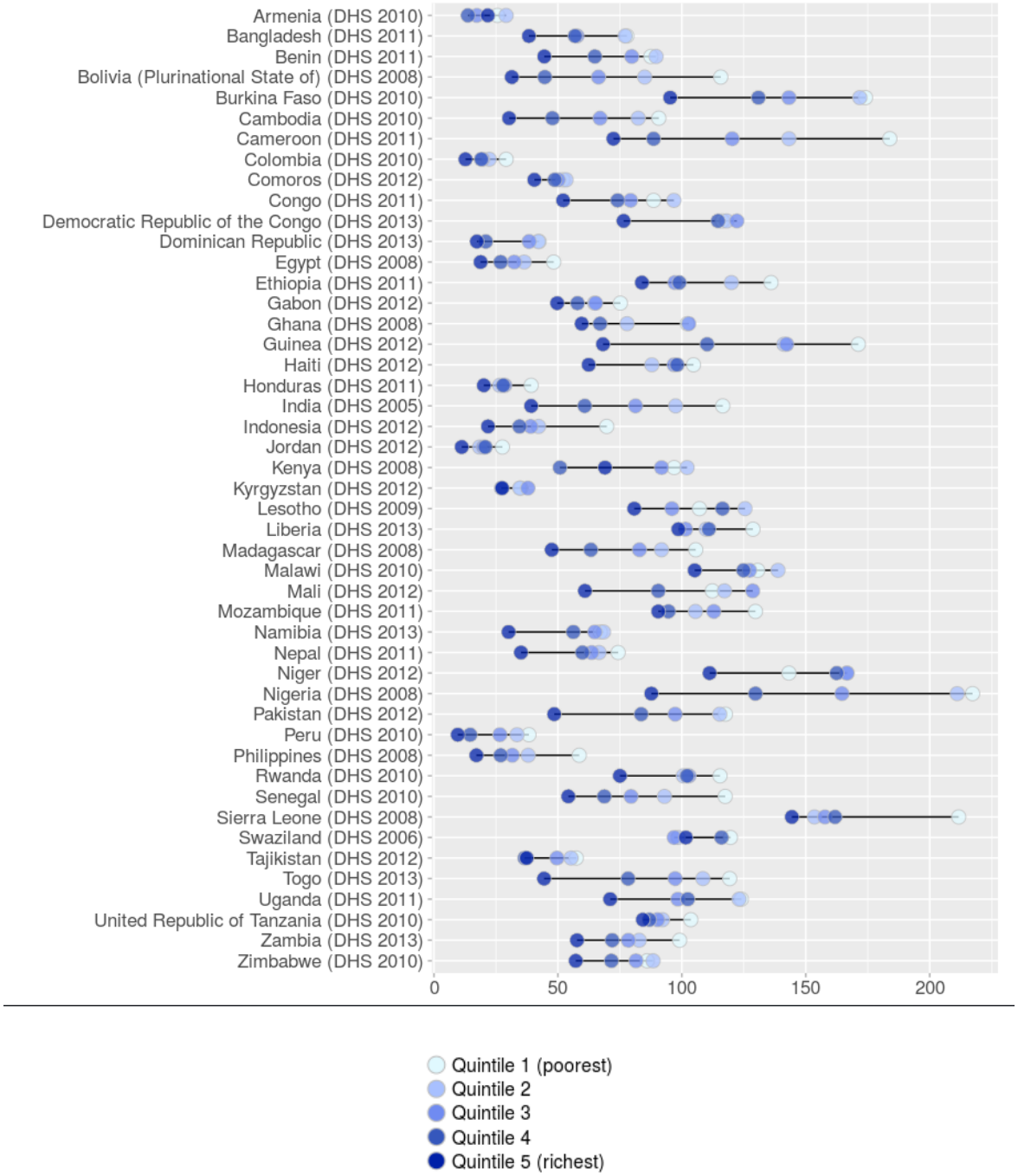
The average child mortality rate per 1000 live births in studied countries was 95.4 per 1000 live birts. The lowest child mortality rate is recorded in Zambia, 2001 and the highest was recorded in Niger, 1998 survey. The average CIX of U5MR was 10.05 point. The most inequitable country in terms of child mortality was Nigeria (CIX of U5MR= -24.7) and the most equitable country was Zambia (CIX of U5MR= -0.9) in the latest surveys.

On average, 62.9 percent of the studied population received the eight maternal and child health interventions included in CCI. The average CIX of CCI was 8.25 and Nigeria, Ethiopia, Mali, and Cameroon was the top most inequitable countries (CIX of CCI=14-30.9) and the most equitable countries were Peru, Vietnam, Colombia, Armenia and Kyrgyzstan (CIX of CCI=0.7-2.5) in the latest surveys.

2.4.1.2. Child mortality rate and inequalities

Figure 2.2 describes the absolute inequality in child mortality according to wealth quintiles in the latest survey-rounds (2005 or later for more comparability) of included countries. The dots with different colors show U5MR of corresponding wealth quintiles and the horizontal bars between dots denote the differences in U5MR between wealth quintiles. Longer bars between dots represent the greater gap between wealth quintiles in terms of U5MR.

Figure 2.2. Under-five mortality rate by different wealth quintiles



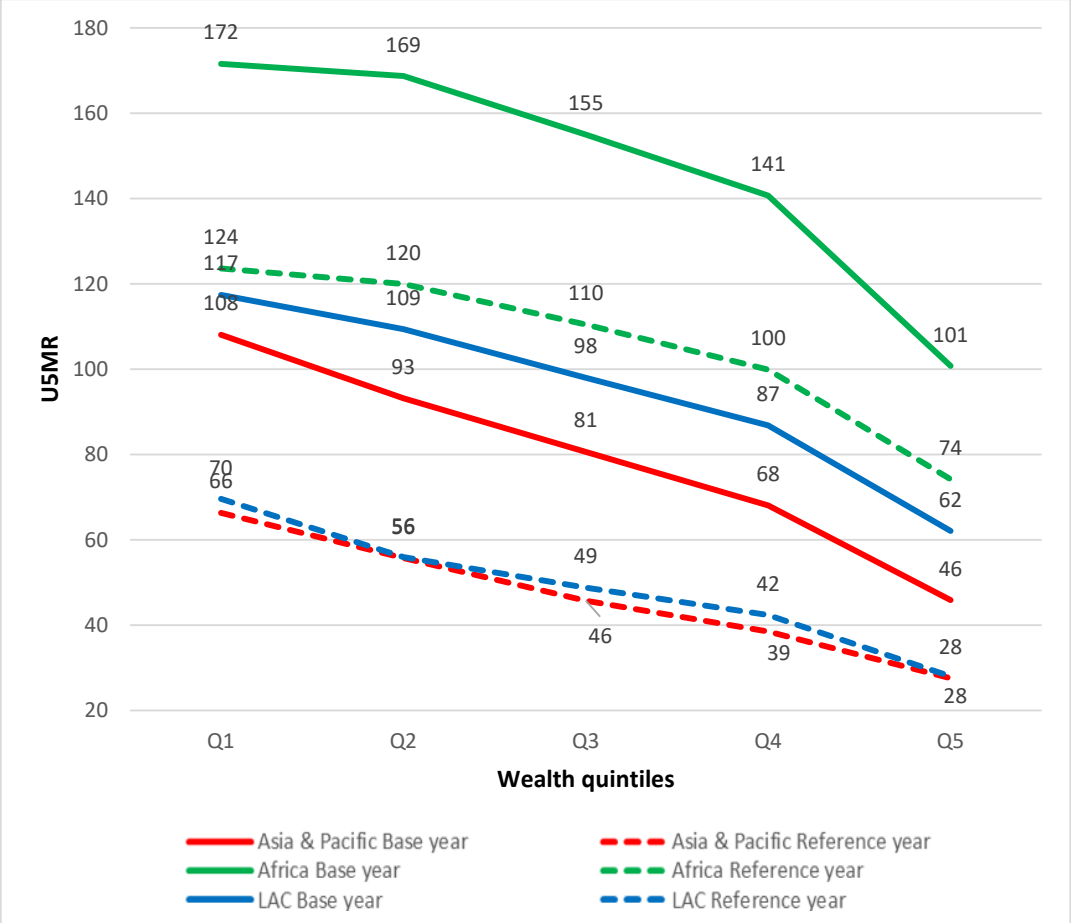
Notes: *Generated by authors using Health Equity Assessment Toolkit (HEAT): Software for exploring and comparing health inequalities in countries. Built−in database edition. Version 2.1. Geneva; World Health Organization; 2018. Data source: The disaggregated data used in this version were drawn from the WHO Health Equity Monitor database (2018 update).*
The horizontal bars between Q1 and Q5 denote the absolute inequity in health intervention coverage between the poorest and wealthiest quintiles of households.

Inequalities in child mortality are present within and between countries. Latin American and Asian middle-income countries (Jordan, Armenia, Colombia, Honduras, Peru, Kyrgyz, and Vietnam) reported the lower level of U5MR, ranging from 16 to 33 deaths per 1000 live births than low-income countries. Sub-Saharan low-income countries (Chad, Mali, Guinea, Burkina Faso, Niger, Nigeria, and Benin) show the highest level of U5MR, ranging from 125 to 197 deaths per 1000 live births among studied countries. Above figure also illustrates that countries with high level of child mortality rates are more likely to have greater inequality in child mortality.

Child mortality rate gets higher in poorer wealth quintiles in all studied countries. The most inequitable country in terms of child mortality was Nigeria (CIX of U5MR= -24.7, U5MR in the wealthiest quintile was 72.2 [65.2-80] deaths per 1000 live births and the poorest was 187.3 [CI=173.3-202.5]) respectively in Nigeria's latest survey of 2013. The most equitable country was Zambia (CIX of U5MR= -0.9, U5MR in the wealthiest quintile was 123.8 [108.2-141.2] deaths per 1000 live births and the poorest was 108.4 [94.7-123.7]) respectively in the latest survey of 2007. Zambia ranks top 11th country by U5MR among studied countries and there was not much difference in U5MR between wealth quantiles, which was all high.

Figure 3 summarizes average child mortality rates in different wealth quintiles by region over time. We followed Victora's (Victora, 2012) approach to examine change in inequality over time by comparing the levels by the earliest and the latest survey. We compared the average values of U5MR in the earliest and latest surveys of the included countries with disaggregated data. It includes a total of 41 countries (27 African, 9 Asian and 5 Latin American), where the earliest survey conducted in 2000 or earlier, and the latest survey conducted after 2000. Earliest and latest surveys of a country both conducted before or after 2000 are excluded from this analysis. Details of the earliest and latest survey year in each country is given in Appendix 3.

Figure 2.3. Child mortality rate by wealth quintiles, across regions and over time



Notes: *Base year and reference year data are extracted from the earlist and latest survey of each country. Average child mortality rate of wealth quintiles in the earlist and latest survey are compared by region. 27 countries in African region, 9 countries in Asian region, and 5 countries in Latin American countries (LAC) are included.*

Child mortality rate is fallen dramatically especially in African region during the studied period, but it is still much higher than the Asian and Latin-American regions.

Child mortality rate was almost two times higher in earliest surveys and three times higher in the latest surveys of African countries than the Asian and Latin American countries, whit average of 147 deaths per 1000 live births in the earliest surveys and 106 deaths per 1000 live births in the

latest surveys, while 79 and 82 in the earliest surveys and 47 and 33 in the latest surveys of Asian and Latin American regions respectively.

The difference in U5MR between the wealthiest and the poorest wealth quintiles was lower (62 and 38) in both surveys in Asia than LAC and Africa. Higher reduction of differences in U5MR between wealth quintiles was noticed in Africa.

Table 2.3. Child mortality rates of different wealth quintiles, average U5MR and CIX of U5MR by income group

Wealth quintiles	Low income				Middle income			
	Earlier survey	Latest survey	Change		Earlier survey	Latest survey	Change	
			Diff (Earlier-Latest)	%			Diff (Earlier-Latest)	%
Poorest	184.0	130.1	54.0	29.3	121.8	82.4	39.5	32.4
Poor	183.1	128.1	55.0	30.1	108.5	72.2	36.3	33.5
Middle	175.1	120.6	54.5	31.1	90.8	61.3	29.5	32.5
Richer	158.3	113.1	45.2	28.6	79.8	50.4	29.5	36.9
Richest	116.7	82.9	33.9	29.0	52.4	37.1	15.3	29.2
Average	165.7	103.9	61.8	37.3	91.3	57.1	34.2	37.5
CIX of U5MR	-10.9	-8.0	-2.9	26.3	-12.8	-8.3	-4.6	35.5

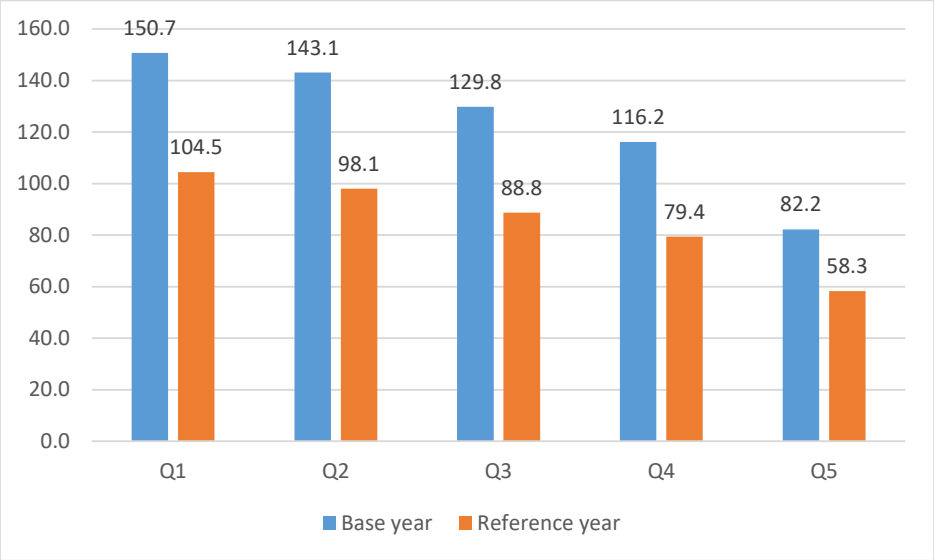
Table 2.3 summarizes average U5MR of different wealth quintiles, average U5MR and CIX of U5MR by countries income group (World Bank classification) in earliest and latest surveys.

On average, U5MR in low-income countries was two times higher than in middle-income countries. Average U5MR was reduced by approximately at the same rate (37.3% and 37.5%) in low- and middle-income groups between earlier and the latest survey rounds.

Difference between average U5MR of richest and poorest wealth quintiles over time was 20.1 % in low-income countries and 24.1 % in middle-income countries respectively. Inequality in child mortality rate was reduced 1.6 times more in middle-income countries than low-income countries.

Figure 2.4 displays average U5MR by wealth quintiles in all included countries in earliest and latest surveys.

Figure 2.4. Average under five mortality rate by wealth quintiles in included countries



Note: Q1*=Quintile 1, the poorest, Q2*=Quintile 2, Q3*=Quintile 3, Q4*=Quintile 4, Q5*=Quintile 5, the richest.
(indicates the 5% significance in the mean equivalence t-test between the base year and the reference year.)*

Overall, average U5MR of included countries reduced between base and reference years, ranging from 29 % to 31.6 %. Reducing income inequalities in health means, improving the health status of the poorer population as fast as possible, while improving the health status of the wealthier population. However, descriptive analysis shows that there is not much improvement in child health outcome of poorest population than the wealthiest population over time.

On average, CIX of U5MR of the earlier survey was -11,9 point and reference year was -8.1 points respectively. According to average CIX of U5MR in included countries, absolute inequality of child mortality was reduced by 32 % between earlier and latest surveys.

2.4.1.3. Maternal and child intervention coverage and inequalities

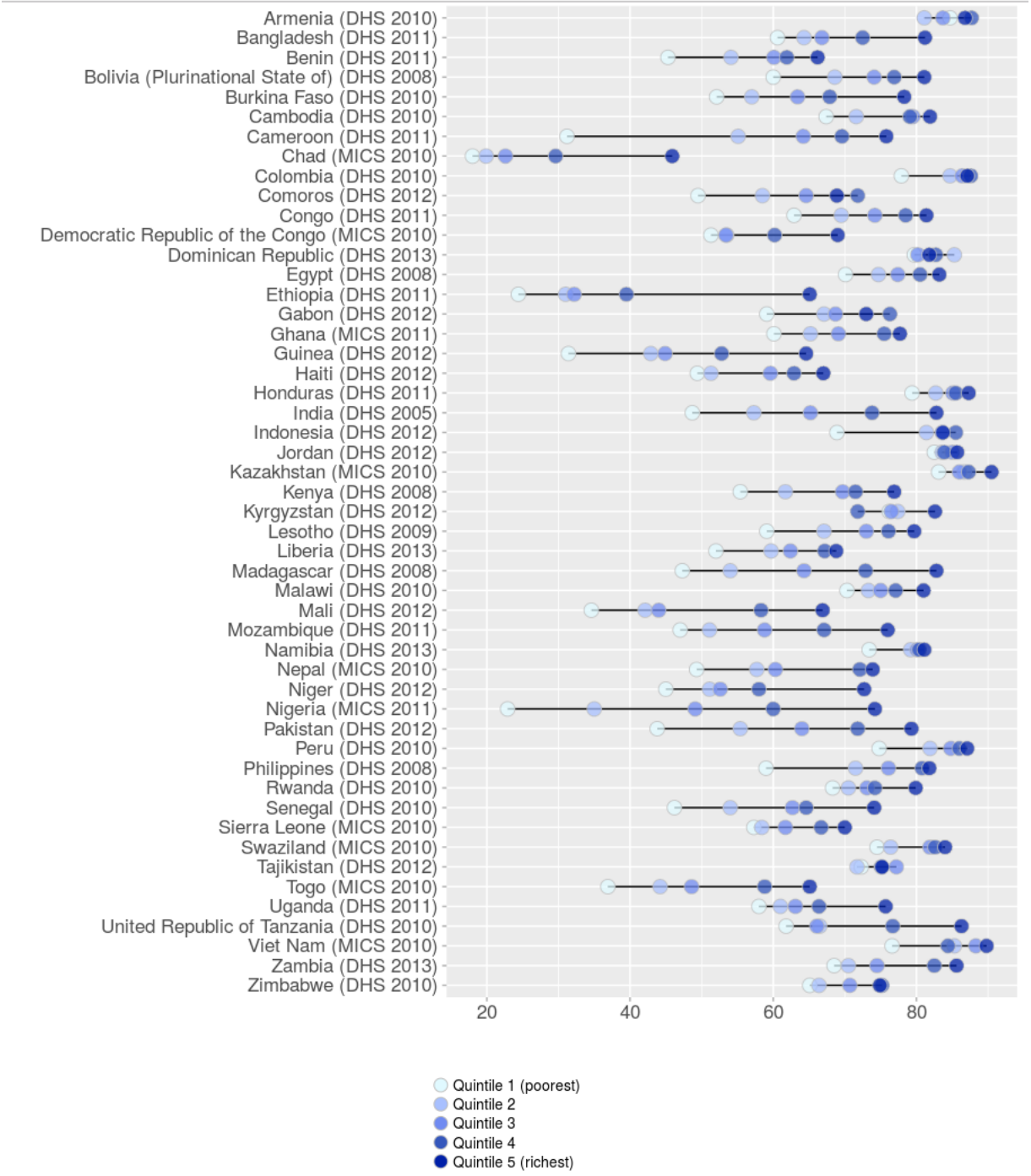
Figure 2.5 displays the absolute inequality of summary indicator for key maternal and child health interventions. The dots with different colors show the percentage of CCI of corresponding wealth quintiles and the horizontal bars between dots denote the differences in CCI between wealth quintiles. Longer bars between dots represent the greater gap between wealth quintiles in terms of CCI.

Inequalities of maternal and child health intervention coverage are present within and between countries. CCI (%) gets higher in richer wealth quintiles in all studied countries.

Latin American and Asian middle-income countries (Armenia, Colombia, Indonesia, Peru, and Vietnam) has the higher level of CCI, ranging from 77 to 84 percent in the latest surveys. Low income, Sub-Saharan countries (Guinea, Nigeria, Mali, Ethiopia and Chad) had the lowest level of CCI.

According to of CIX of CCI, Chad, Nigeria, Ethiopia, Mali, and Cameroon were the top most inequitable countries (CIX of CCI=14-30.9) and the most equitable countries were Peru, Vietnam, Colombia, Armenia and Kyrgyzstan (CIX of CCI=0.7-2.5) in the latest surveys.

Figure 2.5. CCI (%) by wealth quintiles



Notes: Generated by authors, using *Health Equity Assessment Toolkit (HEAT): Software for exploring and comparing health inequalities in countries. Built−in database edition. Version 2.1. Geneva; World Health Organization; 2018. Data source: The disaggregated data used in this version were drawn from the WHO Health Equity Monitor database (2018 update). The horizontal bars between Q1 and Q5 denote the absolute inequility in health intervention coverage between the poorest and wealthiest quintiles of households.*

Table 2.4 summarizes average CCI and CIX of CCI by geographical region and over time. It includes a total of 41 countries (27 African, 9 Asian and 5 Latin American), where the earliest survey conducted in 2000 or earlier, and the latest survey conducted after 2000. Earliest and latest surveys of a country both conducted before or after 2000 are excluded from this analysis. Details of the earliest and latest survey year in each country is given in Appendix 3.

On average, the highest level (27.7 %) of increase in CCI between earlier and the latest surveys observed in Asia and Pacific and the lowest (17.2 %) was in the African region. In terms of inequality of coverage Latin American and Caribbean countries achieved the best result by reducing CIX of CCI by 57.2 %.

The level of inequality of maternal and child intervention coverage was highest in the African region. Africa managed to reduce CIX of CCI by 27.2 points between earlier and the latest surveys. However, this achievement lags more than two times behind the other two regions.

Table 2.4. CCI (%) and CIX of CCI by geographical region

Wealth quintiles	Asia & Pacific				Africa				LAC			
	Earlier survey	Latest survey	Change		Earlier survey	Latest survey	Change		Earlier survey	Latest survey	Change	
			Diff (Latest-earlier)	%			Diff (Latest-earlier)	%			Diff (Latest-earlier)	%
CCI (%)	61.8	75.2	13.4	21.7	53.2	62.3	9.1	17.2	62.5	75.6	12.1	19.4
CIX of CCI	8.2	4.2	-4.0	-48.6	12.4	9.7	-3.3	-27.2	9.6	4.1	-5.5	-57.2

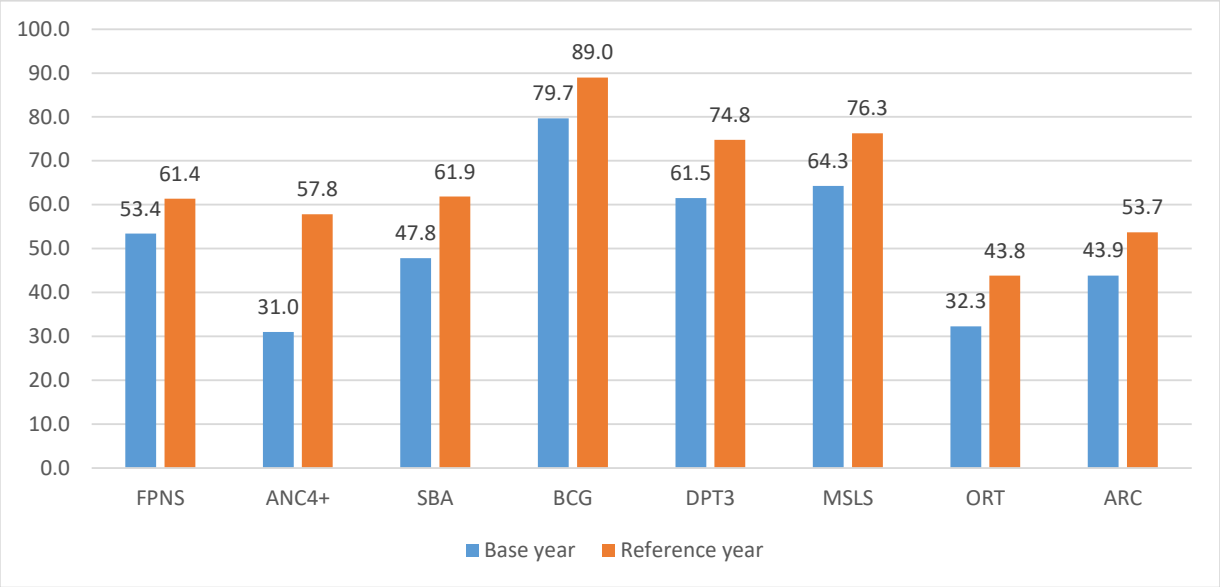
Table 2.5 summarizes average CCI and CIX of CCI by countries income group (World Bank classification) in earliest and latest surveys.

Table 2.5. CCI (%) and CIX of CCI by income group

Wealth quintiles	Low income				Middle income			
	Earlier survey	Latest survey	Change		Earlier survey	Latest survey	Change	
			Diff (earlier-Latest)	%			Diff (earlier-Latest)	%
CCI	47.5	59.0	11.5	24.2	62.7	72.6	9.9	15.8
CIX of CCI	13.6	9.3	-4.3	-31.8	9.4	5.9	-3.5	-36.2

On average, CCI is increased both in low- and middle-income countries. CCI of low-income countries was 1.2 times lower than the middle-income countries in the latest surveys. More improvement of average CCI was observed (24.2 %) in low-income countries than the middle-income countries (change in CCI is 15.8) between earlier and the latest survey rounds. But a greater reduction of inequality in coverage was noticed in the middle-income countries.

Figure 2.6. Maternal and child health intervention coverage in included countries (%)

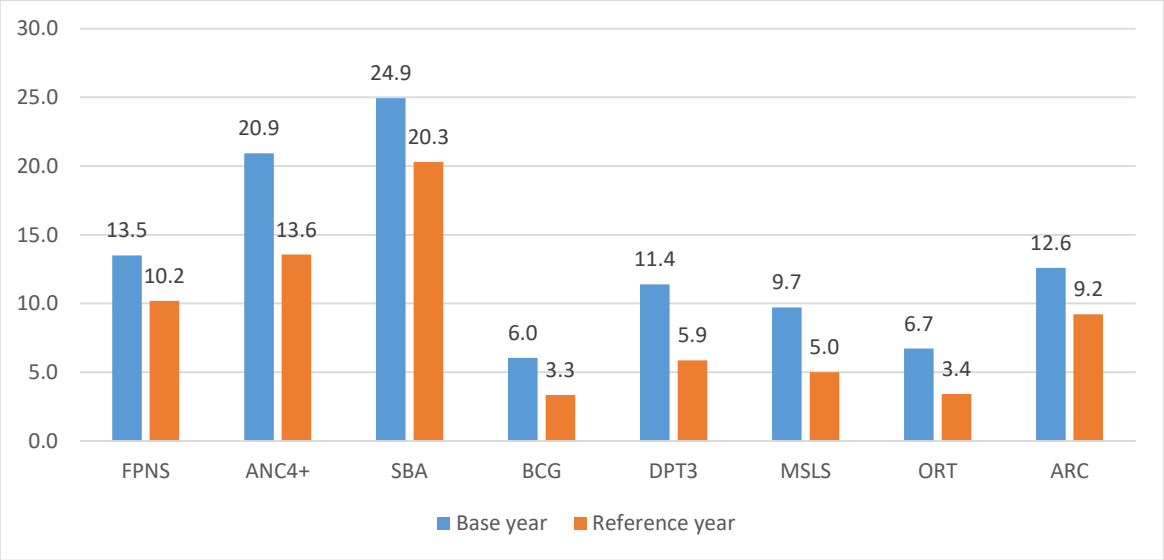


Notes: FPNS*=Family Planning Need Satisfied, ANC4+*=four or more antenatal care visits to health professionals during pregnancy, SBA*=Skilled Birth Attendance, BCG* = Bacillus Calmette–Guérin vaccination for tuberculosis, DPT*=Diphtheria, Pertussis and Tetanus vaccination, MSLS*=Measles vaccination, ORT*=Oral Rehydration Therapy for children with diarrhea, ARS*=Treatment for Acute Respiratory Infection and U5MR=Under-Five Mortality Rate.
(indicates the 5% significance in the mean equivalence t-test between the base year and the reference year.)*

Figure 2.6 displays summary of average coverage for maternal and child health interventions in included countries. On average, coverage increased significantly in included countries during the studied period. Vaccination of children achieved the highest coverage and oral rehydration therapy for children with diarrhea has the least coverage. Coverage of four or more antenatal care visits to health professionals during pregnancy was almost doubled. BCG vaccination was the least expanded intervention among maternal and child health interventions, however, on average, BCG vaccination coverage was highest and reached 89 % in the latest surveys. Victora and colleagues discussed the "inverse equity hypothesis" in their papers, that inequality would only be reduced

when the wealthiest population reach the highest possible level of coverage then the poorest population start to benefit (Victora et al., 2012; Victora et al., 2003). Our analysis shows that coverage of interventions are still very low, except child immunization, indicating there is a long way to reduce inequality in coverage.

Figure 2.7. Average CIX of CCI by maternal and child health interventions in included countries



Notes: FPNS*=Family Planning Need Satisfied, ANC4+*=four or more antenatal care visits to health professionals during pregnancy, SBA*=Skilled Birth Attendance, BCG*=Bacillus Calmette–Guérin vaccination for tuberculosis, DPT*=Diphtheria, Pertussis and Tetanus vaccination, MSLS*=Measles vaccination, ORT*=Oral Rehydration Therapy for children with diarrhea, ARS*=Treatment for Acute Respiratory Infection and U5MR=Under-Five Mortality Rate.
(indicates the 5% significance in the mean equivalence t-test between the base year and the reference year.)*

Figure 2.7 compares inequality of maternal and health intervention coverage in included countries in earlier and the latest surveys. Overall, low- and middle-income countries were successful in the reduction of inequality in coverage, as CIX of coverage is reduced in all interventions. In 2005,

WHO member countries signed the agreement to deliver essential maternal and child health interventions for every child and every mother. Universal healthcare became a key policy to improve the health of the population in developing countries. Efforts have been made during the last decade to expand the interventions, especially for the disadvantaged mothers and children. As a result concentration index of intervention coverage is reduced from 11.13 point to 7.25 point on average during the studied period. Vaccinations were the most equitable intervention, while the skilled birth attendant was the most inequitable intervention among key interventions.

CIX of ORT coverage reduced the most (49.2 %) and CIX of SBA coverage reduced the least (18.6 %) between earlier and the latest surveys of included countries.

2.4.2. Results of panel analysis

2.4.2.1. Link between child mortality rate and inequality of key maternal and child health interventions

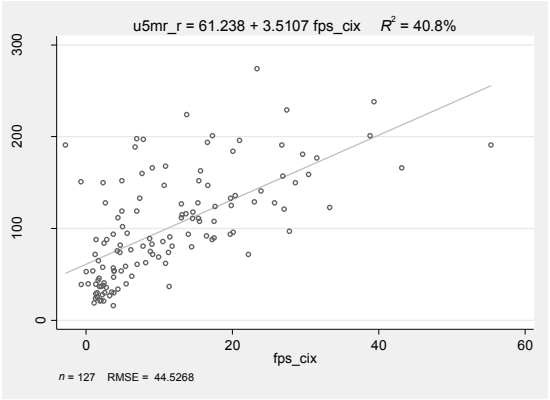
Expansion of maternal and child health intervention coverage, especially for the disadvantaged mothers and children in low and middle-income countries resulted in a reduction of inequality in those interventions. It is important to evaluate how the effort of tackling inequalities saved lives of the children in developing the world.

Table 2.8 presents the linear projection of child mortality rate and inequality in coverage.

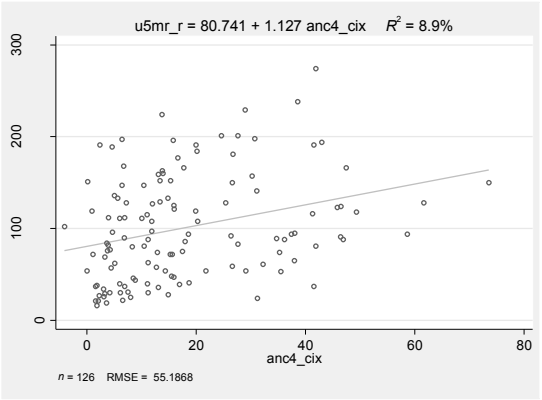
Figure 2.8. Linear projection of child mortality rate and inequality in coverage

a) Linear projections of inequality of intervention coverages before and during pregnancy and intervention at delivery and U5MR

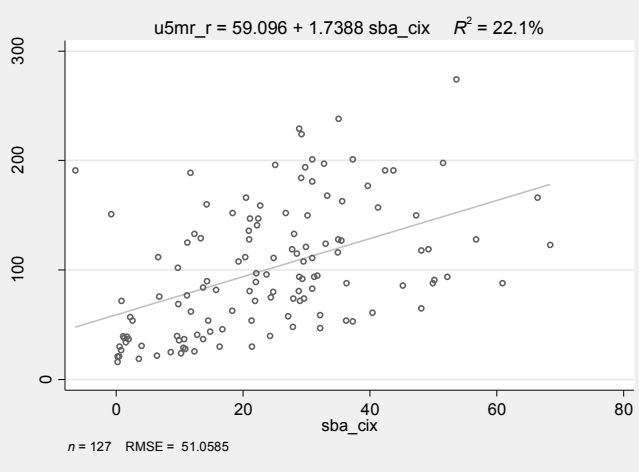
Linear projection of CIX-FPNS and U5MR



Linear projection of CIX-ANC4+ and U5MR

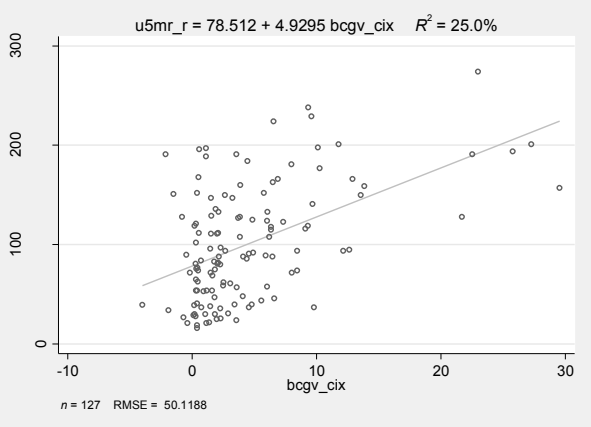


Linear projection of CIX-SBA and U5MR

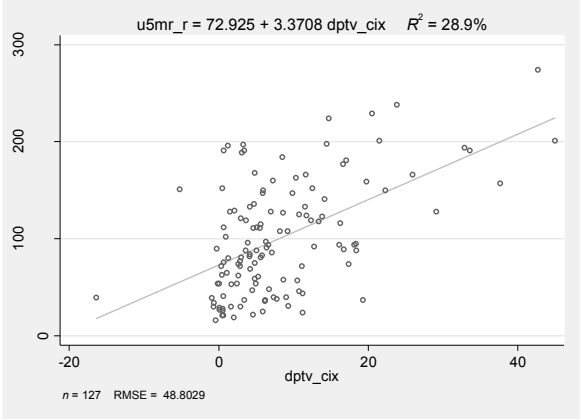


b) Linear projections of inequality of vaccination coverage and U5MR

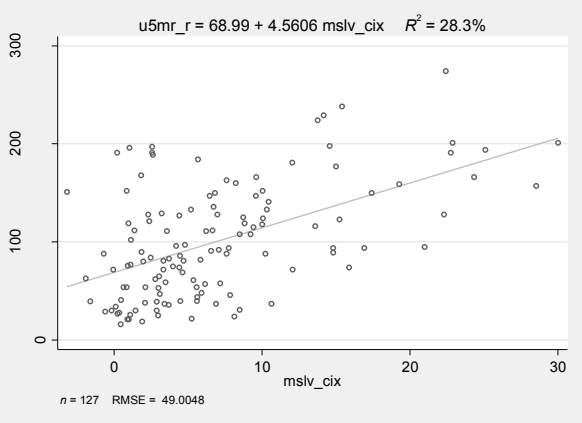
Linear projection of CIX-BCG vaccination coverage and U5MR



Linear projection of CIX-DPT3 vaccination coverage and U5MR

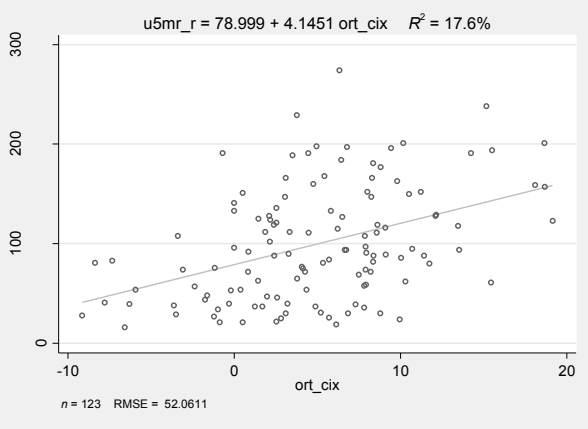


Linear projection of CIX-Measles vaccination coverage and U5MR

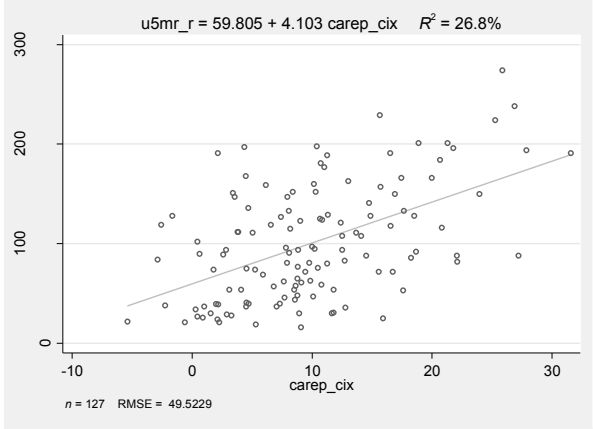


c) Linear projections of inequality of sick child treatment coverage and U5MR

Linear projection of CIX-ORT and U5MR

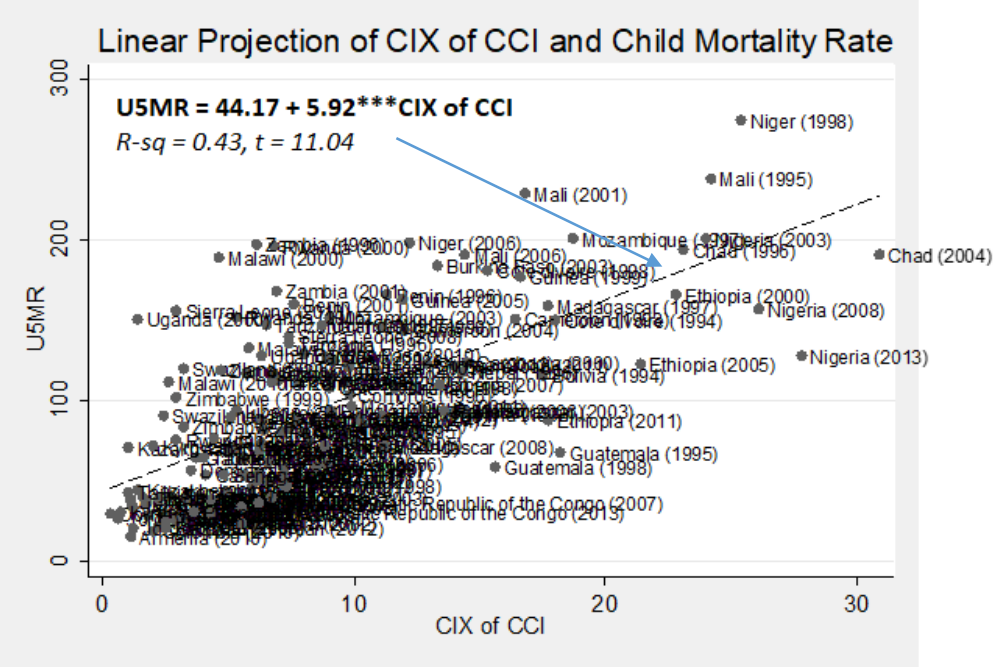


Linear projection of CIX-ARS and U5MR



d) Summary of key intervention coverage (Composite Coverage Index)

Linear projection of CIX of CCI and U5MR



Notes: *Dots in this figure represents U5MR in specific survey rounds of a country according to the CIX of CCI.*

Linear projection of inequality in maternal and child health intervention coverage and child mortality rate shows that there is a strong and positive relationship. A linear relationship between inequality of summary measure of intervention coverages and U5MR suggests that on average, a one-point increase in CIX of CCI results in 5.8*** (0.5379) more child deaths per 1000 live births. Table 2.6 presents the results from pooled OLS, fixed effects and random effects models examining effect of expansion of maternal and child health intervention coverage on child mortality rate, controlled for other important socioeconomic factors, such as GDP per capita,

woman's education, health expenditure per capita, GINI, unemployment rate, percentage of urban population and physicians per 1000 population.

We used results from random effects model as bases of the result interpretation based on the Hausman test result chi2(1)=0.08 (Probe>chi2 = 0.7831) and Breusch-Pagan Lagrange multiplier test result chi2(1) = 56.76 (Prob > chi2 = 0.0000), which suggested that random effects are appropriate.

Holding other factors constant, one percent increase in CCI decreases U5MR by 1.4*** (0.366) deaths per 1000 live births on average. GDP per capita, woman's education has significant negative effect on child mortality rate, which means one percent reduction in GDP per capita in developing countries will avert 164.1*** (31.05) deaths per 1000 live births and one percent increase in woman with secondary or higher education reduces U5MR by 0.427** (0.196) deaths per 1000 live births.

As one might expect, unemployment has a negative effect on child mortality. Our result showed that one percent increase in unemployment rate increases U5MR by 1.196*** (0.409).

Income inequality (GINI), health expenditure per capita, urbanization and number of physicians per 1000 people has no significant effect on child mortality rate in our result.

Table 2.6. Effect of CCI on U5MR

VARIABLES	(1) Pooled OLS	(2) Panel-FE	(3) Panel-RE
CCI	-1.734***	-1.263***	-1.467***
	(0.297)	(0.442)	(0.366)
Log of GDP per capita	-61.66	-192.9***	-164.1***
	(39.78)	(32.70)	(31.05)
Log of GDP per capita squired	2.245	11.69***	9.661***
	(2.845)	(2.017)	(2.051)
GINI	0.239	-0.0651	0.0127
	(0.302)	(0.461)	(0.308)
Woman with secondary or higher education (% of total)	-0.441***	-0.280	-0.427**
	(0.123)	(0.425)	(0.196)
Log of health expenditure per capita	10.02*	11.79	10.77
	(5.899)	(11.89)	(8.016)
Unemployment	1.657***	0.376	1.196***
	(0.436)	(0.686)	(0.409)
Urban population	0.197	-1.096*	-0.0885
	(0.196)	(0.595)	(0.248)
Physicians (per 1,000 people)	-7.961**	-3.007	-4.387
	(3.644)	(7.482)	(3.949)
Constant	466.6***	941.9***	815.7***
	(143.2)	(114.9)	(117.6)
Observations	167	167	167
R-squared	0.729	0.705	0.6931
Number of country	54	54	54

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

We also examined the effect of income-related inequality in intervention coverage (CIX of CCI) on child mortality rate (Table 2.7). Results from the random effects model suggested that inequality in intervention coverage has a negative effect on child mortality rate. Holding other factors constant, a one-point increase in CIX of CCI increases U5MR by 2.872*** (0.594) deaths

per 1000 live births on average. Other confounding factors showed similar results in the previous model.

Table 2.7. Effect of CIX of CCI on U5MR

VARIABLES	(1) Pooled OLS	(2) Panel-FE	(3) Panel-RE
CIX-CCI	3.148***	2.587***	2.872***
	(0.509)	(0.873)	(0.594)
Log of GDP per capita	-103.9**	-197.4***	-181.5***
	(40.44)	(32.81)	(32.51)
Log of GDP per capita squired	4.620	11.86***	10.59***
	(2.831)	(2.032)	(2.130)
GINI	0.0748	-0.0316	-0.0422
	(0.319)	(0.487)	(0.323)
Woman with secondary or higher education (% of total)	-0.599***	-0.318	-0.507***
	(0.123)	(0.402)	(0.193)
Log of health expenditure per capita	14.24**	9.256	10.71
	(6.417)	(12.65)	(8.954)
Unemployment	1.687***	0.159	1.112**
	(0.435)	(0.790)	(0.445)
Urban population	0.232	-0.937	-0.0274
	(0.199)	(0.674)	(0.241)
Physicians (per 1,000 people)	-6.622*	-3.934	-3.888
	(3.972)	(7.239)	(4.165)
Constant	501.4***	869.5***	778.1***
	(144.0)	(117.0)	(117.6)
Observations	167	167	167
R-squared	0.729	0.711	0.7008
Number of country	54	54	54

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

2.4.2.2. Link between inequality in intervention coverage and inequality in child mortality

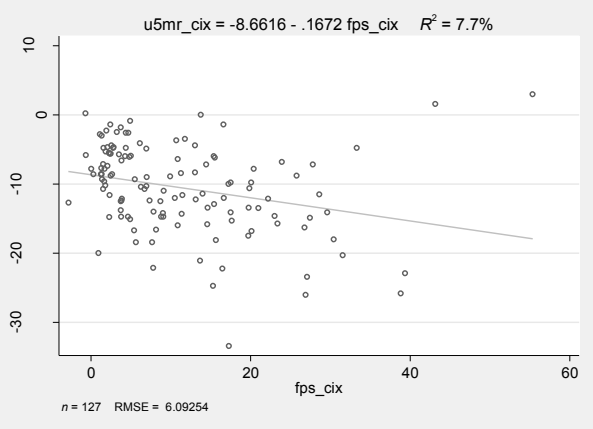
In this section, we examined the link between inequalities in key maternal and child health intervention coverage and inequalities in child mortality. Figure 2.9 (a, b and c) illustrates the linear projection of CIX of eight maternal and child health intervention coverage and CIX of U5MR using data from 167 surveys.

Graphical illustrations of association between inequality of each maternal and child health intervention coverage and inequality in child mortality rate showed that increase in inequality of coverage increases inequality in child mortality rate. Also, association between inequality in summary measurement of eight intervention coverages (CIX of CCI) and inequality in child mortality rate (CIX of U5MR) shows that inequality in intervention coverage increases inequality in child health outcome.

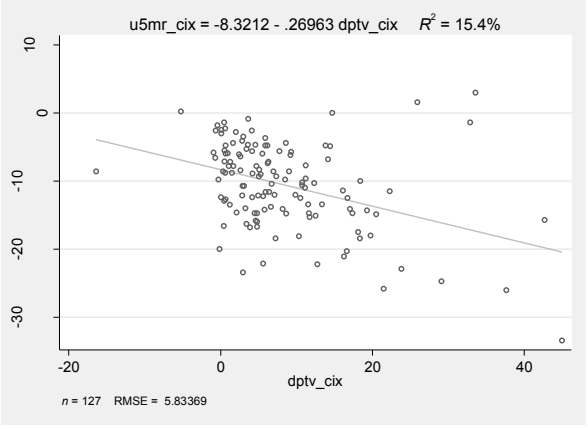
Figure 2.9. Linear projection of inequality in child mortality and inequality in coverage

a) Linear projections of inequality of intervention coverage before and during pregnancy and intervention at delivery and U5MR

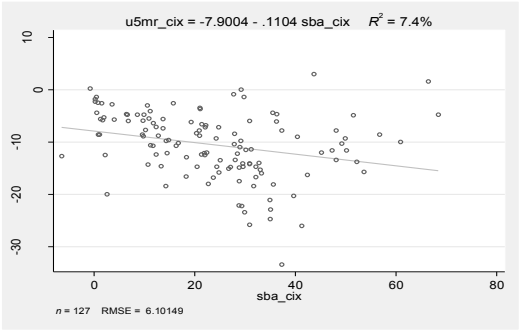
Linear projection of CIX-FPNS and CIX-U5MR



Linear projection of CIX-ANC4+ and CIX-U5MR

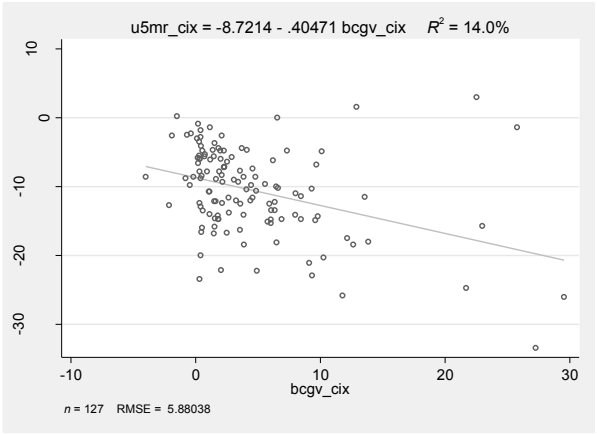


Linear projection of CIX-SBA and CIX-U5MR

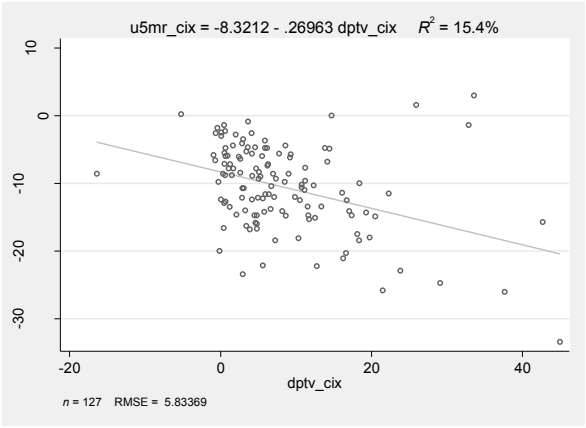


b) Linear projections of inequality of vaccination coverage and U5MR

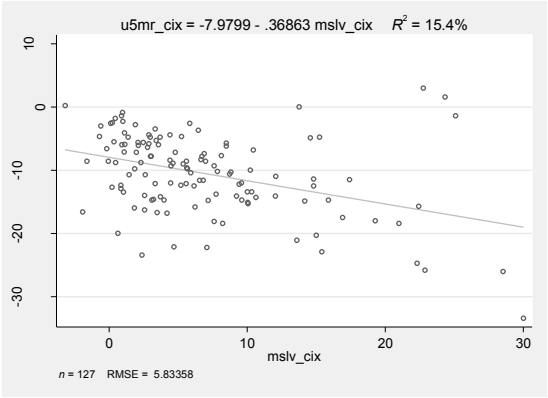
Linear projection of CIX-BCG vaccination coverage and CIX-U5MR



Linear projection of CIX-DPT3 vaccination coverage and CIX-U5MR

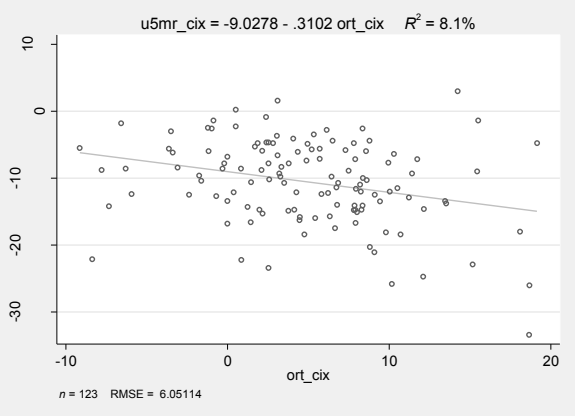


Linear projection of CIX-Measles vaccination coverage and CIX-U5MR

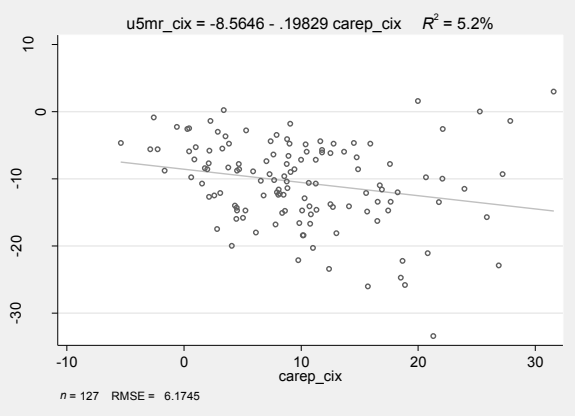


c) Linear projections of inequality of sick child treatment coverage and U5MR

Linear projection of CIX-ORT and CIX-U5MR

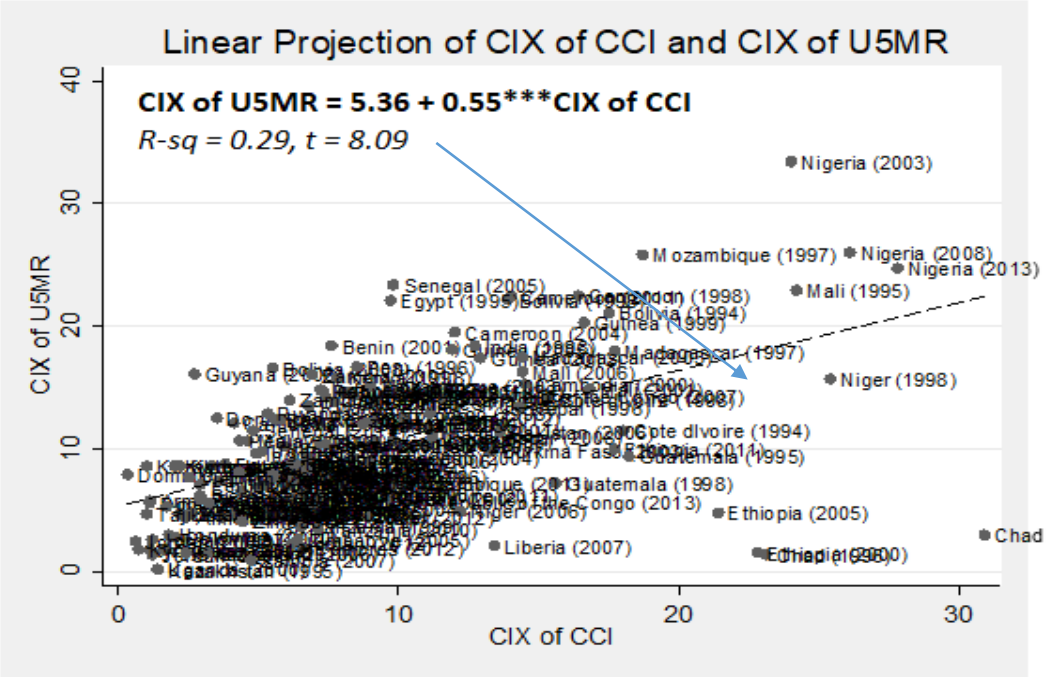


Linear projection of CIX-ARS and CIX-U5MR



d) Linear projections of inequality in the summary of key intervention coverages (CIX of CCI) and inequality in U5MR (CIX of U5MR).

Linear projection of CIX of CCI and CIX of U5MR



Notes: *Dots in this figure represents CIX of U5MR in specific survey rounds of a country according to the CIX of CCI.*

We examined the association between intervention coverage and inequality in child mortality rate (Table 2.8). And then, we examined the effect of inequality in intervention coverage on inequality in child mortality rate (Table 2.9).

The result of empirical models examining the effect of maternal and child health intervention coverage on inequality in child mortality rate suggested that expansion of intervention coverage decreases inequality in child mortality rate. For example, results of panel random effects model suggested that on average, one percent increase in intervention coverage decreases CIX of U5MR by 0.176 ** (0.0826) point, holding other factors constant.

Table 2.8. Effect of CCI on CIX of U5MR

VARIABLES	(1) Pooled OLS	(2) Panel-FE	(3) Panel-RE
CCI	-0.205***	-0.178**	-0.176**
	(0.0738)	(0.0707)	(0.0826)
Log of GDP per capita	25.78***	6.342	15.42**
	(6.416)	(8.477)	(7.434)
Log of GDP per capita squired	-1.572***	-0.568	-0.964*
	(0.448)	(0.531)	(0.500)
GINI	0.128***	-0.0706	0.0539
	(0.0487)	(0.120)	(0.0669)
Woman with secondary or higher education (% of total)	-0.0234	-0.119	-0.0419
	(0.0280)	(0.0813)	(0.0343)
Log of health expenditure per capita	-3.883***	-0.340	-3.302**
	(0.947)	(2.330)	(1.406)
Unemployment	-0.138**	-0.0451	-0.0529
	(0.0594)	(0.137)	(0.0626)
Urban population	0.0473	0.0726	0.0852*
	(0.0317)	(0.155)	(0.0472)
Physicians (per 1,000 people)	-0.0198	0.603	-0.0120
	(0.721)	(1.851)	(0.691)
Constant	-68.63***	10.94	-29.49
	(21.99)	(30.50)	(27.11)
Observations	167	167	167
R-squared	0.358	0.332	0.282
Number of country	54	54	54

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 2.9 displays the result of different empirical models examining the effect of inequality in maternal and child health intervention coverage on inequality of child mortality rate.

Results of panel random effects model show that holding other factors constant, a one-point increase in CIX of CCI increases CIX of U5MR by 0.505*** (0.151) point, on average. In other words, inequality in maternal and child health intervention coverage results in inequality in child health outcome. All other socioeconomic factors have an insignificant effect on inequality of child mortality, except urban population. People living in urban areas tend to have more access to health care and better health outcome. Results show that, on average, one percentage point increase in urban population increases CIX of U5MR by 0.0847* (0.0451) point.

Table 2.9. Effect of CIX of CCI on CIX of U5MR

VARIABLES	(1) Pooled OLS	(2) Panel-FE	(3) Panel-RE
CIX of CCI	0.495***	0.584***	0.505***
	(0.147)	(0.135)	(0.151)
Log of GDP per capita	21.56***	7.323	13.72*
	(6.235)	(8.623)	(7.376)
Log of GDP per capita squired	-1.345***	-0.661	-0.899*
	(0.436)	(0.540)	(0.493)
GINI	0.113**	-0.0509	0.0473
	(0.0501)	(0.104)	(0.0637)
Woman with secondary or higher education (% of total)	-0.0297	-0.110	-0.0369
	(0.0238)	(0.0714)	(0.0297)
Log of health expenditure per capita	-3.195***	-0.319	-2.799*
	(0.954)	(2.532)	(1.490)
Unemployment	-0.137**	-0.0846	-0.0552
	(0.0581)	(0.150)	(0.0639)
Urban population	0.0427	0.107	0.0847*
	(0.0303)	(0.159)	(0.0451)
Physicians (per 1,000 people)	0.218	0.364	0.123
	(0.699)	(1.627)	(0.664)
Constant	-69.41***	-9.588	-38.15
	(22.67)	(32.69)	(27.62)
Observations	167	167	167
R-squared	0.425	0.418	0.387
Number of country	54	54	54

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

The next step of our analysis included both CCI and CIX of CCI in one model and estimated their effects on child mortality rate and inequality in child mortality rate.

First, we examined the effect of both CCI and CIX of CCI on U5MR. One percent increase in coverage reduces child mortality rate by 0.708 (0.488) per 1000 live births, but ones we control for inequality in coverage, the coefficient of CCI became insignificant. Inequality in coverage significantly increases child mortality rate by 2 (1.951**(0.842)) deaths per 1000 live births (Table 2.10).

The second, we tested the effect of both CCI and CIX of CCI on CIX of U5MR. Again, the coefficient of coverage (0.119 (0.094)) loses its significance, when we control for inequality in coverage. Although, the sigh still indicates that expansion of coverage increases inequality in child mortality rate. The result indicates that inequality in coverage significantly increases CIX of child mortality rate by 0.664***(0.049) points (Table 2.10).

The results of models testing effect of CCI on U5MR (Table 2.6) and CIX of CCI on U5MR (Table 2.7) also showed that the effect of CIX of CCI on U5MR is greater than the effect of CCI on U5MR.

The results of the analysis imply that scaling-up the key maternal and child health intervention coverage is important to improve both level and equity in child health outcome. But improving equity in intervention coverage is more important to save lives of children and reduce child health inequality.

Poorest mothers and children are at greater health risk and have greater demand for healthcare (WHO report, 2005) than the richer ones. Expanding health care coverage for those in greater need will promote countries goal to improve the health status of the population and equity in health.

Table 2.10. Effect of CCI and CIX of CCI on U5MR and CIX of U5MR

	Outcome variables	
VARIABLES	U5MR	CIX of U5MR
CCI	-0.708	0.119
	(0.488)	(0.0949)
CIX of CCI	1.951**	0.664***
	(0.842)	(0.181)
lnGDP	-168.2***	9.299
	(31.09)	(8.459)
GDPsq	9.825***	-0.688
	(1.982)	(0.559)
Ln of health expenditure per capita	0.0130	0.0278
	(0.318)	(0.0678)
Urban population (%)	-0.405**	-0.0371
	(0.198)	(0.0340)
Woman with secondary or higher education (%)	10.93	-2.329
	(8.537)	(1.550)
Unemployment rate	1.085**	-0.0427
	(0.442)	(0.0695)
Physicians per 1000 people	-0.0694	0.113**
lnGDP	(0.253)	(0.0524)
	-4.286	-0.196
	(3.902)	(0.625)
Constant	770.4***	-29.19
	(114.3)	(30.54)
Observations	167	167
Number of country	54	54

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

2.4.3. Priority interventions for improving child health and health equity

The results of the analysis in previous sections suggested that expansion of essential maternal and child health intervention coverage significantly reduce child mortality rate and improve equity in health. But inequality in coverage has a negative effect on child mortality and equity in health.

Three recent studies suggested that prioritizing high impact interventions promote child health (Darmstadt et al., 2005; Jones et al., 2003, Onarheim et al., 2012).

We examined the effect of each eight intervention coverage included in the CCI to see which interventions are particularly important to improve child health and health equity.

Table 2.11 displays the results of models examining the effect of each eight intervention coverage and inequality in coverage on child mortality rate. Results for the effects of each eight intervention coverage and inequality in coverage on child mortality rate and health inequality in coverage in separate models are available in the appendix 2.5-2.8. The results show that both coverage and inequality of interventions that have a direct effect on children's health has the significant effect on child health outcome. Especially coverage and equity in coverage of Diphtheria, Pertussis and Tetanus vaccination (DPT) and measles vaccination (MSLS) significantly reduce child mortality rate.

If we look at the magnitude of the coefficients, the effect of inequality in coverage of included interventions has a greater effect than the level of coverage on child mortality rate. For example, one percentage point increase in measles vaccination coverage will reduce child mortality rate by 0.577**(0.287) deaths per 1000 live births, while one point reduction in inequality in measles coverage will reduce child mortality rate by 1.407***(0.407) deaths per 1000 live births.

Among coverage of all included interventions, the impact of family planning has the most significant effect on reduction of child mortality rate (Table 2.11). If the percentage of women of reproductive age who are sexually active and who have their need for family planning satisfied (FPNS) with modern contraceptive methods increase by one percent, then child mortality rate would fall by 1.132***(0.236) deaths per 1000 live births. The effective family planning in low- and middle-income countries, especially improvement of modern contraceptive methods used by women at reproductive age helps women to control birth spacing, prevents unwanted pregnancies, and births in very young or old ages and high parity, which will have an adverse effect on child survival (Trussell, 1984). Therefore, family planning strategies should target more on socioeconomically disadvantaged women to reduce child mortality, as well as improve health equity as they experience higher child mortality than the better off women.

Among inequality in coverage variables, CIX of Bacillus Calmette–Guérin (BCG) vaccination for tuberculosis has the most significant effect on reducing child mortality rate. The results suggest that one point reduction of a concentration index of inequality in BCG vaccination coverage will save more than two children's lives per 1000 live births (Table 2.11). Tuberculosis is more prevalent among the poor because they have inadequate nutrition and they live at high density (Roberts, 2003; Spence, 1993). Therefore, equitable distribution of BCG vaccination for the children would greatly improve child health status in resource-poor settings.

In terms of inequality in child mortality, the Oral Rehydration Therapy (ORS) for children with diarrhea was the most effective intervention (Table 2.12). Diarrhea is more prevalent among children of the poorest families, because of lack of safe drinking

water, poor hygiene, poor health education etc (Nguyen, 2006). Adequate ORS for poorer children could potentially improve equity in child health.

The result showed that the coverage and inequality of BCG and measles vaccination significantly increases inequality in child mortality rate. One would have imagined that if live saving vaccination coverage favors richer families, the health of the poorer children who are in greater need would worsen. Although we showed in the descriptive analysis of this chapter that coverage is increased and inequality in intervention coverage is reduced over time, the result of this disaggregated analysis suggests that the expansion of coverage, especially important child survival vaccinations for the poorer children was not enough to reduce inequality in child health outcome.

Table 2.11. Effect of each eight intervention coverage and CIX of coverage on U5MR

	Dependent Variable: U5MR							
VARIABLES	FPNS	ANC4+	SBA	BCG	DPT	MSLS	ORT	ARS
Coverage	-1.132***	-0.115	-0.321	-0.157	-0.402**	-0.577**	-0.0288	-0.201
	(0.236)	(0.245)	(0.306)	(0.233)	(0.188)	(0.287)	(0.183)	(0.285)
CIX of coverage	0.121	0.656*	0.537	2.298***	1.284***	1.407***	1.179**	0.940
	(0.319)	(0.378)	(0.349)	(0.517)	(0.252)	(0.407)	(0.491)	(0.592)
lnGDP	-133.3***	-201.5***	-224.5***	-177.9***	-164.6***	-155.5***	-188.5***	-187.9***
	(48.90)	(43.98)	(51.08)	(43.54)	(42.44)	(45.25)	(48.92)	(47.42)
GDPsq	7.712**	12.17***	13.47***	10.55***	9.622***	8.867***	11.25***	11.32***
	(3.196)	(2.996)	(3.209)	(2.890)	(2.806)	(3.090)	(3.228)	(3.044)
Ln of health expenditure per capita	0.497	0.340	0.248	0.496	0.452	0.506	0.172	0.224
	(0.383)	(0.412)	(0.375)	(0.359)	(0.343)	(0.381)	(0.340)	(0.363)
Urban population (%)	-0.493***	-0.683**	-0.701***	-0.783***	-0.667***	-0.720***	-0.927***	-0.850***
	(0.187)	(0.276)	(0.224)	(0.238)	(0.237)	(0.231)	(0.238)	(0.215)
Woman with secondary or higher	1.164	7.802	13.58	5.088	6.487	10.22	5.957	6.298
education (%)	(8.119)	(10.57)	(10.67)	(9.368)	(9.148)	(9.346)	(9.851)	(10.08)
Unemployment rate	0.301	0.682	0.891	0.246	0.0596	0.239	1.201*	0.615
	(0.619)	(0.758)	(0.671)	(0.846)	(0.834)	(0.826)	(0.649)	(0.826)
Physicians per 1000 people	0.200	0.147	0.161	0.105	0.131	0.0462	0.279	0.108
lnGDP	(0.205)	(0.252)	(0.250)	(0.276)	(0.265)	(0.261)	(0.257)	(0.281)
	0.972	-6.669	-2.783	-2.223	-4.207	-3.109	-4.491	-3.925
	(4.868)	(4.720)	(4.380)	(5.184)	(4.933)	(5.130)	(5.021)	(4.962)
Constant	685.1***	859.3***	943.6***	792.6***	754.0***	729.1***	826.6***	830.1***
	(169.0)	(156.5)	(170.5)	(155.3)	(148.8)	(160.8)	(170.2)	(164.3)
Observations	127	126	127	127	127	127	123	127
Number of country	41	41	41	41	41	41	40	41

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 2.12. Effect of each intervention coverage and CIX of coverage on CIX of U5MR

	Dependent Variable: CIX of U5MR							
VARIABLES	FPNS	ANC4+	SBA	BCG	DPT	MSLS	ORT	ARS
Coverage	0.0340	0.0257	0.0883	0.127**	0.0643	0.164**	-0.0938***	-0.0124
	(0.0563)	(0.0771)	(0.0987)	(0.0604)	(0.0539)	(0.0656)	(0.0261)	(0.0535)
CIX of coverage	0.201	0.173	0.223*	0.564***	0.357***	0.601***	0.267*	0.124
	(0.133)	(0.118)	(0.132)	(0.127)	(0.0955)	(0.0994)	(0.139)	(0.125)
lnGDP	10.15	9.917	3.604	10.48	9.047	7.790	10.48	9.256
	(11.40)	(10.10)	(11.50)	(9.527)	(9.834)	(9.934)	(9.020)	(9.756)
GDPsq	-0.741	-0.761	-0.377	-0.917	-0.743	-0.701	-0.676	-0.670
	(0.810)	(0.727)	(0.815)	(0.677)	(0.685)	(0.694)	(0.635)	(0.683)
Ln of health expenditure per capita	-0.0532	-0.0191	-0.0758	-0.0608	-0.0658	-0.0123	-0.0245	-0.0826
	(0.0894)	(0.0898)	(0.0925)	(0.0814)	(0.0859)	(0.0846)	(0.0882)	(0.0947)
Urban population (%)	-0.0341	-0.0340	-0.0511	-0.0377	-0.0295	-0.0526	-0.0584	-0.0428
	(0.0478)	(0.0414)	(0.0442)	(0.0380)	(0.0429)	(0.0393)	(0.0370)	(0.0419)
Woman with secondary or higher	-3.038*	-1.933	-1.638	-2.067	-2.160	-1.968	-2.849	-2.662
education (%)	(1.675)	(2.032)	(1.857)	(1.876)	(1.798)	(1.766)	(1.754)	(1.769)
Unemployment rate	-0.00107	0.0808	0.0991	0.0944	0.0226	-0.0140	0.0207	0.0584
	(0.134)	(0.146)	(0.154)	(0.154)	(0.159)	(0.163)	(0.125)	(0.150)
Physicians per 1000 people	0.189***	0.170**	0.179**	0.226***	0.181**	0.224***	0.143**	0.166**
lnGDP	(0.0709)	(0.0772)	(0.0762)	(0.0736)	(0.0785)	(0.0807)	(0.0624)	(0.0779)
	-1.475	-2.059	-1.663	-1.992*	-1.487	-1.364	-0.749	-1.544
	(1.193)	(1.364)	(1.363)	(1.196)	(1.176)	(1.221)	(0.781)	(1.198)
Constant								
lnGDP	-19.87	-22.45	-2.254	-28.12	-18.28	-23.92	-17.89	-12.70
	(40.36)	(38.68)	(39.78)	(34.64)	(35.74)	(35.82)	(33.19)	(35.64)
Observations	127	126	127	127	127	127	123	127
Number of country	41	41	41	41	41	41	40	41

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

In order to set priority interventions, we estimated four models that includes all eight interventions in one model. First, we estimated the effect of eight interventions on under-five mortality rate and inequality in the under-five mortality rate (Table 2.13). The result showed that the FPNS coverage and DPT vaccination coverage significantly reduce the under-five mortality rate (Model 1) and ORT coverage has a significant effect on reducing inequality in the under-five mortality rate.

The second, the effect of inequality in eight interventions on under-five mortality rate and inequality in the under-five mortality rate were estimated (Table 2.14). Inequality in DPT vaccination coverage has the greatest effect on both under-five mortality rate and inequality in the under-five mortality rate (Model 3 and 4). The result also shows that the inequality in FPNS coverage significantly increases under-five mortality rate.

These results imply that the expansion of intervention coverage of family planning is relatively important to reduce the child mortality rate and treatment of the sick child, namely ORT coverage is more important to reduce inequality in child mortality rate compared to other interventions.

On the other hand, inequality in DPT vaccination coverage is relatively important to reduce the under-five mortality rate and improve equity in under-five mortality rate.

Table 2.13. Effect of intervention coverages on U5MR and CIX of U5MR

VARIABLES	(1) U5MR	(2) CIX-U5MR
FPNS coverage	-1.054***	-0.0573*
	(0.217)	(0.0342)
ANC4+ coverage	0.0749	-0.0378
	(0.203)	(0.0507)
SBA coverage	-0.243	-0.0514
	(0.251)	(0.0468)
BCG coverage	-0.00986	0.0600
	(0.177)	(0.0442)
DPT coverage	-0.592**	-0.0520
	(0.247)	(0.0658)
MSLS coverage	-0.0351	0.0329
	(0.347)	(0.0955)
ORT coverage	-0.0571	-0.110***
	(0.176)	(0.0313)
ARC coverage	0.195	0.00932
	(0.209)	(0.0517)
lnGDP	-105.4**	12.77
	(46.86)	(10.63)
GDPsq	5.744*	-0.846
	(3.178)	(0.732)
Ln of health expenditure per capita	0.580	0.00477
	(0.365)	(0.0933)
Urban population (%)	-0.201	0.0151
	(0.190)	(0.0518)
Woman with secondary or higher education (%)	3.481	-3.050
	(8.256)	(2.045)
Unemployment rate	0.326	0.0191
	(0.725)	(0.137)
Physicians per 1000 people	0.191	0.193**
lnGDP	(0.313)	(0.0958)
	-1.746	-1.596
	(6.050)	(1.057)
	609.7***	-24.18
Constant	(168.6)	(37.20)
Observations	122	122
Number of country	40	40

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 2.14. Effect of inequality in intervention coverages on U5MR and CIX of U5MR

VARIABLES	(3) U5MR	(4) CIX of U5MR
CIX of FPNS coverage	0.672**	0.0102
	(0.323)	(0.0877)
CIX of ANC4+ coverage	-0.352	-0.0183
	(0.336)	(0.0701)
CIX of SBA coverage	-0.0217	0.0968
	(0.422)	(0.0764)
CIX of BCG coverage	1.103	-0.444
	(1.109)	(0.290)
CIX of DPT coverage	1.717**	0.442***
	(0.712)	(0.139)
CIX of MSLS coverage	-1.417	0.115
	(1.200)	(0.360)
CIX of ORT coverage	0.356	0.172*
	(0.450)	(0.104)
CIX of ARC coverage	0.245	-0.0159
	(0.394)	(0.0756)
lnGDP	-144.1***	8.112
	(51.80)	(10.81)
GDPsq	8.271**	-0.622
	(3.393)	(0.703)
Ln of health expenditure per capita	0.524	0.00280
	(0.419)	(0.0811)
Urban population (%)	-0.760***	-0.0632
	(0.223)	(0.0397)
Woman with secondary or higher education (%)	-0.281	-1.290
	(10.00)	(1.720)
Unemployment rate	0.497	-0.0622
	(0.842)	(0.139)
Physicians per 1000 people	0.315	0.150**
lnGDP	(0.239)	(0.0691)
	-1.390	0.605
	(5.494)	(0.778)
	659.0***	-19.44
Constant	(177.9)	(38.94)
Observations	122	122
Number of country	40	40

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

2.5. CONCLUSIONS

We aimed to examine the effect of the expansion of essential maternal and child health intervention coverage on reducing child mortality and improving health equity, using longitudinal cross-country data from the low and middle-income countries.

Substantial inequalities in both key maternal and child health intervention coverage and child mortality were present within and between countries.

Child mortality rate in low-income countries was two times higher than the middle-income countries. Poorer families experience higher child deaths in all studied countries. Descriptive analysis showed that child mortality rate is reduced by 30 percent and income-related inequality in child mortality reduced by 32 percent during the studied period in included countries.

On average, maternal and child health intervention coverage increased significantly both in low- and middle-income countries. Coverage of low-income countries was 1.2 times lower than the middle-income countries. Coverage increased more (24.2 %) in low-income countries than the middle-income countries (15.8 %) during the studied period. But the greater improvement of inequality in coverage was noticed in the middle-income countries.

Vaccination of children achieved the highest coverage and oral rehydration therapy for children with diarrhea has the least coverage in the latest surveys. Coverage of antenatal care visits (4<) to health professionals during pregnancy is almost doubled. BCG vaccination was the least expanded intervention among included maternal and child health interventions, however, BCG vaccination coverage was highest and reached 89 % in the latest surveys.

Child vaccinations were the most equitable intervention, while skilled birth attendant during delivery was the most inequitable intervention among other interventions.

A summary measure of eight maternal and child health intervention coverage gets higher in richer wealth quintiles in all studied countries. Chad, Nigeria, Ethiopia, Mali, and Cameroon were the most inequitable countries (CIX of CCI=14-30.9 percentage point) in terms of intervention coverage. The most equitable countries were Peru, Vietnam, Colombia, Armenia, and Kyrgyzstan (CIX of the CCI=0.7-2.5 percentage point) in the latest surveys.

The magnitude of inequality in maternal and child intervention coverage was highest in the African region. Africa managed to reduce inequality in coverage by 27 percent, however, achievement lags behind the Asian and Latin American countries more than two times.

Victora and colleagues discussed the "inverse equity hypothesis" in their papers, that inequality would only be reduced when the wealthiest population reach the highest possible level of coverage then the poorest population start to benefit (Victora et al., 2012; Victora et al., 2003). Our analysis shows that coverage of interventions are still very low, except child immunization, indicating that there is a long way to reduce inequality in coverage.

Further, we examined the effect of the expansion of maternal and child health intervention coverage on child mortality rate and inequality in child mortality rate using panel random effects models. Findings of this study showed that expansion of intervention coverage significantly contributed to the reduction of child mortality rate and improvement of health equity.

If the summary measure of key maternal and child health intervention coverage increase by one percent, then the child mortality rate falls by 1.4 deaths per 1000 live births and equity in child mortality improve by 0.176 points. These results are in line with other studies (Corsi et al., 2014; Moreno-Serra et al, 2012; Victora et al., 2012), although the measurement of inequality, study sample size, and studied countries are different.

This study also investigated the effect of inequality in intervention coverage on the level of child mortality rate and inequality in child mortality rate over time. The results of panel random effects models suggested that inequality in life-saving interventions have a significant harmful effect on child health and health equity. On average, one point increase in inequality in coverage results in three more under-five deaths per 1000 live births and inequality in child mortality rate increase by 0.5 point, holding other factors constant. A country-level study of Tanzania also suggested that equal distribution of maternal and child health intervention coverage averts more child mortality in the poorest population, and improves equality in child health outcome (Ruhago et al., 2012).

The effect of inequality in coverage is greater than the expansion of coverage on child mortality rate as well as equity in mortality. This is confirmed by results from further analysis that included both CCI and CIX of CCI into one model, to see which one is more important.

Although the sign of the coefficient of coverage variable indicates that expansion of coverage reduces child mortality rate, it loses its significance when we control for inequality in coverage. It was same for the model testing effect of both coverage and inequality in coverage on inequality in child mortality rate. This indicates that inequality in coverage has a greater effect than the level of coverage on level and inequality of child mortality.

We also examined the effect of each eight intervention coverage included in the CCI to see which interventions are particularly important to improve child health and health equity. The results showed that interventions that have the direct effect on child health such as Diphtheria, Pertussis and Tetanus vaccination and measles vaccination for children significantly reduce child mortality rate and improve health equity. Among coverage of all included interventions, the impact of family planning has the most significant effect on reducing child mortality. The effective family planning in low- and middle-income countries, especially improvement of modern contraceptive methods

used by women at reproductive age helps women to control birth spacing, prevents unwanted pregnancies, and births in very young or old ages and high parity, which will have an adverse effect on child survival (Trussell, 1984). Therefore, family planning strategies should target more on socioeconomically disadvantaged women to reduce child mortality.

Among inequality in coverage variables, inequality in Bacillus Calmette–Guérin (BCG) vaccination for tuberculosis has the most significant effect on reducing child mortality rate. Tuberculosis is more prevalent among the poor, because of their inadequate nutrition and high density in living space (Roberts, 2003; Spence, 1993). Therefore, equitable distribution of BCG vaccination for children would greatly improve child health status in resource-poor settings.

In terms of inequality in child mortality, only Oral Rehydration Therapy for children with diarrhea contributed to reducing inequality in child mortality. Diarrhea is more prevalent among children of the poorest families, because of lack of safe drinking water, poor hygiene, poor health education etc (Nguyen, 2006). Adequate ORS for poorer children could potentially improve equity in child health.

Findings of this study imply that international efforts to expand essential maternal and child health intervention coverage significantly contributed to reduce child mortality rate and improve equity in child mortality. Expanding interventions to equal levels would potentially reduce more child mortality in the poorer families than the rich, which will eventually lead to equitable progress to countries goal to reduce child mortality. Therefore, persistent efforts must continue to be made to expand coverage of essential maternal and child health interventions for the poorest mothers and children as fast as possible, in order to save lives of children and reduce inequality in both health care and health outcome.

APPENDIXIS

Appendix 2.1. List of included surveys by country and year

Country	Survey year					
	Survey 1	Suvey 2	Suvey 3	Suvey 4	Suvey 5	Suvey 6
Armenia	2000	2005	2010			
Bangladesh	1993	1996	1999	2004	2007	2011
Benin	1996	2001	2006	2011		
Bolivia	1994	1998	2003	2008		
Burkina_Faso	1998	2003	2010			
Cambodia	2000	2005	2010			
Cameroon	1998	2004	2011			
Chad	1996	2004				
Colombia	1995	2000	2005	2010		
Comoros	1996	2012				
Congo	2005	2011				
Cote dIvoire	1994	1998	2011			
Democratic Republic of the Congo	2007	2013				
Dominican Republic	1996	1999	2002	2007		
Egypt	1995	2000	2005	2008		
Ethiopia	2000	2005	2011			
Gabon	2000	2012				
Ghana	1993	1998	2003	2008	2011	
Guatemala	1995	1998				
Guinea	1999	2005	2012			
Guyana	2006	2009				
Haiti	1994	2000	2005	2012		
Honduras	2005	2011				
India	1998	2005				
Indonesia	1997	2002	2007	2012		
Jordan	1997	2002	2007	2012		
Kazakhstan	1995	1999				
Kenya	1993	1998	2003	2008		
Kyrgyzstan	1997	2006	2012			
Lesotho	2004	2009				
Madagascar	1997	2003	2008			
Malawi	2004	2010				
Mali	1995	2001	2006			

Mozambique	1997	2003	2011			
Namibia	2000	2006	2013			
Nepal	1996	2001	2006	2011		
Nicaragua	1998	2001				
Niger	1998	2006	2012			
Nigeria	1999	2003	2008	2013		
Pakistan	2006	2012				
Peru	1996	2000	2004	2009	2012	
Philippines	1993	1998	2003	2008	2013	
Rwanda	2000	2005	2010			
Senegal	2005	2010	2014			
Sierra Leone	2008	2013				
Swaziland	2006	2010				
Tajikistan	2005	2012				
Tanzania	1996	1999	2004	2010		
Togo	1998	2013				
Uganda	1995	2000	2006	2011		
Vietnam	1997	2002	2010			
Zambia	1996	2001	2007			
Zimbabwe	1994	1999	2005	2010		

Appendix 2.2. List of included countries by World Bank income classification (2017)

Low income (GNI per capita$1,005 or less)	**Lower middle income** (GNI per capita of more than $1,006 but less than $3,955)	**Upper middle income** (GNI per capita of more than $3,956but less than $12,235)
Benin	Armenia	Colombia
Burkina_Faso	Bangladesh	Dominican Republic
Chad	Bolivia	Gabon
Comoros	Cambodia	Guyana
Democratic Republic of the Congo	Cameroon	Kazakhstan
Ethiopia	Congo	Namibia
Guinea	Cote dIvoire	Peru
Haiti	Egypt	
Madagascar	Ghana	
Malawi	Guatemala	
Mali	Honduras	
Mozambique	India	
Nepal	Indonesia	
Niger	Jordan	
Rwanda	Kenya	
Senegal	Kyrgyzstan	
Sierra Leone	Lesotho	
Tanzania	Nicaragua	
Togo	Nigeria	
Uganda	Pakistan	
Zimbabwe	Philippines	
	Swaziland	
	Tajikistan	
	Vietnam	
	Zambia	

Appendix 2.3. List of countries by geographical region

Latin America	**Asia**	**Africa**
Bolivia	Armenia	Benin
Colombia	Bangladesh	Burkina Faso
Haiti	Cambodia	Cameroon
Nicaragua	India	Chad
Peru	Indonesia	Comoros
	Kyrgyzstan	Congo Republic
	Nepal	Cote dIvoire
	Philippines	Egypt
	Vietnam	Ethiopia
		Gabon
		Ghana
		Guinea
		Jordan
		Kenya
		Madagascar
		Malawi
		Mali
		Mozambique
		Namibia
		Niger
		Nigeria
		Rwanda
		Tanzania
		Togo
		Uganda
		Zambia
		Zimbabwe

Appendix 2.4. The earliest and latest survey year in included countries

Country	Base year	Reference year	Country	Base year	Reference year
Armenia	2000	2010	Kenya	1998	2008
Bangladesh	1999	2011	Kyrgyzstan	1997	2012
Benin	1996	2006	Madagascar	1997	2008
Bolivia	1994	2008	Malawi	2000	2010
Burkina_Faso	1998	2010	Mali	1995	2006
Cambodia	2000	2010	Mozambique	1997	2011
Cameroon	1998	2011	Namibia	2000	2013
Chad	1996	2004	Nepal	1996	2011
Colombia	1995	2010	Nicaragua	1998	2001
Comoros	1996	2012	Niger	1998	2012
Congo Republic	2005	2011	Nigeria	1999	2013
Cote dIvoire	1994	2011	Peru	1996	2012
Egypt	1995	2008	Philippines	1993	2013
Ethiopia	2000	2011	Rwanda	2000	2010
Gabon	2000	2012	Tanzania	1996	2010
Ghana	1998	2011	Togo	1998	2013
Guinea	1999	2005	Uganda	1995	2011
Haiti	2000	2012	Vietnam	1997	2010
India	1998	2005	Zambia	1996	2007
Indonesia	1997	2012	Zimbabwe	1994	2010
Jordan	1997	2012			

Appendix 2.5. Effect of eight intervention coverage on CIX of U5MR

VARIABLES	(1) FPNS	(2) ANC4+	(3) SBA	(4) BCG	(5) DPT	(6) MSLS	(7) ORT	(8) ARS
Coverage	-0.0927*	-0.0785*	-0.0749	-0.00289	-0.0659	-0.0671	-0.115***	-0.0673
	(0.0501)	(0.0408)	(0.0590)	(0.0697)	(0.0523)	(0.0795)	(0.0335)	(0.0579)
Log of GDP per capita	14.36	8.907	7.492	9.118	12.73	12.35	11.65	10.53
	(9.439)	(9.165)	(9.180)	(9.023)	(9.712)	(9.857)	(8.522)	(9.411)
Log of GDP per capita squired	-0.949	-0.607	-0.566	-0.651	-0.885	-0.866	-0.723	-0.723
	(0.663)	(0.634)	(0.641)	(0.633)	(0.671)	(0.682)	(0.595)	(0.650)
GINI	-0.0125	-0.0139	-0.0419	-0.0463	-0.0260	-0.0344	-0.0129	-0.0659
	(0.0861)	(0.0952)	(0.0899)	(0.0872)	(0.0906)	(0.0896)	(0.0902)	(0.0948)
Woman with secondary or higher	-0.0219	-0.0430	-0.0407	-0.0630	-0.0499	-0.0503	-0.0397	-0.0574
education (% of total)	(0.0505)	(0.0395)	(0.0452)	(0.0387)	(0.0414)	(0.0438)	(0.0373)	(0.0400)
Log of health expenditure per	-3.497**	-2.891*	-1.895	-2.877*	-2.771*	-2.594	-3.704**	-2.557
capita	(1.581)	(1.715)	(1.920)	(1.644)	(1.628)	(1.712)	(1.619)	(1.734)
Unemployment	-0.0194	0.0656	0.0573	0.0431	0.00585	0.0284	0.0186	0.0340
	(0.121)	(0.134)	(0.137)	(0.130)	(0.130)	(0.126)	(0.127)	(0.134)
Urban population	0.137**	0.188***	0.164**	0.154**	0.142**	0.134*	0.139**	0.132*
	(0.0643)	(0.0644)	(0.0676)	(0.0697)	(0.0633)	(0.0698)	(0.0610)	(0.0723)
Physicians (per 1,000 people)	-0.798	-1.432	-0.983	-1.329	-1.208	-1.196	-1.680	-1.272
	(1.050)	(1.174)	(1.040)	(1.100)	(1.173)	(1.145)	(1.222)	(1.138)
Constant	-27.04	-11.27	-5.393	-11.05	-21.25	-19.47	-18.64	-13.67
	(34.04)	(33.83)	(33.81)	(32.62)	(34.76)	(34.84)	(31.17)	(33.82)
Observations	127	126	127	127	127	127	123	127
Number of country	41	41	41	41	41	41	40	41

Appendix 2.6. Effect of CIX of eight intervention coverage on U5MR

VARIABLES	(1) FPNS	(2) ANC4+	(3) SBA	(4) BCG	(5) DPT	(6) MSLS	(7) ORT	(8) ARS
CIX	1.102***	0.780**	0.784***	2.456***	1.628***	2.049***	1.192**	1.131**
	(0.251)	(0.307)	(0.277)	(0.524)	(0.278)	(0.425)	(0.477)	(0.497)
Log of GDP per capita	-185.4***	-200.8***	-226.9***	-179.3***	-179.7***	-174.6***	-189.7***	-194.1***
	(49.51)	(43.16)	(51.24)	(43.56)	(42.14)	(44.94)	(50.32)	(47.73)
Log of GDP per capita squired	11.07***	12.11***	13.63***	10.52***	10.52***	10.04***	11.32***	11.69***
	(3.204)	(2.851)	(3.236)	(2.858)	(2.769)	(3.033)	(3.264)	(3.050)
GINI	0.361	0.335	0.230	0.479	0.414	0.548	0.163	0.252
	(0.399)	(0.407)	(0.378)	(0.360)	(0.358)	(0.378)	(0.349)	(0.349)
Woman with secondary or higher	-0.727***	-0.671**	-0.752***	-0.782***	-0.713***	-0.787***	-0.934***	-0.839***
education (% of total)	(0.222)	(0.261)	(0.213)	(0.239)	(0.244)	(0.237)	(0.217)	(0.225)
Log of health expenditure per	3.123	7.908	11.84	5.428	6.539	9.094	6.091	5.431
Capita	(10.35)	(10.32)	(11.15)	(9.404)	(9.395)	(9.566)	(10.24)	(10.20)
Unemployment	0.176	0.634	0.840	0.326	0.198	0.208	1.203*	0.611
	(0.765)	(0.760)	(0.672)	(0.788)	(0.814)	(0.839)	(0.639)	(0.796)
Urban population	0.284	0.0755	0.132	0.159	0.146	0.184	0.272	0.155
	(0.232)	(0.273)	(0.248)	(0.247)	(0.263)	(0.251)	(0.253)	(0.243)
Physicians (per 1,000 people)	-3.415	-7.068	-4.043	-3.208	-4.239	-3.292	-4.207	-4.151
	(4.745)	(4.448)	(4.364)	(4.597)	(4.607)	(4.886)	(4.677)	(4.883)
Constant	809.0***	852.1***	940.0***	786.6***	784.5***	757.1***	830.3***	842.6***
	(174.9)	(150.8)	(174.8)	(155.4)	(150.9)	(162.2)	(173.6)	(166.0)
Observations	127	126	127	127	127	127	123	127
Number of country	41	41	41	41	41	41	40	41

Appendix. 2.7. **Effect of CIX of eight intervention coverage on U5MR**

VARIABLES	(1) FPNS	(2) ANC4+	(3) SBA	(4) BCG	(5) DPT	(6) MSLS	(7) ORT	(8) ARS
CIX	1.102***	0.780**	0.784***	2.456***	1.628***	2.049***	1.192**	1.131**
	(0.251)	(0.307)	(0.277)	(0.524)	(0.278)	(0.425)	(0.477)	(0.497)
Log of GDP per capita	-185.4***	-200.8***	-226.9***	-179.3***	-179.7***	-174.6***	-189.7***	-194.1***
	(49.51)	(43.16)	(51.24)	(43.56)	(42.14)	(44.94)	(50.32)	(47.73)
Log of GDP per capita squired	11.07***	12.11***	13.63***	10.52***	10.52***	10.04***	11.32***	11.69***
	(3.204)	(2.851)	(3.236)	(2.858)	(2.769)	(3.033)	(3.264)	(3.050)
GINI	0.361	0.335	0.230	0.479	0.414	0.548	0.163	0.252
	(0.399)	(0.407)	(0.378)	(0.360)	(0.358)	(0.378)	(0.349)	(0.349)
Woman with secondary or higher education (% of total)	-0.727***	-0.671**	-0.752***	-0.782***	-0.713***	-0.787***	-0.934***	-0.839***
	(0.222)	(0.261)	(0.213)	(0.239)	(0.244)	(0.237)	(0.217)	(0.225)
Log of health expenditure per	3.123	7.908	11.84	5.428	6.539	9.094	6.091	5.431
Capita	(10.35)	(10.32)	(11.15)	(9.404)	(9.395)	(9.566)	(10.24)	(10.20)
Unemployment	0.176	0.634	0.840	0.326	0.198	0.208	1.203*	0.611
	(0.765)	(0.760)	(0.672)	(0.788)	(0.814)	(0.839)	(0.639)	(0.796)
Urban population	0.284	0.0755	0.132	0.159	0.146	0.184	0.272	0.155
	(0.232)	(0.273)	(0.248)	(0.247)	(0.263)	(0.251)	(0.253)	(0.243)
Physicians (per 1,000 people)	-3.415	-7.068	-4.043	-3.208	-4.239	-3.292	-4.207	-4.151
	(4.745)	(4.448)	(4.364)	(4.597)	(4.607)	(4.886)	(4.677)	(4.883)
Constant	809.0***	852.1***	940.0***	786.6***	784.5***	757.1***	830.3***	842.6***
	(174.9)	(150.8)	(174.8)	(155.4)	(150.9)	(162.2)	(173.6)	(166.0)
Observations	127	126	127	127	127	127	123	127
Number of country	41	41	41	41	41	41	40	41

Appendix 2.8. Effect of CIX of eight maternal and child health interventions on CIX of U5MR

VARIABLES	(1) FPNS	(2) ANC4+	(3) SBA	(4) BCG	(5) DPT	(6) MSLS	(7) ORT	(8) ARS
CIX	0.202**	0.143**	0.152*	0.434***	0.307***	0.428***	0.310**	0.173
	(0.0990)	(0.0696)	(0.0809)	(0.168)	(0.0919)	(0.134)	(0.146)	(0.125)
Log of GDP per capita	22.79***	4.922	4.142	11.63	11.75	13.60	8.578	9.080
	(8.546)	(10.08)	(10.13)	(9.102)	(8.934)	(9.702)	(8.635)	(8.491)
Log of GDP per capita squired	-1.399**	-0.459	-0.389	-0.863	-0.889	-1.037	-0.593	-0.636
	(0.620)	(0.671)	(0.709)	(0.635)	(0.615)	(0.672)	(0.601)	(0.596)
GINI	0.130**	-0.218	-0.0438	-0.0138	-0.0239	0.0158	-0.0375	-0.0412
	(0.0589)	(0.139)	(0.0869)	(0.0806)	(0.0800)	(0.0824)	(0.0853)	(0.0851)
Woman with secondary or higher education (% of total)	-0.0329	-0.0339	-0.0409	-0.0390	-0.0249	-0.0358	-0.0957***	-0.0469
	(0.0357)	(0.0538)	(0.0414)	(0.0375)	(0.0401)	(0.0403)	(0.0360)	(0.0404)
Log of health expenditure per	-4.587***	-1.283	-1.254	-2.498	-2.176	-1.707	-2.282	-2.734*
Capita	(1.269)	(2.870)	(1.836)	(1.713)	(1.666)	(1.657)	(1.694)	(1.661)
Unemployment	-0.175	-0.0251	0.0745	-0.00436	-0.0279	-0.0398	0.0322	0.0173
	(0.116)	(0.285)	(0.139)	(0.135)	(0.135)	(0.130)	(0.135)	(0.131)
Urban population	0.0764	0.146	0.163**	0.151**	0.147**	0.151**	0.132**	0.142**
	(0.0470)	(0.178)	(0.0698)	(0.0667)	(0.0691)	(0.0650)	(0.0617)	(0.0645)
Physicians (per 1,000 people)	0.245	-1.617	-1.111	-1.051	-1.190	-1.000	0.300	-1.238
	(1.044)	(2.712)	(1.324)	(1.096)	(1.135)	(1.163)	(0.730)	(1.145)
Constant	-69.25**	5.182	-1.086	-23.77	-24.90	-34.14	-13.23	-14.10
	(30.51)	(36.53)	(36.33)	(33.63)	(33.34)	(36.09)	(31.58)	(31.44)
Observations	127	126	127	127	127	127	123	127
R-squared	0.303	0.332	0.331	0.378	0.426	0.395	0.287	0.229
Number of country	41	41	41	41	41	41	40	41

Appendix 2.9. Summary of reviewed articles: Studies evaluated effect of expansion of maternal and child health intervention coverage on health outcome

Citation (year) Country of study	Intervention types	Health outcome measurement	Overall quality	Summary of results	Effect on health outcome
(Corsi & Subramanian, 2014), **35 sub-Saharan African countries**	Eight MCH interventions and CCI	U5MR	+	CCI was associated with a reduction in U5MR of 29.0 per 1,000 (95% CI: 43.2, 14.7). A unit increase in CCI was associated with an odds ratio of 0.86 for child mortality (95% CI: 0.82-0.90).	+
(Kipp et al., 2016), **46 African countries**	Seeking ARI treatment and SBA	U5MR	+	Among factors contributed to reduction of child mortality in Africa, seeking treatment for ARI was one of the most significant factor (β=0.26 to β=0.22, respectively.	+
(Greenwell & Winner, 2014), **Guinea**	ANC, delivery in a health facility, SBA, postnatal care	Neonatal and infant mortality	++	Delivery care and postnatal care was related to better survival outcomes for infants. But delivery care did not contribute to the reduction of neonatal survival, also prenatal care has no effect on infant survival.	+-
(Clermont, 2017), **98 countries**	Total of 18 MCH interventions	Child mortality	++	Expanding essential health interventions to the level of the top wealth quintile prevents 24–32% of child deaths.	+
(Aquino, de Oliveira, & Barreto, 2009), **Brazil**	Family Health Program to improve provision of MCH care services.	Infant and child mortality	+	Infant mortality rate could reduce by 13.0%, 16.0%, and 22.0%, respectively for the different levels of FHP coverage.	+
(Darmstadt et al., 2008), **60 countries**	16 MCH interventions	Neonatal mortality	++	Expanding coverage of 16 interventions to 90 % could save 0.59-1.08 million lives in South	+

in sub-Saharan Africa and South Asia				Asia and 0.45-0.80 million lives in sub-Saharan Africa annually.	
(Gakidou et al., 2007), **42 countries**	Environmental and nutritional interventions	Child mortality	+	Fifty percent coverage of the same environmental and nutritional interventions would reduce child mortality by 26 900, 0.51 million, and 1.02 million in the Latin America and the Caribbean, South Asia and sub-Saharan Africam, respectively, if the interventions are implemented among the poor first.	+
(Friberg et al., 2010), **42 sub-Saharan African countries**	MNCH interventions	Maternal, neonatal and child mortality	+	At 90 % of coverage, 486,000 lives will be saved at cost an additional US$1.21 per capita.	+
(Mercer, Khan, Daulatuzzaman, & Reid, 2004), **Cuba**	PHC service	IMR		Over forty years of changes in access, organization and delivery of PHC contributed to reduce IMR by 40 percent, while countries socioeconomic situation did not change much.	+
(Garchitorena et al., 2018), **Madagascar**	MCH and Household care-seeking for illness last 4 weeks	Neonatal, infant and child mortality	++	CCI increased by 30.1 % and this improvement resulted reduction of under-five and neonatal mortality 19.1% and 36.4%, respectively. Generally SII of coverage reduced, but both SSI and CIX for care-seeking behaviors for ARI or ANC (4+ visits) were increased.	+

Abbreviations: MCH-Maternal and child health, U5MR-under-five mortality rate, IMR-Infant mortality rate, RD-rate difference, RR-Rate Ratio, SII-Slope Index of Inequality, CIX-Concentration index of inequality, SES-Socioeconomic situation, FHP-Family health program

Notes: Quality of the study: ++ strong and + moderate

Appendix 2.10. Studies evaluated effect of expansion of maternal and child health intervention coverage on inequality in health outcome

Citation (year) Country of study	Intervention types	Health outcome measurement	Inequality dimension/ Measurement	Overall quality	Summary of results	Effect on health outcome/ Health equity
(Victora, Vaughan, Barros, Silva, & Tomasi, 2000), Brazil	Child vaccinations ORS, median time child was breastfed, ever breastfed, child weighed in past three months, growth chart available, weight	IMR, U5MR, weight, stunted growth, prevalence of diarrhea.	Income/ Rate Ratio	++	Coverage of interventions increased and inequality in coverage decreased over time. These improvements resulted improvement in health outcomes, but inequality in outcome remained largely unchanged.	+/--
(Limwattananon, Tangcharoensathien, & Prakongsai, 2010), Thailand	Family planning, prenatal care and delivery by a skilled health worker, and delivery in a health facility, treatment for child illness and child immunization	Teenage pregnancy, low birth weight, child malnourishment and childhood illnesses.	Wealth, place and education/ RR and CIX	+	Maternal and child health (MCH) intervention coverage is relatively equitable in Thailand. However, inequality in child health outcome was considerably high.	+/-
(Bhutta et al., 2013), 75 countries	Interventions for diarrhoea and pneumonia	IMR, Neonatal mortality, U5MR	Wealth/Child death averted in poorest two quintiles	++	If implemented at present annual rates of increase in each of the each studied countries, these interventions and packages of care could save 54% of diarrhoea and 51% of pneumonia deaths by 2025. Effect of the interventions was greatest in the poorest quintiles, which results improvement of equity in child mortality.	+/+
(Onarheim et al., 2012),	14 MCH interventions	U5MR, life expectancy	Age/ inequality in	+	Expansion of coverage decreases U5MR by 101.0 in 2011 to 68.8, 42.1 and 56.7 per 1000	+/+

Ethiopia		and inequality in age at death	age at death ($Gini_{health}$)		live births, increase life expectancy at birth from expected 60.5 years in 2015 to 62.5, 64.2 and 63.4 years and reduce inequality in age of death ($Gini_{health}$) substantially from 0.24 to 0.21, 0.18 and 0.19 when coverage achieve the government target levels, 90% coverage or 90% coverage of the five interventions with the highest impact, respectively.	
(Bishaia, Koenig, & Khan, 2003), Bangladesh	Measles vaccination	U5MR	SES/RR	++	Child deaths in vaccinated group was much lower than the unvaccinated group and RR of U5MR in intervention group was 2.27 and unvaccinated group was 1.42.	+/+
(Ahmed & Chowdhury, 2006), Bangladesh	BRAC intervention to provide antenatal care and family planning	Child mortality	SES/Risk ratio	++	Children of intervention group had 1.9 times lower risk (CL 1.09-3.25) of dying compared to non BRAC children.	+/+
(Zeng, Yan, Cheng, & Dibley, 2011), China	Supplement of multiple micronutrients	Infant mortality and U5MR	Wealth/RR	++	Iron/folic acid supplements greater impact on neonatal survival than multiple micronutrients. The intervention had a larger effect on poorer woman than the wealthier woman.	+/+
(Ruhago, Ngalesoni, & Norheim, 2012), Tanzania	Various MCH interventions	Child mortality and maternal mortality	Wealth/CIX	++	Equitable intervention coverage reduces child mortality rate by 286 per 100,000 live births in the poorest wealth quintile and 156 in the richest quintile. That reduces CIX from −0.11 to −0.03.	+/+
(Akseer et al., 2016), Afghanistan	Key eight MCH interventions and CCI	Infant and child mortality	Wealth/SII and CIX	+	If intervention coverage scaled-up to 90%, about 7700 newborns and 26,000 post-neonates could be saved and the effect is stronger in poorer quintiles.	+/+

(Mosquera et al., 2012), Bogotá – Colombia	Primary Health Care (PHC) strategy	IMR, U5MR and acute malnutrition	Quality of Life Index/CIX	++	PHC contributed to reduce inequalities in coverage. It was associated with a reduction in the effect of the inequality that affected disadvantaged localities in under-5 mortality (24%), IMR (19%) and acute malnutrition (7%).	+/+
(Mercer et al., 2004), Bangladesh	Family health visitor to provide family planning, counseling, contraceptives	Infant mortality, U5MR and maternal mortality	Income/RD	++	IMR reduced by 24.5/1000 live births among poorest children, 13.4/1000 among other children in the intervention area. U5MR also declined more in the poorest group.	+/+
(Boerma, Bryce, Kinfu, Axelson, & Victora, 2008), 54 countries	Eight MCH interventions and CCI	U5MR	Wealth/RD and RR	++	Coverage gap was reduced in most of the studied countries. And coverage gap index was correlated ($r=0.63$, $p<0.0001$) with U5MR.	+

Abbreviations: MCH-Maternal and child health, U5MR-under-five mortality rate, IMR-Infant mortality rate, RD-rate difference, RR-Rate Ratio, SII-Slope Index of Inequality, CIX-Concentration index of inequality, SES-Socioeconomic situation, FHP-Family health program

Notes: Quality of the study: ++ strong and + moderate

Effect on health outcome: + improved health outcome; Health equity: - No impact, + improved equity in health outcome, -- mixed result

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CHAPTER THREE: EFFECT OF ACCESS BARRIERS ON SERVICE USE IN MATERNAL HEALTH CARE: EVIDENCE FROM CAMEROON

3.1. BACKGROUND

Results of chapter two showed that coverage of skilled antenatal care and delivery care was the lowest among essential maternal and child health interventions and income inequalities in delivery care attended by trained medical personnel was the highest, followed by four or more antenatal care visits to health faculty in low- and middle-income countries. Huge income-related inequalities in maternal care were also evident from the recent literature (Houweling, 2007; Gage, 2007; Sado, 2014; Tsawe, 2015). Expansion of maternal health care coverage in low- and middle-income countries in last two decades improved availability, affordability, acceptability, and accessibility of health care (Jacobs, 2011). However, it is evident that the poor still benefit less from these improvements (Victora, 2003). Because improving only supply-side factors doesn't necessarily increase utilization of health care, particularly for poorer, uneducated and rural women. Demand-side factors play an important role to improve the use of modern health services, especially when it comes to reproductive health in developing countries (Jacobs, 2011). Maternal health care service is culturally sensitive, so that demand-side barrier such as getting permission to go for treatment from their husband or parents, and having no accompanying person to go to hospital cause underutilization of modern health care, even its available and affordable (Gage, 2007). For example, antenatal care may be less used in developing countries, because there is a perception that pregnancy is the non-illness life event that doesn't require to go for checkup in health facilities (Thaddeus, 1994; Ganatra, 1998). It creates difficulties for women to get permission to go for antenatal care from their relatives, particularly from husbands and parents in law (Cleland, 1988;

Ensor, 2004). Uneducated, poor women living in rural area reports more difficulties to the utilize health care than educated, richer and urban woman (Cleland, 1988; Rai, 2012; Thaddeus, 1994).

Therefore, the better understanding of the utilization of maternal care requires research not only on supply-side factors but also demand-side factors. However, impact of demand-side access barriers on health care use is an under-researched area in developing countries.

The aim of this study was to estimate the effect of access barriers on service use in maternal care in Cameroon to provide more evidence to the rare literature in developing countries.

The main strategic objective of Cameroon's health sector is to improve the health of the poorest and most vulnerable population. Heath programs against the burden of diseases targeted to the poorest, and primary healthcare are designed to bring health care closer to the people since 1985 in Cameroon.

Per capita health expenditure of Cameroon is 61 USD, which is the highest among sub-Saharan countries, except South Africa (World Bank, 2013). Hospitals and clinics are most widely present and equally distributed in urban and rural areas in Cameroon comparing to other 35 African countries (Armah-Attoh, Selormey, & Houessou, 2016). However, data have shown that Cameroon failed to improve utilization of health care for the poorest and also failed to improve health outcomes of the population. It is documented in the international reports that well off Cameroonians still have better access to health services (World Bank, 2013). Although coverage of key maternal and child health interventions increased over time, coverage for the poorest mothers and children did not improve much and even decreased for some interventions. For example, the percentage of live births assisted by a skilled provider decreased by 60 percent and percentage of live births delivered at a health facility was decreased by 55 percent in the poorest wealth quintile between 1991 and 2011, while coverage of other well-off wealth quintiles

increased. Income-related inequality in maternal and child health intervention coverage is one of the highest among African countries.

Health status of the population of Cameroon also did not improve much and even got worse in the last two decades. Life expectancy of the population of Cameroon decreased by two years, while the average life expectancy of sub-Saharan Africa increased by five years (World Bank, 2013). On average, there is no significant improvement in maternal and child health outcomes in the last two decades in Cameroon. Cameroon ranks top sixth, according to U5MR in the latest surveys of 27 African countries, where availability of modern health care is lower than Cameroon. Inequality in child mortality is the second highest among the African countries. There is a huge gap in child and maternal mortality rate of richest and poorest wealth quintiles and it remains wide over time. Ongoing supply-side interventions, such as strengthening health system, improving the availability of health facilities for the poor, decentralization of management and planning, co-financing of health care costs in Cameroon doesn't show significant impact on underutilization of health care and health outcome. The case of Cameroon called research for determinants of utilization of health care, other than the supply side factors.

3.2. LITERATURE REVIEW: ACCESS BARRIERS TO HEALTH CARE IN LOW-INCOME AND MIDDLE- INCOME COUNTRIES

Whether the woman and children are able to access healthcare depends on many factors, including supply and demand side factors. Over the last two decades, international communities largely concerned about supply-side factors, such as availability of health facilities, adequacy of health professionals, free or affordable healthcare service, more health insurance coverage etc. Recent literature has established that improvements in essential maternal and child health care contributed to reduce health inequalities (Bhutta et al., 2013; Zeng, Yan, Cheng, & Dibley, 2011; Mosquera et al., 2012) and improve health outcomes (Clermont, 2017; Friberg et al., 2010; Garchitorena et al., 2018). However, utilization of health care remains limited in low- and middle-income countries due to various economic, cultural and physical barriers, known as access barriers to health care in the literature. And access barriers negatively affect equity in health service utilization, well as health outcomes.

Therefore, it is important to pay attention to both demand side and supply side factors to improve access to health care service, which is critical for health outcomes.

Consumer fee barrier

Poor of the poorest countries often experience more difficulties than the better off, when they need health care. They face difficulties to access health care, because the health care service fee is not affordable for the poor, or even the service is free, they still need to make informal payments or bribes. Recent studies have shown that financial problems are the most significant barrier when women seek medical care. For example, a Bangladeshi study (Barkat, Helali, Rahman, Majid, & Bose, 1995) showed that 45.5 percent of women don't seek for care in obstetric emergencies, because of relatively high cost to utilize such service. More evidence from Africa (Gilson, 1997;

Mbugua, Bloom, & Segall, 1995) also confirms that the cost of health care service prevents people to seek health care and its true especially for the poor. A cross-country study (Russell & Gilson, 1997), which includes 26 low- and middle-income countries showed that many of the studied countries have no specific policy to exempt the user fee for the poor and even there is such a policy exist, its often fail to properly implemented in real life situation, because of many reasons including economic, informational and political constraints. The importance of individual financial barrier is also addressed in another multicounty study (McNamee, Ternent, & Hussein, 2009), which examined common barriers in health system level, provider level, patient and community level. The result showed that inpatient and community level, financial constraints were the most common barrier to utilize health care among studied countries. The authors concluded that financial barrier is the cause of missed appointments and delayed seeking care especially for patients living in the remote rural area.

Distance and transportation barrier

Distance and transportation are known as one of the most important access barriers to health care in the literature. Long distance to health facility, poor transportation, and transportation costs may lead to missed appointments or delayed care, which eventually lead to poorer health outcomes (Syed, Gerber, & Sharp, 2013).

In rural South Africa, people need to travel an average of 81 minutes to reach to the nearest clinic and longer travel time was significantly linked to the lesser use of health care(Tanser, Gijsbertsen, & Herbst, 2006). A study from Uganda suggested that the distance is more important barrier than the quality or cost of health care service for many Ugandan women. Other studies from Mali (Gage, 2007), Indonesia (Matsuoka, Aiga, Rasmey, Rathavy, & Okitsu, 2010), Canada (Tanser et

al., 2006) consistently showed that distance to the health facility is associated to underutilization of health care service, especially in rural settings.

Long distance to health care is closely linked with the transport barrier. Transport barrier includes transport cost, transport, and fuel shortage, transport network management, social and cultural restrictions on the woman and children's mobility (Martin-Prével, Traissac, Delpeuch, & Maire, 2001; Schmidt, 2008). When the distance is long, transportation is not readily available and costly, woman and children choose to walk a great distance in the unfavorable environment to get health care in developing countries. Woman are less likely to seek preventive care when they need to pay for transport or walk for long distance. They often choose to delay health care or use traditional birth assistants, local and traditional healers, home-based remedies and private drug sellers, except severe illness (Schmidt, 2008).

Social and cultural attitudes also restrict a woman to travel for a long distance without permission from relatives and accompanying persons to seek health care. These social and cultural barriers worsen the negative effect of distance and transport barriers on the utilization of health care in developing countries (Shaikh & Hatcher, 2004).

Social, cultural and knowledge barriers

Social and cultural barriers accessing health care may prevent women from utilizing health services, even its available and affordable (Gage, 2007). In some cultures, women are expected to stay at home, and they need permission to go for treatment for herself or her child, even in the emergency situation. Also buying medicine, contraception use, the emergency Caesarian section requires husband's and father's permission. If the father doesn't give permission to have surgery, doctors have no right to do so (Ismail, 2013).

Also, women need to have an accompanying person when they travel to get access to medical care, especially during pregnancy. The reason why they do not want to go alone to access health care is many. Woman need somebody to accompany to avoid potential risks during the travel to health facilities when the distance is long, transportation is unsafe or unavailable, or they need to walk for hours to get health care. About 64 percent of Ethiopian women reported that not wanting to go alone is a big problem when they need health care. And utilization of antenatal care and professional delivery care is more than two times lower for a woman with such barrier than a woman without such barrier (Onarheim, Taddesse, Norheim, Abdullah, & Miljeteig, 2015).

Perception of illness plays an important role in seeking treatment and utilization of health care. Antenatal care maybe less used in developing countries, because there is a perception that pregnancy is a non-illness life event that doesn't require to go for checkup in the hospital (Thaddeus, 1994; Ganatra, 1998). It creates difficulties for women to get permission to go for antenatal care from their relatives, particularly from husbands and parents in law (Cleland, 1988; Ensor, 2004).

There is a lack of knowledge about the potential harms of illness and potential benefits of modern treatment and medical technologies (O'Donnell, 2007). An evidence from India showed that about 30 percent of mothers have no knowledge about the benefits of child vaccination, and moreover they do not know where to go get immunization for their children. As a result, 40 percent of children in India are not fully vaccinated when immunization is free (Pande & Yazbeck, 2003).

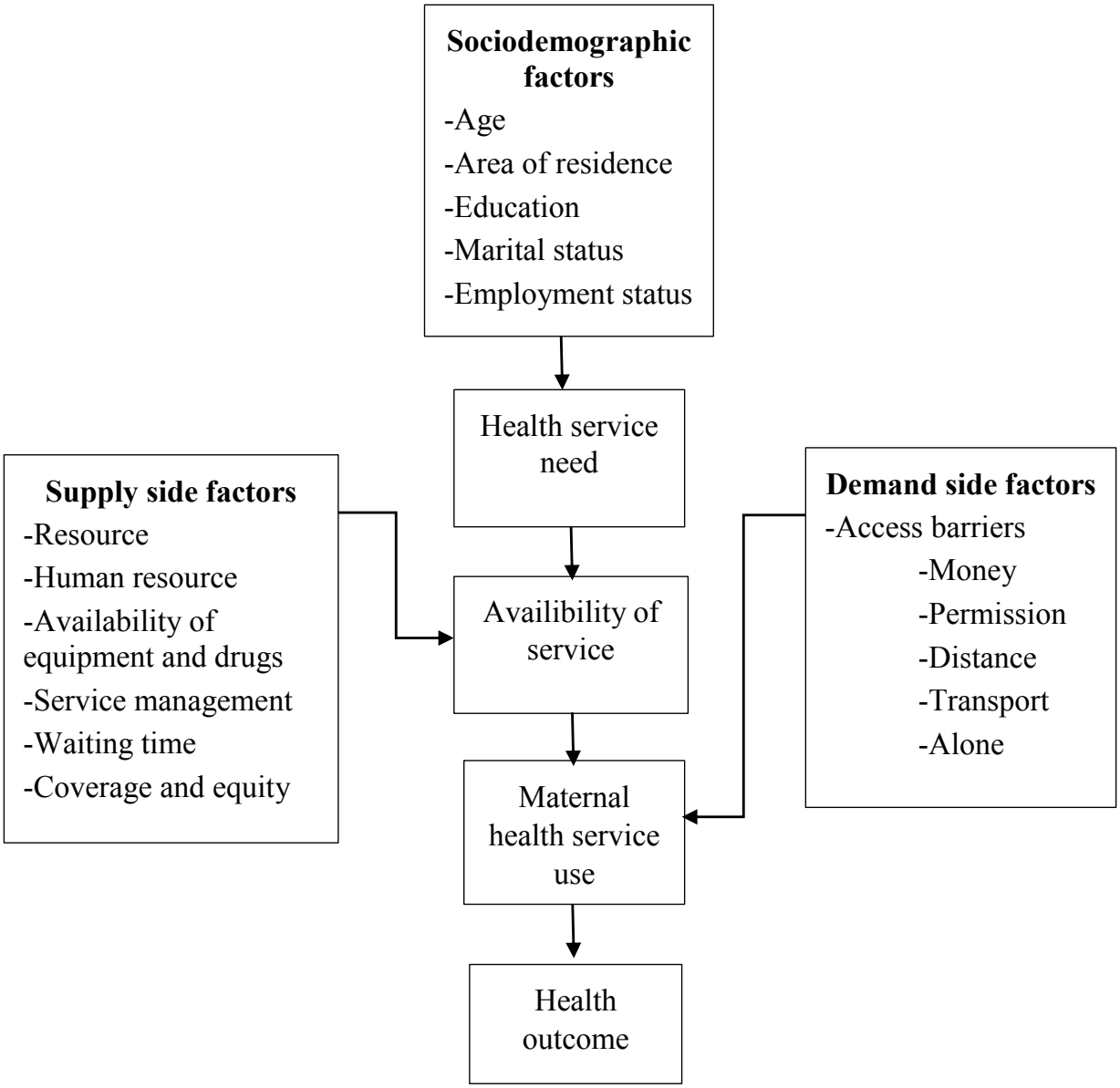
Conclusion

Increased funding, more health personnel or medical equipment doesn't necessarily guaranty improved access to health care, especially for the socioeconomically disadvantaged population. Demand-side barriers such as money for getting treatment, distance to health facility, transport, getting permission to go for treatment and not wanting to go alone play an important role to determine the utilization of health care. Moreover, these barriers are closely related to each other and the effect of having such barriers get stronger when two or more barriers combined. Long distance to health care makes people travel hours on the poor road by unsafe transportation. Also when women need to travel a long distance to seek health care they need someone to accompany, which makes indirect health care cost even higher.

Demand-side barriers cited as an important determinant of utilization of health care, especially in rural settings of developing countries. Demand-side barriers also determine health outcomes in resource-poor settings (Adedini, Odimegwu, Bamiwuye, Fadeyibi, & Wet, 2014) (Figure 3.1). Therefore, it is important to consider demand-side interventions as much as supply-side interventions, when formulating health policies and strategies to improve utilization of effective health interventions and improve health outcomes.

However, systematic attempts to examine the effects of access barriers to health care on utilization and health outcomes are not sufficient in developing the world. Future studies not only need to address the importance of access barriers to health care on utilization of health care and health outcomes but also need to examine which barriers have the strongest effect on missed or delayed health care and bad health outcomes to prioritize demand-side interventions for designing effective health policies.

Figure 3.1. Conceptual model of factors related to maternal health service use



3.3. OVERVIEW OF COUNTRY CONTEXT

Cameroon is a lower middle-income country, located in Central Africa. The country borders with Nigeria, Chad Equatorial Guinea, the Central African Republic and Gabon. Cameroon is divided into ten major regions and 58 divisions (Egbe, 2013).

The countries total population is estimated at 24.6 million as of 2018 and 58 percent of the population live in urban areas. Average life expectancy at birth for the male is 57 and the female is 59 (WHO, 2016).

Almost 70 % of the population is Christian, 21% is Muslim and rest has other or no religion. GDP (PPP) of Cameroon is 76.9 billion dollar and GDP per capita is 3249 dollars. More than eight million people live in poverty (WB, 2016).

Health system and health policy

The healthcare system of Cameroon consists of various public, private and traditional health organizations and institutions. The system is divided into three levels as described in Table 3.1.

Table 3.1. Structure of health sector in Cameroon

Structures	Health care levels		
	Central	**Intermediate**	**Peripheral**
Administrative	Ministry of Public Health (MoH)	Provincial delegations	District health services
Health care organizations	The general hospitals, the Hospital-Universities Centers, the central hospitals and agencies under MoH.	The provincial hospitals and assimilated.	The district hospitals, medical centers and district health centers.
National Essential Drugs Supply System	National Center to supply essential drugs, private wholesalers, the central purchasing of the private non-profit sector.	Provincial Pharmaceutical Supply Center and the pharmacies in general hospitals.	Public and private pharmacies.

Source: www.medcamer.org

Ministry of Public Health of Cameroon is responsible for formulating health policies, strategies and concepts, as well as coordinating and regulating the health care organizations belongs to the central level of health system structure. General hospitals, the Centers Hospital-Universities, the central hospitals and agencies under MoH, which are public health organizations all belong to MoH.

The intermediate level is administrated by different provincial delegations that provide technical support to the health districts. The peripheral level is the operational level responsible for the implementation of the national programs at the districts (Egbe, 2013; Prime, 2018). The country has 162 district hospitals 2043 public medical facilities.

About 5.5 percent of GDP spent for healthcare and the main source of funding comes from the government, public enterprises, foreign aid donors, private enterprises, households, religious missions and Non-Governmental Organisations (Ntangsi, 2013).

Health insurance is almost doesn't exist in Cameroon and people pay a high price for health care regardless of their socioeconomic situation (Gaston Sorgho). The government of Cameroon is responsible for financing salaries of health workers, training, and other inputs provided and the population pays the rest of the cost of primary health care (Egbe, 2013).

Health policy and key interventions

The government of Cameroon develops annual Health Sector Development Program and Health Sector Strategy since 2001, which involves health sector planning and management.

The main objectives of health sector strategy are:

- Reduce the burden of disease by one third among the poorest and most socioeconomically disadvantaged population
- Reduce under-five mortality rate by two thirds and maternal mortality rate by 3/4 as stated by health-related goal of MDGs and SDGs
- Improve efficiency and management of health system at all levels
- Strengthen provincial and district level hospitals to contribute to achieving the above-mentioned objectives.

Cameroon's major health interventions are developed to fight against the top causes of morbidity and mortality in the country, which includes malaria, measles, malnutrition, lower respiratory infections, diarrhea and HIV/AIDS. Cameroon developed various programs for the fight against malaria, tuberculosis, leprosy, trypasomiasis, buruli ulcer, cancer, Guinea worm, onchocerciasis and polio with well stated strategic plans. Some of the programs already shown the positive impact on reducing morbidity and mortality. For example, mortality caused by malaria reduced after the implementation of the program against malaria (Egbe, 2013a).

Health care coverage and health status

Table 3.2 compares Cameroon's main indicators of maternal and child health care coverage, health outcome and inequalities in health with African countries and developing countries. The information in this table is extracted from the data of chapter two, which includes data from 27 African countries and 42 developing countries.

Table 3.2. Health care coverage and health outcome indicators

Indicators	Cameroon	Africa	Developing countries
Under-five mortality rate (per 1000 live births)	122	97	79
CIX of U5MR	22.4	8.4	8.1
Composite coverage index (%)	59	62	66
CIX of CCI	14.0	9.2	7.5
Antenatal care visits (4<) (%)	62.2	53.2	56.9
Skilled delivery care (%)	63.6	58.3	61.8
DPT3 vaccination coverage (%)	68.9	73.4	74.7
Measles vaccination coverage (%)	70.5	74.7	76.2
BCG vaccination coverage (%)	87.06	87.1	88.9

Hospitals and clinics are most widely present and equally distributed in urban and rural areas in Cameroon comparing to other 35 African countries (Armah-Attoh, Selormey, & Houessou, 2016). However, coverage of child health interventions relatively low compared to an average coverage of African region and other developing countries. And coverage of maternal health interventions slightly higher than Africa and developing countries average, where health facilities are not adequate as Cameroon. Income-related inequality in maternal and child health intervention coverage is one of the highest among African countries. Although coverage of key maternal and child

health interventions increased over time, coverage for the poorest mothers and children did not improve much and even decreased for some interventions (Table 3.3). For example, the percentage of live births assisted by a skilled provider decreased by 60 percent and percentage of live births delivered at a health facility was decreased by 55 percent in the poorest wealth quintile between 1991 and 2011, while coverage of other well-off wealth quintiles increased.

Cameroon ranks top sixth, according to U5MR in the latest surveys of 27 African countries. Inequality in child mortality is the second highest among the African countries. On average, there is no significant improvement in maternal and child health outcomes in the last two decades in Cameroon. There is a huge gap in child and maternal mortality rate of richest and poorest wealth quintiles and it remains wide over time (Table 3.4).

As we discussed in the previous section, the main objective of Cameroon's health sector is to improve the health of the poorest and most vulnerable population. Heath programs against the burden of diseases target to the poorest and primary healthcare is designed to bring health care closer to the people since 1985 in Cameroon. However, data have shown that Cameroon failed to improve utilization of health care for the poorest and also failed to improve health outcomes of the population. Ongoing supply-side interventions, such as strengthening health system, improving the availability of health facilities, decentralization of management and planning, co-financing of health care costs in Cameroon doesn't show significant impact on underutilization of health care and health outcome. This makes us think of demand-side barriers which may prevent population to utilize readily available and affordable health care service.

Table 3.3. Main indicators of maternal and child health intervention coverage of Cameroon by wealth quintiles

Survey year	Wealth quintiles					Average
	Lowest	Second	Middle	Fourth	Highest	
Percentage of live births in the five years preceding the survey who received antenatal care from a skilled provider						
1991 DHS	50.9	69	77.9	91.7	98.8	78.2
2004 DHS	60.6	71.4	85.9	92.2	96.2	80
2011 DHS	57.2	82	92.2	96.3	98.5	84.7
Percentage of live births in the five years preceding the survey assisted by a skilled provider						
1991 DHS	32	48.4	57.8	81.2	94.7	63.5
2004 DHS	27.2	41.3	68.7	83.2	93.3	58.9
2011 DHS	19.1	54.5	75.3	89.5	96.8	63.6
Percentage of live births in the five years preceding the survey delivered at a health facility						
1991 DHS	31.1	46.8	56.9	79.5	93	62.2
2004 DHS	27.6	42.5	68.2	83.9	91.2	59
2011 DHS	17.1	52.5	71.9	86.7	95	61.2
Percentage of children 12-23 months who had received all 8 basic vaccinations						
1991 DHS	27.4	27.3	29.9	46.5	63.5	40
2004 DHS	36.4	47.4	50.8	50.8	60.3	48.2
2011 DHS	32.3	51.1	56.7	61.3	70.3	53.2

Source: DHS database.

Table 3.4. Key maternal and child health outcome indicators of Cameroon by wealth quintiles

	IMR (per 1000 live birth)				U5MR (per 1000 live birth)				MMR (per 10000 live birth)	
Survey	1991 DHS	1998 DHS	2004 DHS	2011 DHS	1991 DHS	1991 DHS	2004 DHS	2011 DHS	2004 DHS	2011 DHS
Lowest WQ	104	108	101	90	201	199	189	184	NA	
Second WQ	101	86	91	71	171	162	162	144		
Middle WQ	79	73	83	66	142	136	150	120		
Fourth WQ	65	59	63	58	120	117	115	90		
Highest WQ	51	56	51	51	82	87	88	72		
Average WQ	64	77	74	62	125	151	144	122	729	676

Source: DHS database and Databank of World bank

Note: WQ-weath quintile, IMR-infant mortality rate, U5MR-under-five mortality rate, MMR-maternal mortality rate
Disagrregated data for MMR were not available.

3.4. DATA AND METHODS

3.4.1. Data source

We used population-based, cross-sectional data from the 2004 and 2011 Demographic and Health Survey (DHS) of Cameroon in this study. The survey elicited information on demographic and health indicators from a nationally representative sample of 29455 and 43312 live births in five years pressing the survey of 2004 and 2011, respectively. Data were collected from face-to-face interviews from women age 15-49. The latest two DHS of Cameroon asked women whether each of the following factors would be a big problem or not a big problem in seeking health care for themselves: getting permission to go for treatment, getting money for treatment, distance to health facility, not wanting to go alone, having to take transport. This information allowed us to examine the effects of these barriers on the utilization of maternal care.

Mother's individual and household characteristics, mother's problems accessing health care and access to maternal health interventions were collected.

Methods

Following multiple logistic regression models were used to examine the effects of demand side barriers on access to skilled antenatal care and delivery care in Cameroon.

$$logit\ (q_i) = \ln \frac{(q_i)}{(1 - q_i)} = \beta_0 + \ \beta_i P + \alpha_i \bar{x} + e_i$$

Where; q_i – is the odds ratio of a woman having four or more antenatal care visits or delivery attended by skilled health personnelversus not having at least four antenatal care visits or no health personnel attended during delivery, β_i – represents the effects of barriers to accessing health care, α_i is the effects of individual background characteristics and household characteristics.

Further, to examined how barriers to health care influence on maternal health care, five different models were fitted for each barrier, such as getting permission to access health care, not wanting to go alone, getting money needed for treatment, distance to health care facility and having to take transportation when the respondent is sick. These univariate models examine the independent effect of the financial barrier to health care on skilled antenatal care and skilled delivery care. Then we included all five access barriers into one model, to examine the relative importance of the barriers. The main concern about this model was the multicollinearity issue which leads to the biased result since the review of previous studies showed that money, transport and distance barriers closely linked with each other. Multicollinearity test result has shown that there is no severe collinearity between access barrier variables. However, we still had to be careful especially with money, distance, and transport barriers. Therefore we run regression omitting one barrier variable each time and saw how the significance of coefficients and their standard errors change. When we run regression omitting money barrier the significance of distance and transport barriers variables has changed. It indicates that there is a multicollinearity issue in this model. Then we combined money, transport and distance barriers together into one binary variable and included in the model with the other two barriers to examine the effect of each barrier on the utilization of maternal care. Each of the models is controlled for individual background characteristics and household characteristics, known to be associated with utilization of health care from the previous literature.

3.4.2. Variables and definitions

Dependent variable

The dependent variable in this study is four or more antenatal care visits during pregnancy, defined as the probability of having at least four antenatal care visits to health professionals. This is measured as binary outcome, 0 if pregnant woman received no antenatal care, 1 if pregnant woman visited to health professionals at least four times for antenatal care.

Independent variables

In terms of exposure, the main independent variables of interest were five barriers, which prevent woman to access health care. In the DHS women data, women were asked whether a range of factors would be a big problem for them in accessing health care. These factors included: getting permission to access health care, not wanting to go alone, getting money needed for treatment, distance to health care facility and having to take transportation when the respondent is sick. This set of questions give an answer to the major barriers preventing her from getting a medical advice or treatment.

Responses to these questions were categorized as: 0 if above mentioned problems considered “no problem” or “not a big problem” and 1 if it is a big problem.

Other independent variables that are known to affect access to health care are taken from the exiting literature,such as woman’s age at birth, educational attainment, and employment status, number of children, marital status, living area and economic status. Refer to the Table 3.5 for more detailed information about the dependent and independent variables.

Table 3.5. Variables and definitions

Variable name	Type	Definition
Dependent variable		
Four or more antenatal care visits	Binary: 0 = received no antenatal care 1 = received four or more antenatal care	Four or more visits to health professionals for antenatal care.
Births attended by skilled health personnel	Categorical: 0 = trained medical birth attendant was not present during delivery 1 = skilled birth attendant were present during delivery	Doctors, nurses and midwives or one of them assisted with the delivery of the child.
Independent variables		
Problems accessing health care		
Permission	Categorical: 0= Not a big problem 1 = A big problem	Getting permission to go for treatment for themselves when they are sick.
Money	Categorical: 0= Not a big problem 1 = A big problem	Getting money for treatment for themselves when they are sick.
Distance	Categorical: 0= Not a big problem 1 = A big problem	Distance to health facility for treatment for themselves when they are sick.
Having to take transportation	Categorical: 0= Not a big problem 1 = A big problem	Having to take transport for treatment for themselves when they are sick.
Going alone	Categorical: 0= Not a big problem 1 = A big problem	Not wanting to go alone for treatment for themselves when they are sick.
Physical	Categorical: 0= Not a big problem 1 = A big problem	Barrier indicator, combining money, transport, and distance barriers
Individual characteristics		
Age of woman	Categorical:0 = 20 or younger, 1= 20-34, 2=35-49	Woman's age
Woman's education	Categorical: 0 = no education, 1= primary, 2=secondary, 3 = higher	Mother's highest education attained.
Marital status	Categorical: 0 = not married, 1= married	Mother's current marital status.
Employment status	Categorical: 0 = unemployed, 1= employed	Worked or not in the 12 months preceding the survey.
Parity	Categorical: 0 = 1-2 children, 1= 3-5 children 2=6 or more	Total number of living children of the mother.

Religion of woman	Categorical: 0 = no religion, 1 = Catholic, 2=Muslim, 3=Protestant, 4=other	Religion of woman
Household characteristics		
Wealth	Categorical: 1 = poorest, 2 = poorer, 3=middle, 4=richer, 5= richest	Wealth index factor score.
Urban	Categorical: 0=rural, 1=urban	Whether the respondent lives in urban area.
Head of the household	Categorical: 0=male headed, 1=female headed	Whether head of the household is female or male

3.5. RESULTS

3.5.1. Results of descriptive analysis

3.5.1.1. Summary of data

Information on 71767 live births in five years preceding the survey of 2004 and 2011 is analyzed in this study. Total of eighteen percent (12932) of the sample size has information on antenatal care visits and 26.7 percent (19164) of the total sample size has data on skilled delivery care.

Table 3.6 displays a summary of utilization of skilled antenatal care and delivery care in Cameroon.

Table 3.6. Summary of utilization of skilled antenatal care and delivery care in Cameroon

VARIABLES	2004 DHS		2011 DHS	
	N	%	N	%
Four or more antenatal care visits				
Received no or less than four antenatal care	2109	40	2840	37
Received four or more antenatal care	3134	60	4799	63
Total	**5243**	**100**	**7639**	**100**
Births attended by skilled health personnel				
Skilled birth attendant were not present during delivery	3334	41	4671	42
Skilled birth attendant were present during delivery	4758	59	6401	58
Total	**8092**	**100**	**11072**	**100**

About sixty percent of the woman had four or more antenatal care visits to skilled health professionals in 2004 and it increased by three percent in 2011. About 59 percent of the woman

had delivery care attended by trained medical personnel and its decreased by one percent in 2011. Approximately 40 percent of the woman had no sufficient antenatal care from skilled health personnel during pregnancy and had no doctor or nurses were present during delivery.

Variables used in modeling utilization of maternal health care are presented in Table 3.6. Getting money for treatment when the women are sick was the greatest barrier, as 72 to 77 percent of the woman reported it is the big problem. Women reported the least difficulties (21-23 percent) going alone to the health facilities when they need health care. The barrier to getting permission to go for health care increased by three times during the studied period. More than forty percent of woman reported distance to health care and having to take transportation is a big problem when they need health care.

More than half of the respondents were aged between 35 and 49. About 60 percent of the woman resides in the urban area. Majority of the woman (about 70 percent) have primary or higher education and 30 percent of them were uneducated. Almost half of the woman belongs to the poorest and poorer wealth quintiles. Although the woman in the poorest wealth quintile decreased by three percent, the woman in the poorer wealth quintile increased by four percent between 2004 and 2011.

Table 3.7. Summary of variables used in modeling utilization of maternal healthcare

VARIABLES	2004 DHS		2011 DHS	
	N	%	N	%
Money				
Not a big problem	8316	28	4667	23
Big problem	21092	72	15734	77
Transportation				
Not a big problem	17287	59	NA	
Big problem	12106	41		
Distance				
Not a big problem	16858	57	11790	58
Big problem	12536	43	8605	42
Permission				
Not a big problem	26045	89	14159	69
Big problem	3346	11	6245	31
Alone				
Not a big problem	23313	79	15685	77
Big problem	6076	21	4688	23
Woman's age				
<20	765	3	1022	2
20-34	13175	44	18776	44
35-49	15515	53	22514	54
Residence				
Urban	17849	61	25531	60
Rural	11606	39	16781	40
Education				
No education	8987	30	12554	30
Primary	13222	45	18185	43
Secondary	7009	24	10679	25
Higher	237	1	894	2
Wealth quintile				
Lowest	7095	24	8920	21
Second	5939	20	10143	24
Middle	6857	23	9356	22
Fourth	5322	18	7837	19
Highest	4242	15	6056	14

Marital status				
Not married	7599	26	11943	28
Married	21856	74	30369	72
Parity				
0	251	1	275	1
1-2	5216	18	7417	17
3-5	12314	41	19440	46
6<	11674	40	15180	36
Work				
Not working	7154	24	9752	23
Working	22291	76	32462	77
Total	**29455**	**100**	**42312**	**100**

3.5.1.2. Equity analysis on access barriers and utilization of maternal care

Inequality in access barriers

Poor woman, with no education in rural areas may face more difficulties accessing health care when they need. Table 3.8 displays the percentage of the woman reported access barriers by wealth quintiles. It shows that there are substantial disparities in access barriers according to wealth quintiles. Access barriers reduced significantly during the studied period, except getting permission to go for treatment. Wealthier women reported more difficulties to get permission to go for treatment in 2011 than in 2004. However, the wealthier woman reported much less difficulties in utilizing health care than the poorer women.

We estimated summary measures of wealth-related inequality in access barriers (Table 3.9). According to the rate difference and rate ratio estimations, greatest inequality in access barrier that women in Cameroon experience was the distance to the health facility when they need health services, followed by getting money for treatment and having to take transportation. The poorest

woman experience approximately two times more difficulties to use health services because of money, distance, and transport.

Inequality in access barriers reduced in Cameroon during the studied period. The most significant reduction is noticed in inequality in money barrier with 25 percent.

Table 3.8. Percentage of women reported access barriers by wealth quintiles

Survey year	Wealth quintile					Average
	Lowest	Second	Middle	Fourth	Highest	
Getting permission to go for treatment						
2004 DHS	20.2	17.2	14.5	10.6	10.6	14.3
2011 DHS	16.2	15.7	15.2	11.8	12.6	14
Getting money for treatment						
2004 DHS	84.6	76.6	67.5	59.6	46.9	65.6
2011 DHS	43.4	36.9	37.4	32	30.7	35.4
Distance to health facility						
2004 DHS	61.8	51.4	35.6	27.3	24.3	38.7
2011 DHS	28.5	21.9	19.2	13.6	12.3	18.2
Having to take transport						
2004 DHS	59.6	49.3	35.2	26.2	21.9	37
2011 DHS	NA	NA	NA	NA	NA	NA
Not wanting to go alone						
2004 DHS	37.7	28.4	23.5	20.8	20.9	25.8
2011 DHS	16.1	13.3	12.9	9.2	10	12

Source: DHS of Cameroon, 2004 and 2011

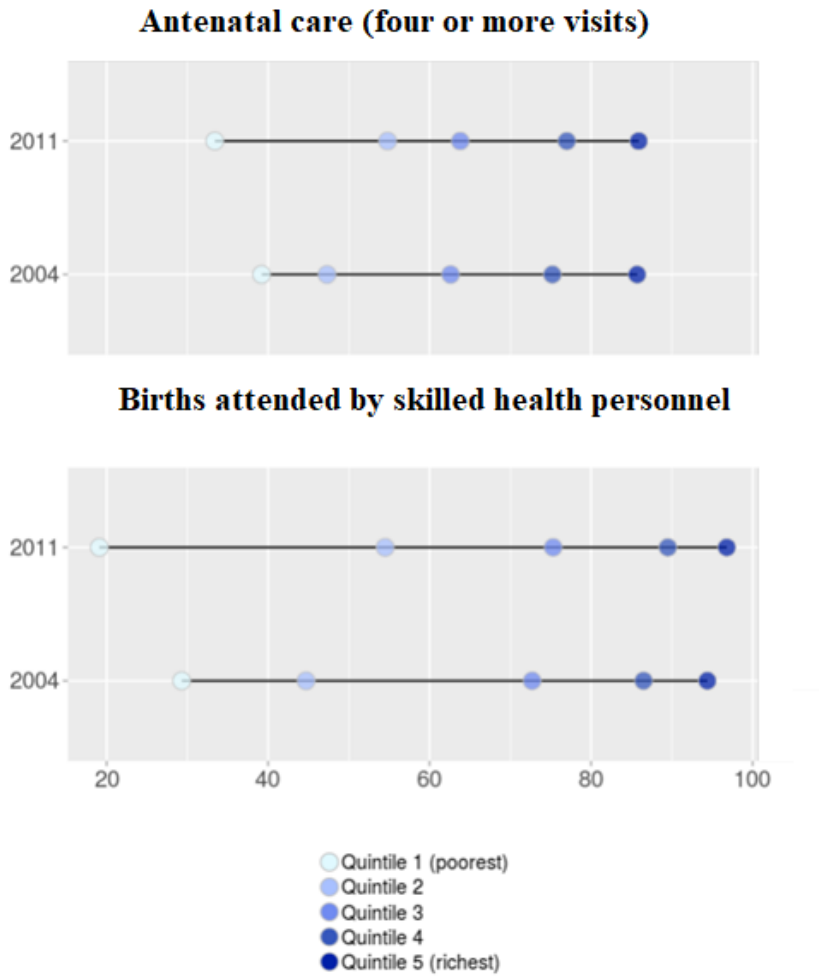
Table 3.9. Summary measures of wealth-related inequalities in access barriers and their change over time

Access barriers	Rate Difference (Poorest-Richest)		Rate Ratio (Poorest/ Richest)		Change in	
	2004	**2011**	**2004**	**2011**	**rate differene**	**rate ratio**
Getting permission to go for treatment	9.6	3.6	1.9	1.3	6	0.6
Getting money for treatment	37.7	12.7	1.8	1.4	25	0.4
Distance to health facility	37.5	16.2	2.5	2.3	21.3	0.2
Having to take transport	37.7	NA	2.7	NA	NA	NA
Not wanting to go alone	16.8	6.1	1.8	1.6	10.7	0.2

Inequality in maternal health service utilization

We also examined the magnitude of inequality in maternal health service use. Maternal health service is more utilized by wealthier women in Cameroon. The gap between rich and poor in terms of maternal health care use in Cameroon is huge and even increased over time (Figure 3.2).

Figure 3.2. Maternal health service use by wealth quintiles, DHS 2004 and 2011



Source: *Health Equity Assessment Toolkit (HEAT): Software for exploring and comparing health inequalities in countries. Built-in database edition. Version 2.1. Geneva, World Health Organization, 2018.*

According to inequality measures of the latest survey, the woman in the richest wealth quintile utilizes skilled antenatal care 2.6 times and skilled delivery care 5.2 times more than the woman in the poorest wealth quintiles (Table 3.10).

Table 3.10. Estimation of inequality measures of maternal service use and its changes

Summary indicators	ANC		SBA		Change in	
	2004	2011	2004	2011	ANC	SBA
Rate Difference	46.5	52.5	62.8	78.7	6	15.9
Rate Ratio	2.2	2.6	3.1	5.2	0.4	2.1
CIX	9.6	10.2	13.9	15.7	0.6	1.8

Source: WHO health equity monitor database

All three inequality measures showed that inequaity in maternal health services increased during studied period. Gap between the poorest and the richest increased by six percent for antenatal care and 16 percent for the delivery care. The ratio between the poorest and richest increased by two times.

Results from equity analysis showed that there are there are disproportional barrier issues against poorer women and huge and increasing inequalities in the utilization of maternal health service.

3.5.2. Effect of access barriers on utilization of maternal care

Table 3.10 and 3.11 reports the results of multiple logistic regression models, which examines the effects of each barriers accessing health care on skilled antenatal care and delivery care in Cameroon.

The results show that problems accessing health care, such as getting money for treatment, distance to health facility, having to take transport, getting permission to go for treatment and not wanting to go alone for treatment for themselves when they are sick have negative effects on antenatal care and delivery care.

The adjusted odds ratios of both skilled antenatal care and delivery care were significantly lower (OR=0.730*** and OR=0.783***) if women report getting money for treatment is a big problem than if they reported money is not a big problem. Similarly, the woman with distance, transport, getting permission and going alone to access health care have significantly (13-29 %) lower utilization of skilled antenatal care and delivery care.

Table 3.11. Effects of access barriers on utilization of antenatal care

BARRIER VARIABLES	(1) Money	(2) Transportation	(3) Distance	(4) Permission	(5) Alone
Problem					
Not a big problem	1	1	1	1	1
Big problem	0.730***	0.776***	0.714***	0.776***	0.807***
	(0.0409)	(0.0386)	(0.0463)	(0.0462)	(0.0465)
Woman's age at birth					
<20	1	1	1	1	1
20-34	1.348***	1.337***	1.282**	1.340***	1.340***
	(0.110)	(0.109)	(0.134)	(0.109)	(0.109)
35-49	1.842***	1.805***	1.768***	1.810***	1.810***
	(0.204)	(0.200)	(0.257)	(0.200)	(0.200)
Residence					
Rural	1	1	1	1	1
Urban	1.336***	1.255***	1.331***	1.320***	1.312***
	(0.0881)	(0.0836)	(0.111)	(0.0870)	(0.0866)
Education					
No education	1	1	1	1	1
Primary	1.969***	1.986***	2.059***	1.980***	1.963***
	(0.129)	(0.130)	(0.174)	(0.130)	(0.129)
Secondary	3.006***	3.061***	2.844***	3.048***	3.016***
	(0.251)	(0.256)	(0.307)	(0.255)	(0.252)
Higher	7.941***	7.890***	11.12***	8.116***	7.887***
	(2.988)	(2.967)	(8.141)	(3.051)	(2.966)
Wealth quintile					
Lowest	1	1	1	1	1
Second	1.340***	1.348***	1.160	1.373***	1.356***
	(0.0956)	(0.0962)	(0.107)	(0.0979)	(0.0966)
Middle	1.695***	1.719***	1.618***	1.756***	1.739***
	(0.131)	(0.133)	(0.156)	(0.136)	(0.134)
Fourth	2.620***	2.712***	2.402***	2.768***	2.741***
	(0.252)	(0.260)	(0.286)	(0.265)	(0.262)
Highest	3.893***	4.143***	3.716***	4.217***	4.216***
	(0.464)	(0.492)	(0.556)	(0.499)	(0.499)
Marital status					
Not married	1	1	1	1	1
Married	1.402***	1.414***	1.379***	1.428***	1.426***
	(0.0854)	(0.0859)	(0.108)	(0.0867)	(0.0866)

Parity					
0	1	1	1	1	1
1-2	1.169	1.176	1.285	1.166	1.172
	(0.237)	(0.239)	(0.311)	(0.236)	(0.237)
3-5	0.998	1.009	1.101	0.997	0.996
	(0.204)	(0.207)	(0.270)	(0.204)	(0.204)
Work					
Not working	1	1	1	1	1
Working	1.123**	1.132**	1.093	1.115*	1.127**
	(0.0629)	(0.0634)	(0.0806)	(0.0625)	(0.0630)
Head of the household					
Male headed	1	1	1	1	1
Female headed	0.820***	0.832***	0.844**	0.834***	0.825***
	(0.0537)	(0.0545)	(0.0724)	(0.0547)	(0.0540)
Religion					
No religion	1	1	1	1	1
Catholic	0.697***	0.695***	0.679***	0.724***	0.699***
	(0.0834)	(0.0832)	(0.0986)	(0.0867)	(0.0835)
Muslim	1.023	1.012	0.987	1.014	1.001
	(0.117)	(0.116)	(0.133)	(0.115)	(0.114)
Protestant	0.850	0.846	0.895	0.833	0.828
	(0.123)	(0.122)	(0.159)	(0.120)	(0.119)
Other	(0.0190)	(0.0206)	(0.0203)	(0.0192)	(0.0172)
Constant	0.339***	0.295***	0.320***	0.271***	0.280***
	(0.0850)	(0.0732)	(0.0960)	(0.0666)	(0.0691)
Observations	8,916	8,913	5,290	8,916	8,914

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3.12. Effects of problems accessing health care on utilization of delivery care

VARIABLES	(1)	(2)	(3)	(4)	(5)
	Money	Transportation	Distance	Permission	Alone
Problem					
Not a big problem	1	1	1	1	1
Big problem	0.783***	0.770***	0.785***	0.866***	0.830***
	(0.0340)	(0.0301)	(0.0453)	(0.0414)	(0.0377)
Woman's age at birth					
<20	1	1	1	1	1
20-34	1.183**	1.172*	1.094	1.175*	1.173*
	(0.0986)	(0.0978)	(0.116)	(0.0979)	(0.0978)
35-49	1.318***	1.286***	1.371**	1.307***	1.297***
	(0.125)	(0.122)	(0.185)	(0.124)	(0.123)
Residence					
Rural	1	1	1	1	1
Urban	1.345***	1.271***	2.284***	1.329***	1.319***
	(0.0702)	(0.0669)	(0.172)	(0.0693)	(0.0689)
Education					
No education	1	1	1	1	1
Primary	1.961***	1.963***	4.232***	1.967***	1.942***
	(0.0991)	(0.0992)	(0.316)	(0.0995)	(0.0986)
Secondary	2.372***	2.403***	7.655***	2.406***	2.377***
	(0.156)	(0.158)	(0.753)	(0.159)	(0.157)
Higher	1.953***	1.951***	7.686***	2.028***	1.972***
	(0.371)	(0.370)	(3.400)	(0.384)	(0.374)
Wealth quintile					
Lowest	1	1	1	1	1
Second	1.019	1.024	1.358***	1.036	1.024
	(0.0569)	(0.0572)	(0.107)	(0.0578)	(0.0572)
Middle	1.488***	1.491***	2.499***	1.527***	1.514***
	(0.0896)	(0.0897)	(0.204)	(0.0916)	(0.0909)
Fourth	1.808***	1.835***	3.337***	1.889***	1.876***
	(0.137)	(0.139)	(0.351)	(0.142)	(0.141)
Highest	1.825***	1.882***	3.647***	1.948***	1.941***
	(0.166)	(0.171)	(0.505)	(0.176)	(0.175)
Marital status					
Not married	1	1	1	1	1
Married	0.945	0.949	1.063	0.956	0.956
	(0.0463)	(0.0465)	(0.0748)	(0.0468)	(0.0467)
Parity					

0	1	1	1	1	1
1-2	1.286	1.301	1.909***	1.300	1.291
	(0.245)	(0.249)	(0.470)	(0.248)	(0.246)
3-5	1.027	1.040	1.423	1.040	1.023
	(0.196)	(0.199)	(0.351)	(0.198)	(0.195)
Work					
Not working	1	1	1	1	1
Working	0.842***	0.846***	0.983	0.837***	0.841***
	(0.0381)	(0.0383)	(0.0668)	(0.0380)	(0.0381)
Head of the household					
Female headed	1	1	1	1	1
Male headed	0.944	0.953	0.722***	0.953	0.947
	(0.0500)	(0.0504)	(0.0578)	(0.0505)	(0.0501)
Religion					
No religion	1	1	1	1	1
Catholic	1.149	1.137	1.060	1.148	1.126
	(0.101)	(0.100)	(0.127)	(0.101)	(0.0993)
Muslim	0.896	0.888	0.732**	0.920	0.903
	(0.0824)	(0.0818)	(0.0941)	(0.0848)	(0.0830)
Protestant	1.242**	1.227**	1.226*	1.236**	1.224**
	(0.109)	(0.108)	(0.146)	(0.108)	(0.108)
Other	1.071	1.071	1.204	1.058	1.043
Constant	0.563**	0.531***	0.135***	0.463***	0.494***
	(0.128)	(0.120)	(0.0402)	(0.104)	(0.111)
Observations	13,343	13,339	8,055	13,338	13,333

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Geographical location, education, wealth, marital status, employment status and religion of woman found to have the significant effect on utilization of skilled antenatal care and delivery care.

The married and working woman who lives in the urban area with more education have a significantly higher chance to utilize professional maternal care than not married, the unemployed woman lives in a rural area with no education. Wealthier woman utilizes skilled maternal care more than the woman in the poorest wealth quintiles.

Being in the female-headed household and being Catholic decreases utilization of professional maternal care in Cameroon.

After examining the effect of each barrier variables on the utilization of skilled maternal care, we included all five access barriers into one model, to see the relative importance of the barriers (Appendix 3.1). The main concern about this model was the multicollinearity issue which leads to the biased result. Review of previous studies showed that money, transport and distance barriers closely linked with each other. Multicollinearity test result has shown that there is no severe multicollinearity between access barrier variables (Appendix 3.1). However, we still had to be careful especially with money, distance, and transport barriers. Therefore, we run regressions omitting one barrier variable each time and saw how the significance of coefficients and their standard errors change. When we run regression omitting money barrier the significance of distance and transport barriers variables has changed. It indicates that there is a multicollinearity issue in this model. Therefore, we combined money, transport and distance barriers together into one binary variable and included in the model with other two barriers to examine the effect of each barrier on the utilization of maternal care (Table 3.13). Each of the models is controlled for individual background characteristics and household characteristics, known to be associated with utilization of health care from the previous literature.

Table 3.13. Effect of demand-side barriers on the utilization of maternal healthcare

VARIABLES	(1)	(2)
	ANC	SBA
Physcal (money+transport+distance)		
Not a big problem	1	1
Big problem	0.756***	0.680***
	(0.0605)	(0.0500)
Permission		
Not a big problem	1	1
Big problem	0.775***	0.910
	(0.0751)	(0.0796)
Alone		
Not a big problem	1	1
Big problem	0.796***	0.939
	(0.0632)	(0.0674)
Woman's age		
<20	1	1
20-34	1.266**	1.099
	(0.132)	(0.117)
35-49	1.693***	1.367**
	(0.247)	(0.185)
Residence		
Rural	1	1
Urban	1.388***	2.351***
	(0.114)	(0.175)
Education		
No education	1	1
Primary	1.969***	4.188***
	(0.168)	(0.317)
Secondary	2.644***	7.446***
	(0.288)	(0.740)
Higher	10.25***	7.323***
	(7.502)	(3.244)
Wealth quintile		
Lowest	1	1
Second	1.161	1.343***
	(0.108)	(0.106)
Middle	1.612***	2.470***
	(0.156)	(0.202)

Fourth	2.359***	3.217***
	(0.282)	(0.341)
Highest	3.616***	3.394***
	(0.545)	(0.473)
Marital status		
Not married	1	1
Married	1.364***	1.047
	(0.108)	(0.0739)
Parity		
0	1	1
1-2	1.284	1.920***
	(0.312)	(0.473)
3-5	1.081	1.402
	(0.266)	(0.346)
Work		
Not working	1	1
Working	1.083	0.981
	(0.0800)	(0.0669)
Head of the household		
Female headed	1	1
Male headed	0.855*	0.729***
	(0.0734)	(0.0585)
Religion		
No religion	1	1
Catholic	1.119	1.088
	(0.152)	(0.131)
Muslim	0.708**	0.743**
	(0.103)	(0.0961)
Protestant	0.989	1.251*
	(0.134)	(0.150)
Other	0.905	1.218
Constant	0.393***	0.171***
	(0.121)	(0.0519)
Observations	5,277	8,033

tandard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The result showed that woman reported money, transport and distance are the big problems to access health care have 25 percent of lower chance to get four and more professional antenatal care visits and even lower chance (32 percent) to have skilled delivery care than the woman have less difficulties.

The coefficients for permission and alone for skilled birth attendance are not statistically significant, indicating that when it comes to delivery care, getting permission to go and going alone for the safe delivery care are not a big problem. But for the antenatal care visits, permission to go for medical treatment and not wanting to go alone are still huge barriers that significantly lower utilization of skilled antenatal care.

Utilization of antenatal care and delivery care gets higher with woman's age. The woman aged above 20 are more likely to utilize skilled maternal care than the woman younger than 20 years old. Woman resides in urban areas utilize antenatal care more than 38 percent higher than the woman lives in a rural area. The effect of living in urban areas even higher for utilization of skilled delivery care. The woman lives in urban areas can have 2.3 times higher chance to have delivery care attended by trained health personnel than the other counterparts in the rural area.

Education plays an important role to determine the utilization of maternal care in Cameroon. Woman with the higher education has ten times higher chance to use antenatal care and seven times higher chance to use skilled delivery care than the uneducated woman.

The woman in the highest wealth quintile utilizes maternal care more than three times compared to the woman in the lowest wealth quintiles.

3.6. CONCLUSION

This study aimed to examine the effect of access barriers on the utilization of skilled maternal care using information of the mothers of 71767 live-born children aged under five years from DHS 2004 and 2011 of Cameroon.

Women who reported the following factors would be a big problem in seeking health care for themselves, such as getting permission to go for treatment, getting money for treatment, distance to health facility, not wanting to go alone, having to take transport were less likely to utilize professional antenatal care and delivery care. Results from equity analysis showed that there are disproportional barrier issues against poorer women and huge and increased inequalities in the utilization of maternal health service.

The results from the logistic regression analysis suggest that access barriers have the significant negative effect on utilization of skilled antenatal care and delivery care. The adjusted odds ratios of both utilization of antenatal care and delivery care were significantly lower if women report getting money for treatment, transport and distance to health facility are a big problem than if they reported less difficulties. Odds ratios for permission and alone barriers for skilled birth attendant indicated that these barriers lead to lower utilization of skilled delivery care. However, the effect of these barriers has not statistically significant, indicating that when it comes to delivery care, getting permission to go and going alone for the safe delivery care becomes no longer a big problem to hinder utilization of the delivery care. But for the antenatal care visits, permission to go for medical treatment and not wanting to go alone are still huge barriers that significantly lower utilization of skilled antenatal care. The estimated effect of getting permission barrier on use of antenatal care may be explained by perception about pregnancy in the society that, pregnancy is "a non-illness life event that doesn't require to go for checkup" in the hospital (Thaddeus, 1994;

Ganatra, 1998). It creates difficulties for women to get permission to go for antenatal care from their relatives, particularly from husbands and parents in law (Cleland, 1988; Ensor, 2004), which causes the underutilization of effective antenatal care even its readily available at affordable price. Proper health education to the society is a key to change perception about pregnancy.

Mothers residing in urban area, mothers with higher level of education, and those in the highest wealth quintiles were most likely to utilize professional antenatal care and delivery care. Association between utilization of health care and woman's education, place of living were also documented in the literature (Workie, 2018; Peters, 2008).

The important barriers to access antenatal care and delivery care in Cameroon was getting money to get medical treatment, distance, and transport to a health facility.

The result of this study implies that policies to reduce access barriers, such as lowering or exempting user fees for essential maternal care especially for the poorest and most vulnerable mothers, bringing healthcare closer to the them, improving infrastructure and organization of transport networks will significantly increase utilization of effective maternal care in the country.

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Appendix 3.1.

Multicollinearity test result

Variable	VIF	1/VIF
Transport	2.6	0.385
Distance	2.52	0.396
Alone	1.2	0.830
Money	1.1	0.907
Permission	1.1	0.910
Mean VIF	1.7	

Appendix 3.2.

Effect of demand side barriers on utilization of maternal health care

VARIABLES	(1)	(2)
	ANC	SBA
Money		
Not a big problem	1	1
Big problem	0.731***	0.794***
	(0.0531)	(0.0520)
Transportation		
Not a big problem	1	1
Big problem	0.885	1.150
	(0.0891)	(0.105)
Distance		
Not a big problem	1	1
Big problem	0.887	0.650***
	(0.0881)	(0.0581)
Permission		
Not a big problem	1	1
Big problem	0.811**	0.939
	(0.0790)	(0.0827)
Alone		
Not a big problem	1	1
Big problem	0.855*	1.001
	(0.0705)	(0.0745)
Woman's age		
<20	1	1
20-34	1.147	0.909
	(0.112)	(0.0901)
35-49	1.241*	0.996
	(0.146)	(0.113)
Residence		
Rural	1	1
Urban	1.349***	2.244***
	(0.113)	(0.170)
Education		
No education	1	1
Primary	1.976***	4.202***
	(0.169)	(0.317)
Secondary	2.694***	7.599***
	(0.294)	(0.755)
Higher	10.93***	7.720***
	(7.997)	(3.410)

Wealth quintile		
Lowest	1	1
Second	1.142	1.324***
	(0.106)	(0.105)
Middle	1.541***	2.389***
	(0.149)	(0.196)
Fourth	2.269***	3.158***
	(0.272)	(0.335)
Highest	3.459***	3.410***
	(0.523)	(0.476)
Marital status		
Not married	1	1
Married	1.294***	1.007
	(0.101)	(0.0705)
Parity		
0	1	1
1-2	1.286	1.301
	(0.245)	(0.249)
3-5	1.027	1.040
	(0.196)	(0.199)
Work		
Not working	1	1
Working	1.078	0.975
	(0.0796)	(0.0663)
Head of the household		
Female headed	1	1
Male headed	0.851*	0.722***
	(0.0730)	(0.0578)
Religion		
No religion	1	1
Catholic	1.129	1.105
	(0.153)	(0.133)
Muslim	0.698**	0.747**
	(0.102)	(0.0967)
Protestant	1.004	1.276**
	(0.136)	(0.153)
Other	1.071	1.071
Constant	0.570***	0.326***
	(0.113)	(0.0608)
Observations	5,277	8,033

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1