UTS UNIVERSITY OF TECHNOLOGY SYDNEY

Coverage of maternal and child healthcare services in Ethiopia: Measuring progress towards universal health coverage using the Demographic Health Surveys

By: Aster Ferede Gebremedhin

A thesis submitted in fulfilment of the requirements for the degree of

Doctor of Philosophy

under the supervision of Professor Andrew Hayen
Professor Angela Dawson

University of Technology Sydney

Faculty of Health

October 2022

CERTIFICATE OF ORIGINAL AUTHORSHIP

I, Aster Ferede Gebremedhin, declare that this thesis is submitted in fulfilment of the requirements for the award of Doctor of Philosophy, in the Faculty of Health at the University of Technology Sydney.

This thesis is wholly my own work unless otherwise referenced or acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

This document has not been submitted for qualifications at any other academic institution.

This research is supported by the Australian Government Research Training Program.

Signature: Production Note:
Signature removed prior to publication.

Aster Ferede Gebremedhin

Date:31/10/2022

Manuscripts incorporated into the thesis

1. Aster Ferede Gebremedhin, Angela Dawson, Andrew Hayen. Determinants of continuum of care for maternal, newborn, and child health services in Ethiopia: Analysis of the modified composite coverage index using a quantile regression approach. PLoS One. 2023 Jan 20;18(1): e0280629, https://doi.org/10.1371/journal.pone.0280629
2. Aster Ferede Gebremedhin, Angela Dawson, Andrew Hayen: Inequalities in maternal, newborn, and child health coverage in Ethiopia: A decomposition analysis using 2000, 2005, 2011, and 2016 Demographic and Health Surveys
3. Aster Ferede Gebremedhin, Angela Dawson, Andrew Hayen, Evaluations of effective coverage of maternal and child health services: A systematic review, Health Policy and Planning, Volume 37, Issue 7, August 2022, Pages 895–914, https://doi.org/10.1093/heapol/czac034
4. Aster Ferede Gebremedhin, Angela Dawson, Andrew Hayen: Effective coverage of newborn postnatal care: measuring inequality and spatial distribution of quality-adjusted coverage (Under review for publication in PLos One journal)

Conference presentation

1. Faculty of Health Research Student Forum, University of Technology Sydney, Australia, 29 June 2022
2. Health in Preconception, Pregnancy, and Postpartum Early- and Mid-Career Researcher Collective (HiPPP EMR-C) International Conference, Australia, 17 November 2021
3. Faculty of Health Research Student Forum, University of Technology Sydney, Australia, 29 July 2020

Acknowledgments

I would like to take this opportunity to express my heartfelt gratitude to the numerous individuals and institutions who have provided unwavering support throughout my PhD journey. Firstly, I extend my sincere appreciation to my supervisors, Professor Andrew Hayen and Professor Angela Dawson, for their guidance, encouragement, invaluable feedback, and profound expertise at every stage of this endeavor. I am truly grateful to them for granting me the opportunity to fulfill one of my life goals. Working under their supervision has been an immense privilege, and I wholeheartedly admire their unwavering commitment and dedication in meticulously reviewing my manuscripts and thesis, as well as arranging productive meetings despite their demanding schedules.

I am profoundly indebted to my supervisors for placing their trust in me from the very first email exchange, thereby initiating my PhD journey, acquainting me with the academic environment at the University of Technology Sydney, and providing me with essential information. Their support, even prior to our in-person meeting, was immeasurable. The past two years of my PhD journey have been particularly challenging, and it is during these times that my supervisors have exhibited exceptional kindness, positivity, and care, always offering me emotional support. Without their unwavering encouragement, patience, and boundless assistance throughout my candidature, I would not have been able to complete my thesis. I am immensely grateful to them.

I would like to extend my gratitude to Professor Andrew Hayen for enabling me to undertake casual academic work during my time at the University of Technology Sydney. It was an invaluable experience that enriched my knowledge and skills.

Furthermore, I would like to acknowledge the Australian Government and the University of Technology Sydney for affording me the opportunity to enroll in the PhD program, as well as for the International Research Training Program (IRTP) scholarship grant. My appreciation also goes to the Faculty of Health at the University of Technology Sydney for their unwavering support. I would like to express my heartfelt thanks to the diligent librarians at the University of Technology Sydney Library for their invaluable assistance during the systematic review search strategy development. Additionally, I would like to extend my gratitude to Andrea Delgado from the University of Technology Sydney for her kind support in translating the literature for my study.

I am grateful to the Demographic and Health Surveys program for granting me access to their data for my PhD research. I would also like to acknowledge the support provided by Debre Markos University during my application stage.

Last but not least, I am deeply appreciative of my friends and colleagues for their continuous encouragement and motivation. I am fortunate to have very kind and caring friends who are studying with me at both UTS and Western Sydney University. They have consistently looked after me like a little sister and embraced me as part of their family.

Finally, I would like to express my deepest gratitude and appreciation to my beloved parents, Ferede Gebremedhin W/ezgi and Semaynesh Belay Araya, my three amazing sisters, Fertuna Ferede, Wintana Ferede, and Eyerusalem Ferede, as well as my supportive extended family. Their unconditional love, support, and encouragement have been the foundation of my PhD journey. Their presence in my life is a constant reminder of the strength and love that surrounds me. This accomplishment is as much theirs as it is mine.

I am truly blessed to have such a loving and supportive family, and I will forever cherish the memories and the love we share.

"I can do all things through Christ who strengthens me." (Philippians 4:13)

Abbreviations

AABF	Age-appropriate breastfeeding
ANC	Antenatal Care
ARI	Acute respiratory infection
BCG	Bacille Calmette–Guérin
CAREP	Care seeking for pneumonia
CC	Crude coverage
CCI	Composite Coverage Index
COC	Continuum of care
CSA	Central Statistical Agency
DHS	Demographic Health Survey
DPT	Diphtheria–Tetanus–Pertussis
EA	Enumeration Area
EC	Effective Coverage
EDHS	Ethiopia Demographic and Health Survey
GPS	Global Positioning System
FMOH	Federal Ministry of Health of Ethiopia
FP	Family planning
HEP	Health Extension Program
HSDP	Health sector development program
HSTP	Health sector transformation program
LMICs	Low and middle-income countries
MCH	Maternal and child health
MSL	Measles

ORT	Oral rehydration therapy
PNC	Postnatal care
PNCM	Postnatal care for mothers
PNCN	Postnatal care for newborns
RMNCH	Reproductive, maternal, neonatal and child health
SBA	Skilled birth attendance
SDG	Sustainable Development Goals
SNNP	Southern Nations Nationalities and Peoples
SSA	Sub-Saharan Africa
TTN	Tetanus toxoid
UHC	Universal Health Coverage
WHO	World Health Organisation

Table of Contents

List of Tables

List of Figures

List of Appendices

Abstract

Background: In low and lower-middle-income countries, maternal and child health interventions have not been considered holistically. Evidence suggests that inequity in the coverage of services impedes progress in maternal and child health and conventional coverage measures do not account for quality. This research aimed to generate policy-relevant evidence by comprehensively assessing the coverage and inequalities in maternal, and child health interventions across the continuum of care in Ethiopia.

Methods: This research comprises a systematic review and three cross-sectional analyses of the Ethiopia Demographic and Health Surveys. The first study identified the determinants of the continuum of care in maternal and child health using quantile regression. The second study assessed inequalities in maternal and child health coverage along the continuum of care and the major contributors to the inequality. The third study presented a systematic review of studies evaluating effective coverage of maternal and child health services. Finally, the fourth study assessed the effective coverage of newborn postnatal care in Ethiopia.

Results: The results of the first study showed that the average composite coverage index was 39%. Postnatal care for newborns had the lowest coverage (12%). Further, individual, socioeconomic and reproductive factors influenced the continuum of care differently across levels of the composite coverage index. Findings from the second study revealed that the composite coverage index increased from 24% in 2000 to 42% in 2016. However, coverage was pro-rich, and the wealth quintile was the major contributor to the inequalities in all survey years.

The systematic review found (1) the effective coverage values were lower when the crude coverage estimates were adjusted to account for the quality of care; (2) quality

assessments addressed structural, process and outcome domains individually or combined; (3) the wealthiest quintile had a higher effective coverage of services than the poorest quintile. The fourth study found that the crude coverage of newborn postnatal care was 13% in Ethiopia, but 9% when adjusted for quality. Further, a spatial variation across regions and a pro-rich inequality in high-quality newborn postnatal care were demonstrated.

Conclusions: Ethiopian women and children are not receiving the best possible health benefits, and government efforts to address inequity are insufficient, underscoring areas for improvement. Tailored interventions are required that address the determinants of the continuum of care. Furthermore, the findings suggest that national policy and programming efforts should prioritise accessibility and high-quality care, particularly for disadvantaged sub-groups and geographical locations that lag behind.

CHAPTER ONE

INTRODUCTION

Chapter 1 Background

1.1 Overview

This research examined the coverage and disparities in maternal newborn and child health (MCH) interventions along the continuum of care in Ethiopia. Ethiopia continues to have one of the highest rates of maternal and child mortality in the world. Existing population-based coverage measures focused on a narrowed scope of the continuum of care, relied on access or health care contact, and showed a noticeable gap between different population subgroups. A comprehensive assessment of coverage and its distribution across different subgroups of the population is crucial for designing appropriate evidence-based programmes and policies and thus, improving MCH outcomes.

The introductory chapter provides background information about the concept of coverage in relation to the Sustainable Development Goals (SDG) and Universal Health Coverage (UHC). The chapter highlights the essential MCH interventions recommended by the World Health Organisation (WHO). In addition, this chapter presents the status of MCH in Ethiopia, and the rationale and aims of my research. General information about Ethiopia including the healthcare system is also provided. The section concludes with the outline of the research.

1.2 Coverage and the Sustainable Development Goals

The goal of the health system is to promote people's health through a network of resources, institutions, organisations, and people. One of the building blocks of the health system is service delivery. Strengthening service delivery is crucial to meeting health-related targets and making progress towards sustainable development (Murray et al., 2003). The importance of service delivery for people has resulted in the measurement of access, availability, utilisation, and coverage having a significant role in the existing health policy

literature (Papanicolas et al., 2022). Access denotes whether there is a continued and organised supply of appropriate and adequate care that is geographically, financially, culturally, and functionally within easy reach of a target population. Availability implies the physical existence or delivery of services that fulfil a minimum standard, while utilisation is related to the quantification of the use of health services (Gulliford et al., 2002). Coverage, a key area of interest for public health analysts, explains what proportion of the target population who need services can receive, or have received, them. The coverage level a program achieves is one measure to determine how well it is performing and is used to guide priority setting. It can be measured at different levels of the health system. Health service coverage indicators describe the relationship between the population in need and the services received (Tanahashi, 1978).

The health and well-being of women and children - vital to creating a healthy world- were the focus of two of the eight Millennium Development Goals (MDGs 4 and 5). The existing SDGs proposed a much broader agenda that goes beyond what has been set for the MDGs through its aim to "ensure healthy lives and promote well-being for all" by 2030. Women's and children's health are addressed under SDG3. Several targets are closely linked with MCH either directly or indirectly (Brizuela and Tunçalp, 2017). By 2030, the SDGs call for significant reductions in maternal, neonatal, and child mortality as well as universal access to sexual and reproductive health care (WHO, 2017b). Monitoring the coverage of interventions in MCH continues to be central to assessing progress towards national and international health goals. As such, further improvements in coverage, quality, and measurement of effective interventions are needed to achieve these goals (Requejo et al., 2020).

UHC has become a priority policy framework to improve global health. Achieving UHC plays an important role in attaining other health-related targets of the SDGs. As countries follow the call for UHC, guidelines and indicators to monitor its progress are required (Tangcharoensathien et al., 2015). UHC consists of three interrelated components: population coverage, financial risk protection, and service coverage. Population coverage measures the percentage of the population reached by the services, while financial protection measures the extent to which the population is protected from the financial hardship of accessing needed health care. The aspiration that all people can obtain the health services they need is reflected by the third component. Several indicators have been suggested as part of these concepts for the measurement of UHC. Reproductive, maternal, newborn, and child health (RMCH) services are a critical part of the UHC framework (WHO, 2010b).

Several interventions have been put in place across different countries to transform the delivery of health care. Poor MCH outcomes have been at the top of the global health agenda for over the last 20 years (Moller et al., 2019). While different factors contribute to maternal and child deaths, one effective means to reduce this burden is the provision of effective RMCH interventions. Appropriate interventions and appropriate health resources have an enormous potential to avert maternal and child deaths (Gülmezoglu et al., 2016). The health and well-being of mothers and children are linked; the measures for improving women's health have positive impacts on child outcomes. MCH care programs should include essential interventions - delivered through health services, family, and community- to improve MCH and survival (Lassi et al., 2014).

1.3 Essential maternal, newborn, and child health interventions

Antenatal care (ANC) is an intervention designed to promote healthy behaviours and preparedness during conception, childbirth, and after delivery, as well as provide early detection and treatment of complications. The components of ANC include health education, health promotion, risk identification, and prevention and management of pregnancy-related diseases. Timely and adequate ANC contact with a health care provider is recommended for early detection of pregnancy complications and to improve women's experience of care (WHO, 2016b). The other intervention, tetanus vaccination, is a major component of the strategy to eradicate maternal and neonatal tetanus. It is estimated that the immunisation of women during pregnancy with at least two doses of tetanus toxoid reduced mortality from neonatal tetanus by 94% (Blencowe et al., 2010). Women of childbearing age also benefit from family planning intervention, as it reduces the risks of unintended pregnancies, unsafe abortion, and associated deaths. Access to contraception allows people to attain their desired number of children or determine the spacing of their pregnancy (WHO, 2010a).

Skilled birth attendance is the other fundamental maternal health indicator that measures the health system's ability to provide sufficient care during birth- a period when death and morbidity rates are very high. A key strategy to ensure skilled care during childbirth is to have all deliveries in health facilities where obstetric complications may be addressed as they develop (WHO, 2004). The 2016 WHO statement on improving the quality of maternal and newborn care emphasises the importance of safe childbirth practices in reducing morbidity and mortality. The guideline stresses the significance of skilled birth attendance, which involves the presence of a trained healthcare professional, such as a midwife, nurse, or doctor, during childbirth. Skilled health personnel are trained to

manage complications that may arise during labour and delivery, reducing the risk of adverse outcomes for both the mother and newborn (WHO, 2016a).

It has also been revealed that postnatal care (PNC), a fundamental component of the continuum of maternal, newborn and child care, is essential for the survival and well-being of mothers and newborn babies (WHO, 2022c). The period beginning immediately after childbirth and extending up to 42 days is the most vulnerable time for both the mother and newborn. Over 65% of maternal deaths occur during this time. In the case of newborns, around 75 percent of deaths occur during the first week of life, with the majority in the first 48 hours. Early detection of conditions that may adversely affect the health and development of the newborn is an important component of quality routine newborn care. However, PNC is the most neglected period having the lowest median national coverage of interventions on the continuum of MCH care persistently (WHO, 2020c).

Child health interventions such as vaccination programs and infant and young child feeding practices (IYCF) are cost-effective and safe prevention strategies against common childhood illnesses. If implemented properly and according to guidelines, immunisations prevent an estimated 2.5 million vaccine-preventable deaths among under-five children annually. The WHO recommends full vaccination to prevent childhood morbidities and mortalities (WHO, 2017a). In developing countries, a child who received a Bacillus Callmete Guerin (BCG) vaccination against tuberculosis; three doses of pentavalent vaccine (DPT-Hep B-Hi-b) against diphtheria, pertussis, tetanus, Haemophilus influenzae type b and hepatitis B, at least three doses of polio vaccine, and one dose of measles vaccine is considered fully vaccinated (Feikin et al., 2016). Further, to ensure good nutrition and safeguard child survival, the WHO recommends that all babies be exclusively breastfed for about the first six months, then gradually introduced to

appropriate complementary foods after six months and breastfed on-demand up to the age of two years or older (WHO, 2021).

1.4 Statement of the problem and rationale

Effective MCH interventions are essential to accelerate progress toward the SDGs. Achieving the SDG target of a global maternal mortality of no more than 70 per 100 000 live births, child mortality of no more than 25 per 1000 live births and neonatal mortality rate of 12 or fewer by 2030 require continued efforts in all countries. There is evidence that reaching the set goals could save the lives of 1.6 million women and 10.2 million children in total (McArthur et al., 2018).

However, in most countries, the essential MCH interventions still do not reach their target populations, and the goals are far from being achieved. The global maternal mortality remains unacceptably high with an estimated 211 deaths per 100,000 live births in 2017 (WHO, 2019b). Likewise, global childhood mortality continues to be high worldwide. In 2020, an estimated 5 million children died before their fifth birthday, approximately half (2.4 million) of which occurred in the first month of life (WHO, 2022a). Low and middle-income countries (LMICs) take the largest share of the burdens of maternal and newborn morbidity and mortality. Approximately 86% of the predicted global maternal deaths in 2017 occurred in the world's least developed regions, Sub-Saharan Africa, and Southern Asia, with sub-Saharan Africa alone accounting for close to 66% (WHO, 2019b). These regions also account for more than 80 per cent of the global under-five deaths in 2020 (WHO, 2022a). Most maternal and child mortalities and morbidities are preventable or can be treated with simple, cost-effective interventions.

Despite adopting comprehensive policy measures, the rate of maternal and child mortality in Ethiopia remains one of the highest in the world. Ethiopia is one of six nations that

account for more than half of the world's annual maternal deaths, with 14,000 maternal deaths occurring each year and a maternal mortality rate of 412 per 100,000 live births. The under-five and infant mortality rates were 67 deaths per 1,000 live births, and 48 deaths per 1,000 live births, respectively (WHO, 2019b, CSA [Ethiopia] and ICF, 2016). It has also been reported that easily preventable diseases claim the lives of more than 704 children every day (United Nations Inter-agency Group for Child Mortality Estimation (UNIGME), 2019). Figure 1 and figure 2 shows pregnancy related deaths per 100,00 live births and under five mortality rates per 1000 live births in Ethiopia from 2000-2016.

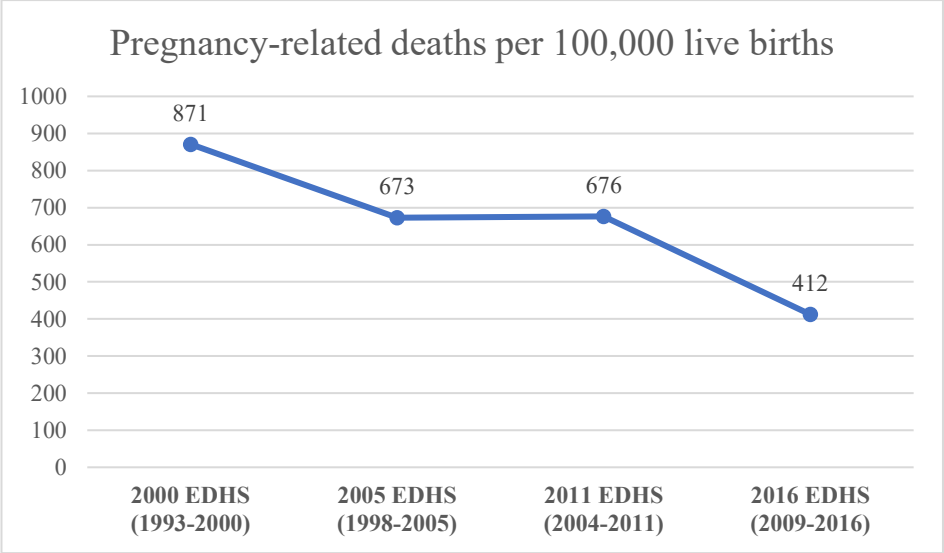


Figure 1. Trends in maternal mortality ratio in Ethiopia from 2000-2016

Source: (CSA [Ethiopia] and ICF, 2016)

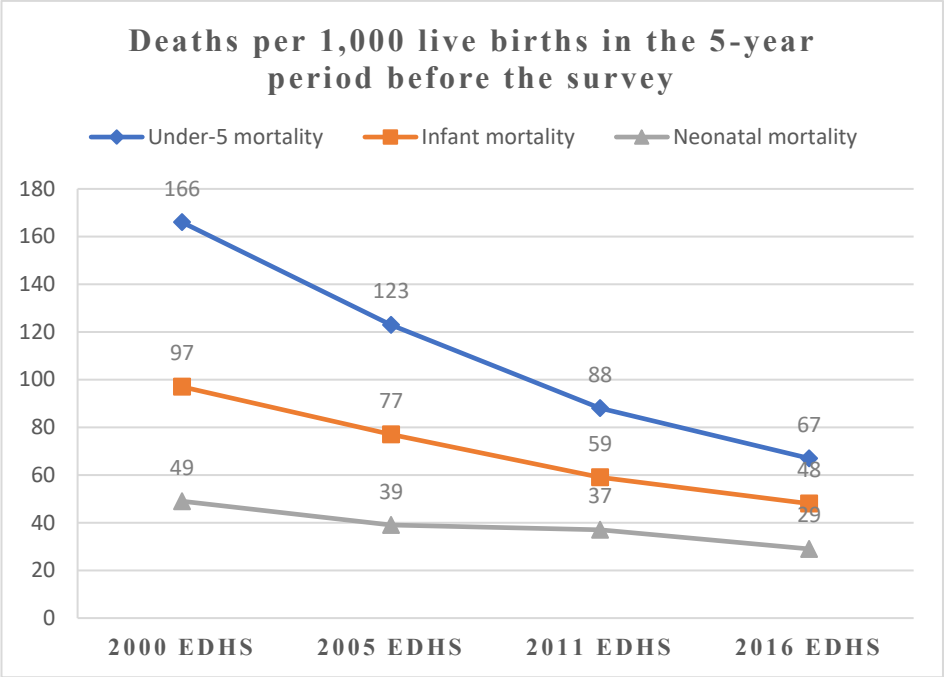


Figure 2. Trends in early childhood mortality rates

Source: (CSA [Ethiopia] and ICF, 2016)

Maternal, newborn, and child morbidity and mortality have significant socioeconomic consequences (Miller and Belizán, 2015, Thomas, 2020). Many strategies have been implemented to reduce maternal and child deaths (Bhutta et al., 2014). The continuum of care has been well known as a potential means to reduce neonatal, child and maternal mortality through integrated service delivery. It is recommended as advantageous over MCH services provided separately to achieve positive MCH outcomes and prevent millions of needless deaths (Kikuchi et al., 2015, Yeji et al., 2015). Although there is progress in each segment of MCH care in Ethiopia, improvements in the coverage of any individual service do not guarantee that women and children receive all required services. Often, MCH services are addressed separately or dealt with a narrowed scope, resulting in gaps within care, affecting newborn babies in particular (Chaka et al., 2019b, Birhane et al., 2022). It has also been shown that progress in MCH is hampered by high levels of disparities in the coverage of key services (Wuneh et al., 2019). In addition, there is a growing

recognition that increased contact with health care is not consistently related to an improved outcome. A possible explanation for this could be the low quality of care received in health facilities (Jannati et al., 2018). Existing population-based coverage measures do not incorporate quality adjustments and rely on access or contact coverage only (CSA [Ethiopia] and ICF, 2016).

Understanding the determinants of the continuum of MCH care is imperative for the successful continuity of interventions and eventually for improvements in MCH outcomes. It is also important to investigate disparities in MCH coverage along with its contributors to focus programme resources on bridging gaps in MCH coverage along the continuum. Ensuring access to high-quality maternal and newborn care is a global priority to minimise avoidable mortality and morbidity. This goal requires measuring the quality of care delivered to women and newborns, and effective coverage measures are currently suggested as best practices. A recent review of evidence identified that postpartum women and newborns were neglected populations in the MCH research studies in Ethiopia, underscoring the need for additional studies (Chan et al., 2021).

1.5 Aims and scope of this research

1.5.1 Research aim

The overall aim of this research was to comprehensively assess the coverage and inequalities in MCH interventions along the continuum of care in Ethiopia. The ultimate objective was to generate policy and program-relevant evidence to improve coverage of MCH and address inequalities.

The specific objectives are as follows:

1. To assess the determinants of the continuum of care for MCH services in Ethiopia using the modified composite coverage index (**Chapter four**)
2. To assess the inequalities in MCH coverage and its contributors in Ethiopia using 2000, 2005, 2011, and 2016 Demographic and Health Surveys (**Chapter five**)
3. To conduct a systematic review of studies examining the effective coverage of MCH services (**Chapter six**)
4. To assess the level, inequality, and geographic distribution of the effective coverage of newborn PNC in Ethiopia (**Chapter seven**)

1.5.2 Overview of Ethiopia

1.5.2.1 Geography, population, and economy

The studies within this thesis focused on Ethiopia, a landlocked country located in the horn of Africa. Ethiopia is bordered by Eritrea in the north, Djibouti in the northeast, Sudan in the west, Somalia in the east and northeast, and Kenya in the south. The country is administratively structured into nine regional states—Tigray, Affar, Amhara, Oromiya, Somali, Benishangul-Gumuz, Southern Nations Nationalities and Peoples (SNNP), Gambela, and Harari—and two city administrations, i.e., Addis Ababa and Dire Dawa Administration Councils. Ethiopia has more than 80 ethnic groups and Addis Ababa is

the nation's capital and largest city in the country (see Figure 3). The country's total surface area is about 1,112,000 square kilometre (472,000 sq. miles). Ethiopia is the second most populous African country next to Nigeria, with a population estimated at 118 million people. In 2021, more than half of the total population was between the ages 15-64 years and women constituted 57% of this age group (World Bank, 2021). The total fertility rate (TFR) in Ethiopia was 4.6 children per woman in 2016 (Central Statistical Agency (CSA) [Ethiopia] and ICF, 2016). The overall life expectancy at birth in the country is 67 years (World Bank, 2020).

There are a variety of distinct topographical zones in Ethiopia, from the highest point at Ras Dashen, 4,550 meters above sea level, to the Affar Depression, 110 meters below sea level. Depending on the geography, the climate can range from 10 degrees Celsius in the highlands to 47 degrees Celsius in the Affar Depression (CSA [Ethiopia], 2009).

More than 80% of Ethiopia's population live in rural areas. Agriculture is the largest sector in the Ethiopian economy, which accounts for about 42% of the total Gross Domestic Product (GDP) and it significantly affects all other economic sectors and development processes (Komarek et al., 2019). According to the world bank, Ethiopia is classified as a low-income country (World Bank, 2022). The Birr is the official currency of Ethiopia and at the current exchange rate, 1 US dollar is equivalent to about 50 Birr. One of Ethiopia's main developmental goals has been to reduce poverty through sustained economic growth. In light of this, the Growth and Transformation Plan (GTP) has been used as a national five-year plan to improve the country's economy (Ethiopia National Planning Commission, 2016). The country has significant rates of illiteracy, and it is estimated at 52%, 73% and 15% among people aged 15 years and above, among youth and among the elderly population (≥65), respectively (World Bank, 2017).

Figure 3: The regional map of Ethiopia

Source: (World Map, 2016)

1.5.3 Health care delivery system in Ethiopia

The health sector in Ethiopia is contributing to economic growth in the country along with other sectors. The government is the main health service provider in the country. The health policy of Ethiopia was developed in 1993 with the aim of providing access to basic packages of primary health care services to the population. Since the inception of the national health policy, the country has developed and implemented strategic documents such as the 20-year envisioning document, Health Sector Development

Program (HSDP), and the Health Sector Transformation Plan (HSTP) to guide the priorities within the health sector (Rono et al., 2022). The HSDP was implemented in four series of five-year phases from 1997 up to 2015. The HSTP, which aligns well with SDG 3, commenced in 2015. The first phase of HSTP covered the period between July 2015 to June 2020, while the second phase covers the period between July 2020 to June 2025 (FMOH, 2021).

The healthcare delivery system in Ethiopia is organized into a three-tier healthcare system: primary, secondary, and tertiary levels of care. The first level is the primary level of care which consists of a primary hospital (covering 60,000–100,000 people), health centres (covering 25,000–40,000 people) and five satellite health posts (covering 3,000–5,000 people). The primary health care unit, composed of a health centre and five satellite health posts, is the unit most accessible to the general population. The secondary level of care comprises a general hospital, covering a population of 1.0–1.5 million. A tertiary health care system includes a specialized hospital serving 3.5–5.0 million people. A referral system has been established between and within the health institutions to connect each level of care (FMOH, 2010).

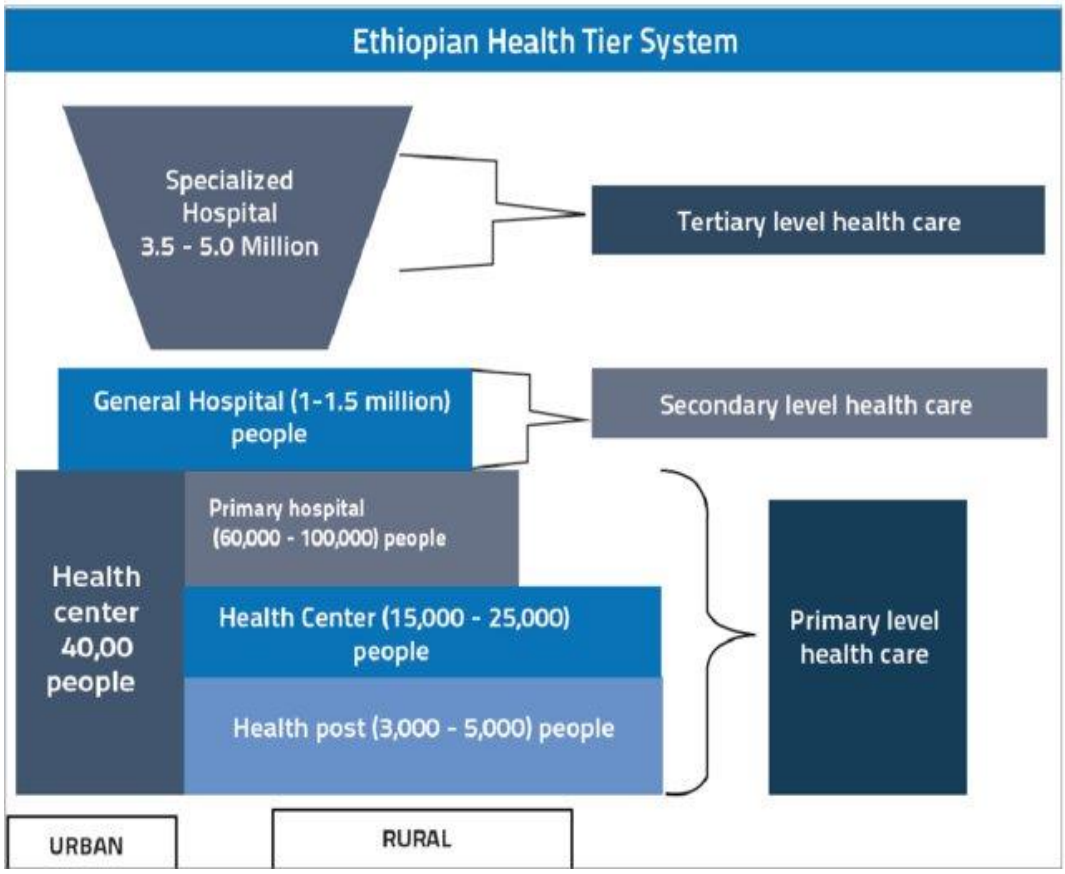


Figure 4. The three-tier health care delivery system of Ethiopia

Despite significant progress in health at the national level, health services are unevenly distributed across different regions, urban and rural areas, and socioeconomic groups. Remote regions in Ethiopia have very limited access to health facilities, making inadequate health coverage a particular concern in these areas. Poor health systems, underdeveloped roads, transport problems and limited infrastructure make it difficult to reach the poor and remote (FMOH, 2020).

The Ethiopian government followed policies, strategies and programs that were pro-poor and put a large amount of effort and resources into strengthening its health system (Admasu et al., 2016). The health system strengthening has been spearheaded by the Ministry of Health with support from multiple stakeholders and it is guided by the six building blocks of a health system outlined by the WHO: (i) service delivery, (ii) health

workforce, (iii) health information systems, (iv) access to essential medicines, (v) financing, and (vi) leadership or governance (WHO, 2007). Amongst locally tailored, multi-faceted pro-poor approaches in Ethiopia are the country's flagship program, called the Health Extension Programme (HEP), the health development army program, the implementation of Social Health Insurance scheme, and the scale-up of Community-based Health Insurance scheme (FMOH, 2010).

All Ethiopians, primarily women and children, receive essential services from HEP at an affordable cost. Community ownership is the cornerstone of HEP, which allows communities to manage health problems specific to their communities, thereby producing their own health. The HEP was launched in 2003 as the main vehicle for achieving universal coverage of primary health care- the core of the health system in Ethiopia. This innovative community-based program was developed with 16 packages under family health services, disease prevention and control, hygiene and environmental sanitation, and health education and communication areas. The health extension workers -the key actors in the implementation of the program – provide basic preventive and curative health services. The HEP contributed to the improvements in the potential coverage of health services and its contribution in the areas of maternal and child health, communicable diseases, hygiene and sanitation, knowledge and health care seeking has been significant (Assefa et al., 2020).

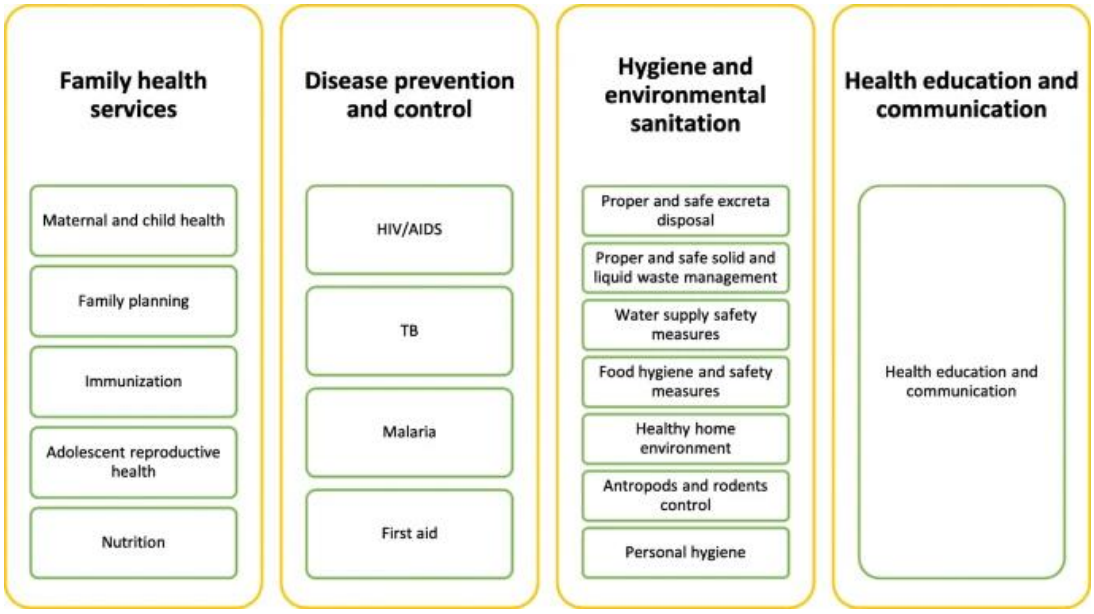


Figure 5. Packages of the Health Extension Program of Ethiopia

Source: (Assefa et al., 2019)

1.6 Thesis outline

This PhD thesis comprises eight chapters: Four of these chapters consist of manuscripts (including two published manuscripts, and two submitted for publication) along with a general introduction, literature, methods summary, and discussion. Chapter one explores the concept of coverage, SDGs, and UHC, providing background information. It also highlights essential MCH interventions, discusses the status of MCH in Ethiopia, and outlines the research aims and rationale. The second chapter contains a review of literature in relation to the summary measures of coverage and the continuum of care providing insights into their measurements and previous studies related to these topics. This chapter also discusses research on the determinants of the continuum of MCH care. Chapter three focuses on the methods employed throughout the research. This chapter provides a concise overview of the study design and settings, data source, and analytical approaches used to address the research aims in the thesis.

Chapter four (study one) investigates the determinants of continuum of care for MCH services in Ethiopia using a quantile regression approach. This rigorous analysis sheds light on the factors influencing the provision of continuity of care for MCH services. In chapter five (study two), inequalities in MCH coverage in Ethiopia are examined through decomposition analyses. This chapter presents a secondary analysis of the Ethiopian Demographic and Health Surveys (EDHS) conducted in 2000, 2005, 2011, and 2016, offering valuable insights into disparities in MCH coverage. Chapter six (study three) presents the findings of a systematic review focusing on the effective coverage of MCH services. It explores strategies for measuring quality and highlights inequalities in effective coverage. Chapter seven (study four) presents a secondary analysis of the effective coverage of newborn postnatal care, examining both its inequality and spatial distribution in Ethiopia. Chapter eight concludes the thesis by summarising the key

findings, discussing their implications, highlighting the strengths and limitations of the research, and offering concluding remarks.

1.7 Chapter summary

Chapter one provided a detailed background on the concept of coverage and its significance in relation to global goals. This chapter also presented the research aims, rationale and study setting. The next chapter is a literature review of the measures of coverage of MCH interventions along the continuum of care.

CHAPTER TWO

MEASURES OF COVERAGE ALONG THE CONTINUUM OF MATERNAL, NEWBORN, AND CHILD HEALTH CARE

Chapter 2 Literature review

2.1 Overview

This chapter focuses on the concept of the continuum of care and measures of coverage along the continuum of MCH care. In this chapter, the available evidence concerning the factors that affect the continuum of care for MCH services is reviewed. In addition to this chapter, study three in chapter six presents a brief systematic review of the evaluations of the effective coverage of MCH interventions.

2.2 The continuum of maternal, newborn, and child health care

Globally, it is estimated that nearly 80% of maternal deaths and up to two third of newborn deaths could be averted if women and children have access to effective health services (Sully et al., 2020). Several intervention indicators have been used to monitor RMCH coverage. In the past MCH policies and programs, there has been a tendency to treat the health and well-being of mothers, newborns and children as separate entities instead of embracing the necessitated fully integrated approach. This resulted in gaps in care and missed opportunities. Strategies for improving maternal health must also incorporate child health elements (Tinker et al., 2005).

The concept of continuum of care has gained attention as a cost-effective measure to improve MCH based on the assumption that MCH are inextricably linked and must be dealt with in an integrated manner. An effective continuum of care meets a woman's health requirements prior to, during and after pregnancy, as well as newborn and childcare throughout the life cycle. The continuum of care provides a more holistic health experience for women and children as each stage builds on the achievements of the preceding stage. A lack of appropriate care at any level of the continuum is linked to poor

MCH outcomes (Owili et al., 2016). As elaborated by Kerber et al., the continuum of care for MCH can be defined over the dimension of time (throughout the lifecycle, including adolescence, pregnancy, childbirth, the postnatal period, and childhood), and over the dimension of places of caregiving (including households and communities, outpatient and outreach services, and clinical-care settings) (Kerber et al., 2007). The time dimension involves building on previous care and preparing for future care, as each contact in the health system is an opportunity to amplify the effect of the subsequent contact. For instance, providing family planning counselling and services before conception contributes to an intended pregnancy at the right time; during the prenatal period, it primes the woman through counselling to the risks associated with short birth intervals and the advantages of spacing, as well as the availability of various modern contraceptive options; and during delivery and postpartum care, it continues the counselling process and, if appropriate, provides the contraceptive of choice.

The continuum of care over the dimension of place connects various levels of the home and community to the first-level facility, as well as a referral linkage to the appropriate higher-level institution to ensure that quality care is provided at the right place and linked to the next level of care when needed. An example of the place dimension could be an effective postpartum care package that involves community-based visits for counselling by community health workers, provision of basic services like family planning at the local health facility, and referral to a hospital for treatment of complications (Lawn and Kerber, 2006).

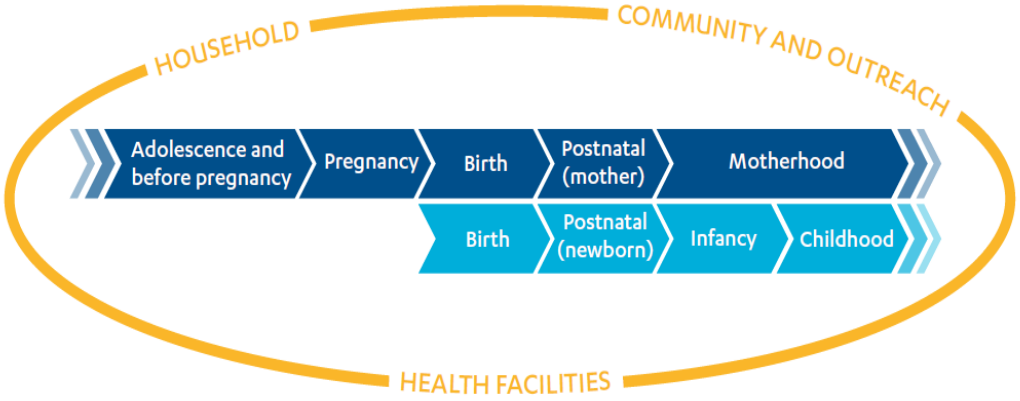


Figure 6. The dimensions of the continuum of care for maternal, newborn and child health

Source: (ICAI, 2018)

2.3 Measures of coverage along the continuum of care

Researchers and policymakers use different ways to measure and monitor the continuum of care for MCH. There isn't yet a commonly accepted representative measurement tool. A handful of studies have applied the narrowed scope of the continuum of care, considering the time component of continuity of care focusing on women during the period from pregnancy to childbirth and after delivery (Abegunde et al., 2015, Akinyemi et al., 2016, Wang and Hong, 2015). The number of coverage indicators differs across studies, but the most frequently featured services comprised the "triad"- ANC, SBA and PNC (Mothupi et al., 2018). Other studies relied on various indicators related to reproductive health, newborn and child health and social determinants of health along the continuum of care (Owili et al., 2016, Panda et al., 2020).

Researchers also developed composite coverage metrics in order to summarise coverage along the continuum of care and give a comprehensive picture of progress regarding essential intervention measures. The two main indices that represent a combination of indicators across different packages of the continuum include CCI and Co-Coverage Index (Barros and Victora, 2013). Each index is composed of eight indicators, five of which

are shared. The Countdown initiative uses composite coverage as an aggregate measure and tracks coverage indicators that span the continuum of care from pregnancy prevention and planning to pregnancy to childbirth to the postnatal period and infancy to childhood and including environmental factors, as well as equality in highest-burden countries (Victora et al., 2012). The co-coverage indicator, proposed in 2005, is a simple count of how many preventive interventions are received by individual mother–child pairs, out of a set of eight interventions: ANC (1+ visit with skilled provider); tetanus toxoid during pregnancy; skilled birth attendant; child received vitamin A supplementation, BCG vaccination, DTP3 vaccination, and measles vaccination; improved drinking water source. Insecticide-treated bed nets are also included in countries where relevant (Victora et al., 2005).

First proposed in 2008, the CCI is an aggregate measure of essential MCH intervention indicators that represent broad categories of the continuum of care. This composite measure was developed to summarise program performance of multiple interventions using a single measure and provide a general picture of inequalities in RMCH coverage between countries and within countries (Bryce et al., 2008).

The original CCI is a weighted average of the percentage coverage of eight interventions along four stages of the continuum of care: reproductive care; maternal care; childhood immunization; and management of childhood illness. The interventions are (i) family planning (FP); (ii) skilled birth attendant (SBA); (iii) at least one antenatal care visit by a skilled provider (ANC1); (iv) Bacille Calmette–Guérin (BCG) vaccination; (v) three diphtheria–tetanus–pertussis (DTP3) vaccinations; (vi) measles (MSL) vaccination; (vii) oral rehydration therapy (ORT) for infant diarrhoea; and (viii) care-seeking for suspected childhood pneumonia (CAREP). The equation places equal weight to all the four domains, and within each domain, all indicators have the same weight. However, in the

immunization component, DPT coverage received twice the weight of other vaccines because it involved multiple contacts with a provider. The original index is calculated using the formula below.

$$\text{CCI} = \frac{1}{4}\left(\text{FP} + \frac{\text{ANC1} + \text{SBA}}{2} + \frac{\text{BCG} + 2\text{DPT3} + \text{MSL}}{4} + \frac{\text{ORT} + \text{CAREP}}{2}\right)$$

The original formula was later revised in order to keep it consistent with changes in the Countdown coverage indicators in that, family planning needs satisfied was replaced with family planning needs satisfied with modern methods; at least one antenatal care visit with a skilled provider was replaced with four or more antenatal care visits, and oral rehydration therapy for children with diarrhoea was replaced with the treatment of diarrhoea with oral rehydration salts (Countdown to 2030 Collaboration, 2018).

$$\text{CCI} = \frac{1}{4}\left(\text{FP} + \frac{\text{ANC4} + \text{SBA}}{2} + \frac{\text{BCG} + 2\text{DPT3} + \text{MSL}}{4} + \frac{\text{ORS} + \text{CAREP}}{2}\right)$$

Wehrmeister et al added newborn coverage indicators such as tetanus toxoid for mothers during pregnancy, early breastfeeding initiation and PNC for babies in the 48 hours after delivery to the CCI (Wehrmeister et al., 2020a), while a study conducted in Lao People's Democratic Republic reflected ten MCH services by adding PNC for mothers, PNC for newborns, and tetanus toxoid to the original formulation (Sakuma et al., 2019). A recent study modified the CCI depending on the Kerber et al's definition of the continuum of care and WHO's recommended MCH care. This formula provided a more comprehensive approach to measuring the continuum of care (Oh et al., 2020).

$$\text{Modified CCI} = \frac{1}{6}\left(\frac{\text{ANC} + \text{TTN}}{2} + \frac{\text{FD} + \text{SBA}}{2} + \frac{\text{PNCM} + \text{PNCN}}{2} + \frac{\text{BCG} + 2\text{DPT3} + 2\text{PL} + \text{MSL}}{6} + \text{AABF} + \text{FP}\right)$$

A handful of studies have demonstrated various levels of coverage estimates by using composite coverage measures. A survey-based study in 49 LMICs, including Ethiopia indicated that the average CCI estimate was 66.8% and the values ranged from 22.3% in Chad to 84.1% in Jordan (Wehrmeister et al., 2016). However, the study focused on limited MCH interventions. Evidence from Gambia showed a low level of continuum of care as measured by the modified CCI (Oh et al., 2020). Similarly, a study conducted in Asia reported that only 6.8% of mothers continued to receive all MCH services and the level of continuum of care was low. The average CCI in this study was estimated at 55% (Sakuma et al., 2019).

According to a study conducted in India, the CCI ranged from 58% in Uttar Pradesh to 87% in Tamil Nadu (Gandhi et al., 2021), while a study in India reported that the CCI estimate was 65% (Pandey et al., 2021). A DHS-based study involving 36 countries, grouped into Central, East, Southern and West Africa subregions found a large difference in CCI between the four regions and the median CCI ranged from 50.8% for West Africa to 75.3% for Southern Africa (Wehrmeister et al., 2020b). The limited findings to date in Ethiopia highlight the need for a comprehensive measure of coverage from preconception to childhood at the national level.

2.4 Determinants of continuum of care for maternal, newborn, and child health services

Studies show that the continuum of MCH care can be influenced by determinants such as the individual attributes, socioeconomic factors, and reproductive or obstetric characteristics. This section presents a review of literature on factors that affect the continuum of MCH care in LMICs.

2.4.1 Individual characteristics

Research has identified a ranged of individual level factors that affect the continuum of MCH care. This section describes individual-level factors focusing on women's age, area of residence, educational status, perceived distance from a health facility and media exposure.

Women's age

Age has been identified in several studies as a predictor of the continuum of MCH care, although the results are inconclusive. In a multi-country study involving SSA countries, women have been found to have a higher continuum of MCH care as their age increases (Alem et al., 2022). Similarly, in Egypt (Hamed et al., 2018) and Cambodia (Chham et al., 2021), it was reported that older women were more likely to have a higher continuum of care. This could relate to the increased risks of pregnancy complications with increasing maternal age, along with knowledge gained from previous pregnancies as women's age advance. Contrary to the findings that reported a positive association between age and the continuity of care, two Ethiopian studies revealed that the completion of the continuum of maternity care was negatively correlated with women's age (Dadi et al., 2021, Emiru et al., 2020).

Area of residence

Completion of continuum of MCH care is affected by where a women lives. As observed in studies from India (Kothavale and Meher, 2021), Indonesia (Titaley et al., 2010) and Gambia (Oh et al., 2020), women residing in rural areas were less likely to attain the completion of the continuum of maternity care compared to those residing in urban areas. This finding was also evident in a secondary analysis of DHSs in SSA (Alem et al., 2022).

Ethiopian studies illustrated that the completion of the continuum of maternity care was negatively correlated with the rural residence (Abebe et al., 2022, Alamneh et al., 2022). Other studies conducted in Northwest Ethiopia reported that the completion of maternity continuum of care was twice (Tsega et al., 2022) and five times (Asratie et al., 2020) higher among urban women than rural women.

Evidence shows that women who live in rural residences experience poor healthcare-seeking behaviour (Tamirat et al., 2020). Disparities in the use of MCH services between rural and urban areas could be attributed to several reasons. In rural areas, barriers such as the limited availability of health facilities, distance from health facilities, lack of infrastructure, limited exposure to mass media or low chance of getting health information, limited access to education and fewer employment opportunities are evident (Samuel et al., 2021, Kurlikar et al., 2020, Kanu et al., 2014). These barriers may in turn lead to less likelihood of completing the continuum of care (Alamneh et al., 2022). Urban women are advantageous in terms of the availability and accessibility of health services. Moreover, urban women have better socioeconomic status, autonomy and access to quality health services. Therefore, they are more likely to have a high completion of the continuum of MCH care (Fekadu et al., 2019, Iqbal et al., 2017).

Women's educational status

Several studies assessed the relationship between women's educational status and continuum of MCH care. A secondary analysis of 32 DHSs conducted in SSA demonstrated that women with primary, secondary, and higher education levels were more likely to have a higher continuum of care compared to those women who have no formal education (Alem et al., 2022). Another multi-country study from SSA reported that the odds of completing continuum of maternity care was found to be higher among

women from communities with a high percentage of educated women. This study also reported that women who attended primary, secondary, and higher educations had higher continuum of care compared to those women with no formal education (Hunie Asratie and Belay, 2022). A range of other studies conducted in different LMICs also reported consistent findings (Chalise et al., 2019, Chham et al., 2021, Kothavale and Meher, 2021, Iqbal et al., 2017, Sakuma et al., 2019). A systematic review of studies conducted in Ethiopia revealed that the level of women's education was positively associated with achieving the complete continuum of maternal care (Addisu et al., 2022). A greater likelihood of achieving a continuum of care among educated women may be related to a high health knowledge of the importance of accessing MCH services, increased awareness of poor MCH outcomes, and increased financial and decision-making autonomy, as well as improved social status of highly educated women. Education can be a powerful tool in enabling individuals to make informed decisions about their health and the health of their children. Women with higher levels of education may have more resources and knowledge to access high-quality care and make informed decisions about their health (Osamor and Grady, 2016).

Perceived distance from a health facility

In LMICS, perceived distance from a health facility is associated with the utilization of maternal continuum of care. For example, two multi-country analyses of DHSs in SSA indicated that the odds of having incomplete utilization of maternal continuum of care were higher for women who perceived the distance from the health facility was a problem (Alem et al., 2022, Hunie Asratie and Belay, 2022). Similarly, studies in Lao PDR (Sakuma et al., 2019), Gambia (Oh et al., 2020), Ghana (Enos et al., 2021), and Guinea (Camara et al., 2021) have found that distance to facility influenced the completion of the continuum of

care. Ethiopian studies showed that women who lived near health facilities were more likely to complete the continuum of care compared to those who lived far from health facilities (Tsega et al., 2022, Tiruneh et al., 2022). Evidence shows that distance is known to be one of the most important nonmonetary barriers that impede access to healthcare. As a result, women may be less motivated to seek care (Riaz et al., 2015).

Media exposure

Mass media exposure has the potential to promote positive health-related behaviours and discourage negative behaviours through direct or indirect pathways. Radio, television, and print media are widely used for disseminating health-related information in SSA (Aboagye et al., 2022). Media exposure has been researched in several studies as a potential determinant of the continuum of MCH care. For example, in studies conducted in Cambodia (Chham et al., 2021), Ghana (Enos et al., 2021), India (Kothavale and Meher, 2021), and Pakistan (Iqbal et al., 2017), it was found that women who have exposure to any mass media were more likely to get the maternity continuum of care than those women who have no exposure to media. A consistent finding has been reported in a multi-country study in SSA (Alem et al., 2022). Furthermore, Ethiopian studies revealed that mass media exposure affected the completion of maternity continuum care positively (Cherie et al., 2021, Shitie et al., 2020, Tsega et al., 2022).

Other individual level factors

Region of residence and health insurance coverage were found to be important determinants of the continuum of MCH care. Two Ethiopian studies reported that there were regional variations in the completion of the continuum of maternity care (Chaka, 2022, Abebe et al., 2022). In addition, evidence of regional differences was reported in other LMICs (Akinyemi et al., 2016, Iqbal et al., 2017, Sserwanja et al., 2021). Health

insurance coverage also affected the completion of the continuum of care. Studies from LMICs confirmed this, revealing that the odds of completing the maternal continuum of care were higher among women who were members of health insurance as compared to those who were not insured (Chham et al., 2021, Kothavale and Meher, 2021). Likewise, studies conducted in Ethiopia indicated that women who were enrolled in community-based health insurance were more likely to utilise the continuum of maternity care than those who were not enrolled (Hailemariam et al., 2022, Seid and Ahmed, 2021). A study by Bosomprah et al., highlighted the significance of health insurance membership in increasing access to and utilisation of MCH care (Bosomprah et al., 2015).

2.4.2 Socioeconomic factors

Socioeconomic factors such as wealth index (economic status) and employment status have been researched in several studies as determinants of the continuum of MCH care.

Wealth index

Socioeconomic status is one of the most researched determinants of the continuum of MCH care, mostly reflected by wealth quintiles. A range of studies conducted in LMICs reported wealth index as a significant predictor of utilization of maternal continuum of care. For example, a study conducted in Cambodia found that household wealth strongly predicted service use and achievement of the continuum of maternal care (Chham et al., 2021). Studies from Sierra Leone (Sserwanja et al., 2022b), Pakistan (Iqbal et al., 2017), India (Kothavale and Meher, 2021), and Ghana (Shibanuma et al., 2018) stated that women who belonged to the wealthiest households were more likely to complete the continuum of maternity care as compared to women who belonged to the poorest households. According to researchers in Tanzania (Mohan et al., 2017) and Nigeria (Akinyemi et al.,

2016), the drop out from maternal care continuum was higher among the poorest segments of the population.

Evidence from Ethiopia revealed that poorer women were disadvantaged in terms of achieving a complete continuum of care (Tiruneh et al., 2022, Alamneh et al., 2022). Another Ethiopian study found that the likelihood of having complete utilization of maternal continuum of care was higher for women who belonged medium and rich wealth status as compared to those who belonged to poor wealth status (Abebe et al., 2022). These findings suggest that women from wealthier households may have better access to health services. On the contrary, women with low socioeconomic status may face barriers to health care access due to lack or autonomy, lower literacy, financial constraints, and poor knowledge regarding the importance of continuity of MCH care. Findings drawn from nationally representative samples of mothers and children in nine LMICs suggested that when interventions are offered as a package without considering equity, the poorest segment of the population would be very disadvantaged (Victora et al., 2005).

Women's employment status

Women's employment status is another important factor associated with the continuum of MCH care. In a study conducted in Egypt, women who were employed had a higher odd of completion of the continuum of care compared with those who were not employed (Hamed et al., 2018). This is consistent with Ethiopian studies reporting a positive correlation between being employed and completion of the continuum of care (Haile et al., 2020, Chaka et al., 2019b). A systematic review and meta-analysis of studies in Ethiopia also confirmed this finding (Addisu et al., 2022). The positive association between being employed and continuum of care completion might be related to the fact that employed women have better autonomy, financial capability, and knowledge about the importance

of MCH services which could facilitate their decision to utilise all MCH services continuously. However, a study from Pakistan has a contrasting finding reporting that employed women were less likely to have complete continuum of care for maternal health services compared with unemployed women (Iqbal et al., 2017).

2.4.3 Reproductive characteristics

It has been shown that a range of reproductive or obstetric characteristics also influence the completion of the continuum of MCH care in LMICs. The reproductive factors such as early initiation of ANC, pregnancy intention and others are discussed in detail.

Early initiation of antenatal care

Among the reproductive characteristics that have been shown to affect the continuum of MCH care, the most commonly cited was the early initiation of ANC. Several studies conducted in LMICs demonstrated that women initiating ANC in the first trimester were more likely to have complete continuum of maternal care compared to their counterparts who initiated ANC after the first trimester (Sserwanja et al., 2022a, Sserwanja et al., 2022b, Sakuma et al., 2019, Oh et al., 2020). Similarly, evidence pooled from studies conducted in Ethiopia concluded that the first ANC visit before 16 weeks was significantly associated with the continuum of maternal healthcare services utilization (Addisu et al., 2022). A study that investigated associated factors of continuum of care in SSA showed that women who had started ANC within the second trimester were three times more likely to complete the maternity continuum of care compared with those who started above the second trimester of gestational age (Hunie Asratie and Belay, 2022). Other studies reported that delayed initiation of ANC was negatively and significantly associated with the continuum of maternity care (Sserwanja et al., 2021, Abebe et al., 2022). Women who present early for ANC could capture the necessary information on the type, time, and importance of MCH

services during pregnancy, delivery and after delivery. Thus, better informed women might have a higher chance to attend the full components of the continuum of care (Berhan and Berhan, 2014, Tizazu et al., 2021).

Unintended pregnancy

Preconception care is an indispensable component of the continuum of care as it avoids health risks that occur before conception. Failure to focus on preconception care is a missed opportunity to get women started on the continuum of care pathway (Dean et al., 2014). Women having unintended pregnancies are less likely prepared to receive MCH services along the continuum of care. Studies conducted in Bangladesh found a strong association between unintended pregnancy at conception and the level of continuum of care attained (Parvin et al., 2022, Khan et al., 2020). Additionally, a study involving SSA countries revealed that women with unintended pregnancy were at lower odds of completing the continuum of care compared to those women whose pregnancy was intended (Alem et al., 2022). Findings from Ethiopia indicated that completion of the maternity continuum of care was better observed in women with intended pregnancy than the counterparts (Addisu et al., 2022, Shitie et al., 2020, Haile et al., 2020, Cherie et al., 2021).

Other reproductive characteristics

Parity, history of pregnancy termination, and mode of delivery were other factors linked with the continuum of MCH care. In different African and south Asian countries, it has been shown that women of higher parity were less likely to receive the elements of the maternal continuum of care compared to primiparous women, which could relate to their reliance on previous maternity experiences (Singh et al., 2016, Parvin et al., 2022, Dennis et al., 2019). Conversely, an Ethiopian study found that higher parity was associated with the completion of the maternity continuum of care (Shitie et al., 2020). Another study

showed that previous history of pregnancy termination affected the continuum of maternity care. In this regard, this study reported that the likelihood of completion of the maternity continuum of care was three times higher among women with a history of terminated pregnancy compared with those who have no history of terminated pregnancy (Hunie Asratie and Belay, 2022). The mode of delivery was also mentioned as another determinant of the continuum of care in LMICs (Tiruneh et al., 2022, Mohan et al., 2017). Based on the existing literature (Iqbal et al., 2017, Sakuma et al., 2019, Shibanuma et al., 2018, Owili et al., 2016), we adapted a conceptual model consisting of three categories of determinants that affect the continuum of MCH. Our model identifies that the continuum of care is directly influenced by individual attributes, socioeconomic status, and reproductive characteristics.

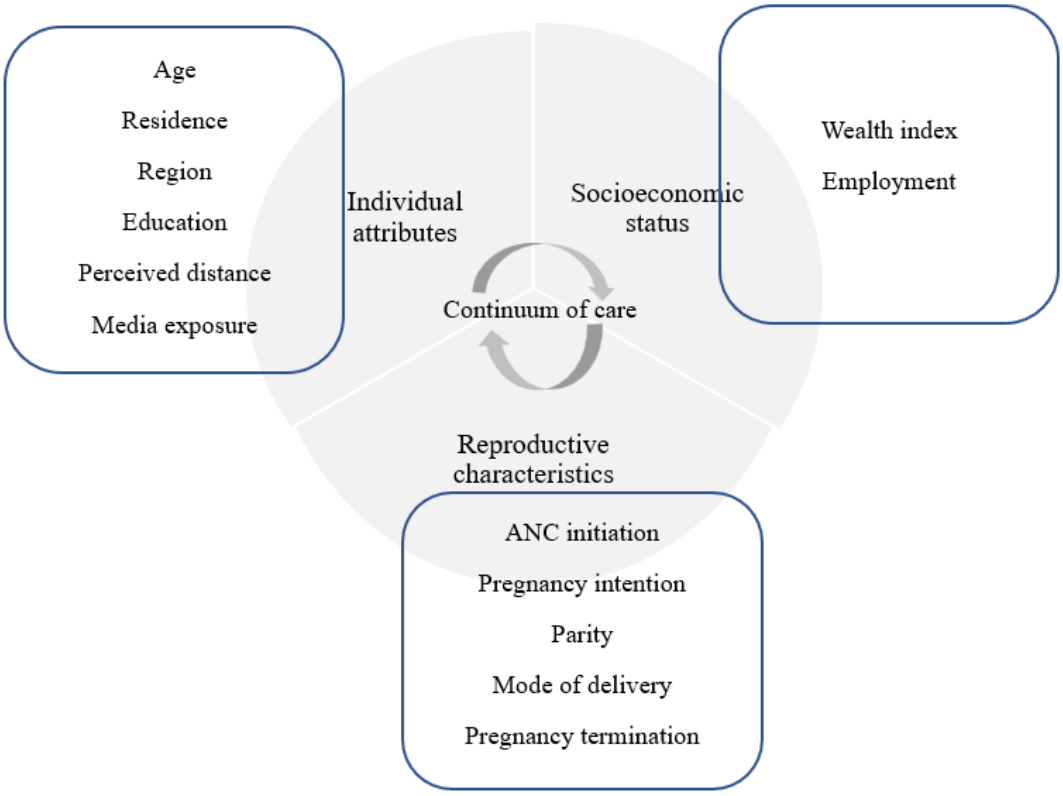


Figure 7. Conceptual framework of factors affecting the continuum of maternal. Newborn and child health care

In summary, prior studies from LMICs found that individual attributes, socioeconomic factors, and reproductive characteristics were linked to the completion of the continuum of care. However, the great majority of studies focused on the continuity of healthcare services provided to women during pregnancy, delivery, and the postnatal period. The comprehensive continuum of care from preconception to childhood and the determinants were studied in limited contexts. The use of a broader range of indicators in summary indices is proposed to assess coverage comprehensively. In Ethiopia, no studies identifying the determinants of the continuum of care using comprehensive coverage measures were found. In addition, the available studies have used analytical techniques that throw light on the mean of the outcome. Hence, their results do not give a complete picture of the relationship between explanatory and outcome variables.

2.5 Effective coverage of maternal and child health services

The other approach to measuring coverage of health services is effective coverage. In 1978, Tanahashi published a model of health service coverage that presents a hierarchical series of five stages. The first three levels include the availability, accessibility and acceptability of a service that indicate potential coverage. The remaining two measures focus on actual coverage and are labelled contact coverage and effective coverage. These five stages show the complex interaction between the health system and the population in ways that can highlight service delivery gaps. At each coverage level, various factors within the health system work together, interacting to influence who has access to services, always with an awareness that there is the potential to lose people from the care seeking pathway at each stage (Tanahashi, 1978).

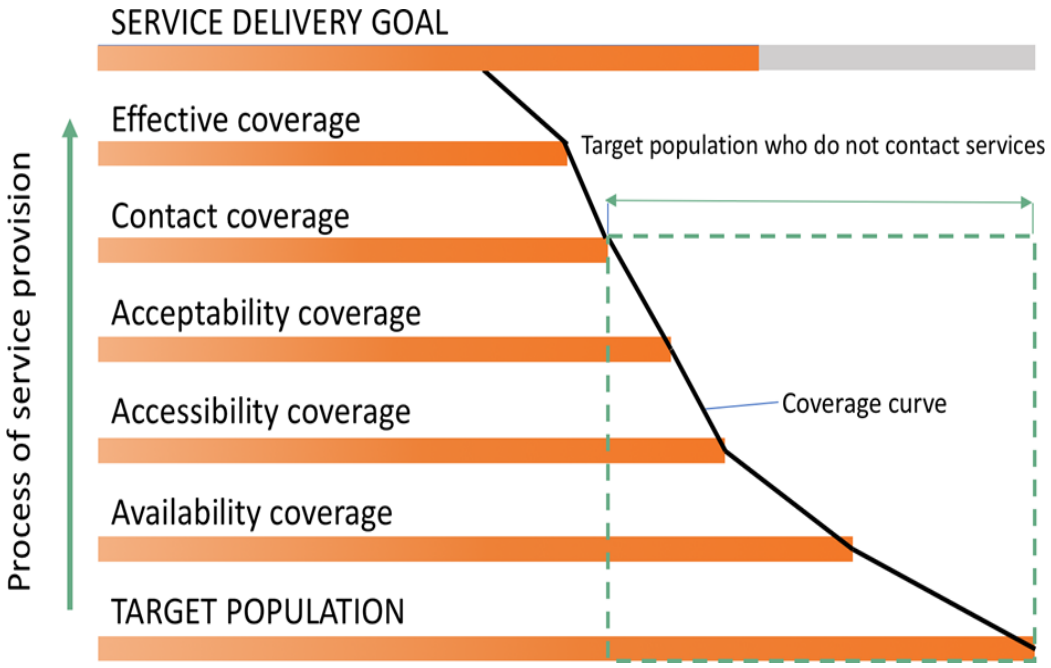


Figure 8. Tanahashi's health service coverage diagram illustrating relationships between the process of service provision and coverage measurements.

A modified version of the model emphasizes three concepts (need, use and quality) that are important in determining whether an individual obtains the desired health gain from an intervention. The conventionally used crude coverage measures access to services and is calculated as the fraction of those who need an intervention who use it, but it does not incorporate quality of care. The formula can be written as:

$$CC_{ij} = \frac{U_{ij}}{N_{ij}}$$

where CC_{ij} is Crude coverage for an individual i receiving intervention j,

U_{ij} is the probability that individual i will receive intervention j, and

N_{ij} is individual i's need for intervention j.

In contrast, effective coverage adjusts contact coverage estimates by the quality of care to yield the quality-adjusted coverage (Ng et al., 2014, Joseph et al., 2020). The formula can be written as (Shengelia et al., 2005):

$$EC_{ij} = Q_{ij} \times \frac{U_{ij|X=1}}{N_{ij}}$$

where EC_{ij} is effective coverage for an individual i receiving intervention j,

Q_{ij} is the expected quality of intervention j to be received by person i,

U_{ij} is the probability that individual i will receive intervention j, and

N_{ij} is individual i's need for intervention j.

The conditional statement $(X = 1)$ is important as it restricts U_{ij} to the condition of individual i truly needing the intervention (X).

As demonstrated above, one of the preconditions for calculating EC is the traditional crude coverage, which can be easily determined by calculating the ratio between the numerator of individuals who received the services and the denominator of those estimated to need those services within a population (Requejo et al., 2013). However, assessment of the quality of care poses several challenges, as there is no consensus on its measurement. Researchers' definitions often rely on the availability of data and their study objectives (Brizuela et al., 2019). The classic framework developed by Donabedian proposed measuring the quality of health care by observing its structure, processes, and outcomes. Structure measures assess the accessibility and availability of material resources or other structural inputs such as the number of trained health professionals. Process measures assess the delivery of health care services by providers, or the activities undertaken by the patient and/or provider. Outcome measures indicate changes in the resulting health status (Donabedian, 1988).

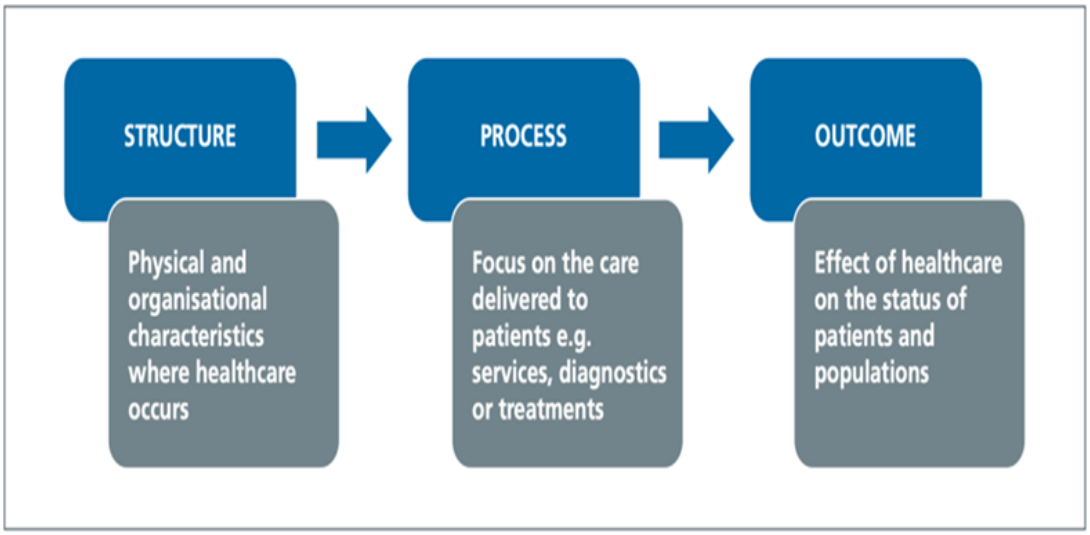


Figure 9. The Donabedian model for quality of care: Definitions of the three domains (structure, process, and outcome)

Effective coverage has been used in evaluating maternal and child health programmes. However, there has not been systematically synthesised evidence that offered a complete account of the specific estimates of the effective coverage of MCH services, as well as the gaps and distributions across socioeconomic status. The systematic review presented in Chapter six assessed the effective coverage of MCH interventions or programmes based on the updated WHO framework for measuring effective coverage. The review also investigated the gap between effective coverage and crude coverage, the quality measurement strategies used and possible disparities across different socioeconomic groups.

Although the systematic review did not restrict studies by country, all of the included studies were conducted in LMICs, including Ethiopia. The review found: (1) the effective coverage values were lower when the crude coverage estimates were adjusted to account for the quality of care; (2) quality assessments addressed structural, process and outcome domains individually or combined; (3) the wealthiest quintile had higher effective coverage of services than the poorest quintile, showing an inequitable distribution of coverage; (4) limited evidence on the effective coverage of newborn postnatal care.

Overall, the systematic review findings helped to identify the research gap in the effective coverage of newborn PNC in Ethiopia and other LMICs and inform the quality measurement strategies while conducting a secondary analysis of the EDHS data in chapter seven.

2.6 Summary of the literature review

The literature review showed that, in LMICs, studies concerning the proportion of women and children who receive individual MCH interventions such as family planning, ANC, SBA, PNC, and others are available. However, a focused approach to each MCH service does not necessarily ensure that every woman and her child receive a series of essential MCH services from the preconception to post-delivery periods. The continuum of care approach integrates the packages of MCH services throughout different reproductive stages for improving MCH outcomes. The review of evidence also highlighted that some of the previous research in LMICs, including Ethiopia, applied the narrowed scope of the continuum of care focusing on only maternal health services and assessed the determinants, while other studies evaluated the continuum of care using summary measures of coverage such as the composite coverage index. Despite the increasing emphasis on the need to incorporate an appropriate and broader set of indicators in summary indices for assessing coverage and the determinants comprehensively, findings to date are limited. Moreover, since the available studies have analysed outcome means, they lack a clear picture of how explanatory variables influence outcomes.

In this literature review, it was found that conventionally used coverage measures do not capture quality of care and hence do not show potential health gain. According to the systematic review findings in chapter six, the effective coverage of MCH interventions lagged substantially behind crude coverage and there were disparities in LMICs. PNC is

neglected in the MCH research in Ethiopia, and literature concerning the effective coverage of newborn PNC is scarce.

2.7 Chapter summary

Chapter two briefly described the measures of coverage along the continuum of MCH care. This chapter also highlighted the findings of different studies and identified the gaps in research. This section also reviewed the available evidence concerning the determinants of the continuum of care for maternal, newborn, and child health services. In the next chapter, the overall methodological approaches used in this research will be presented.

CHAPTER THREE

METHODOLOGY

Chapter 3 Methodology

3.1 Overview

I begin this chapter by outlining the overall methodology, describing the study setting and highlighting the data source for the studies in chapters four, five and seven. A general overview of the major Ethiopia Demographic and Health surveys (EDHS) is presented in this chapter. This chapter also provides a description of the variables, analysis techniques and statistical tools used in this research. Also presented here is the ethical aspect of this research.

3.2 Summary of the methodology

This thesis employed three quantitative studies (chapters four, five and seven) and a systematic review (chapter six) based on the aims of each study. The three quantitative studies used the EDHS data to measure the coverage of MCH services along the continuum of care. The first study (chapter four) computed the modified composite coverage index as a summary measure of coverage and identified the determinants of the continuum of MCH care. The second study (chapter five) also generated modified composite coverage indices as summary measures of coverage and then assessed inequalities in MCH coverage along with the major contributors to the inequalities. In the third study (chapter six), the available evidence on the effective coverage of MCH services was explored systematically, while study four (chapter seven) assessed the effective coverage of newborn PNC in Ethiopia. Reproductive-aged women in Ethiopia whose most recent children were aged 12 to 23 months were the population of interest for the first (chapter four) and second (chapter five) study. The systematic review (chapter six) included studies that focused on women aged 15-49, newborns and children under five years. In the fourth study (chapter seven) reproductive-aged women who had a birth

in the two years preceding the 2016 EDHS survey were considered as the study participants. The table below provides an overview of the general methodological approaches used in the research papers that make up this thesis.

Table 1. Summary of the methodology

Chapter	Objective	Data source	Study design	Study participants	Outcome	Data analysis
Chapter four	To assess the continuum of MCH care and associated factors in Ethiopia	EDHS 2016	Quantitative study	Women aged 15–49 years with their most recent children being 12–23 months of age	Modified composite coverage index	Bivariable and multi variable quantile regression
Chapter five	To assess inequalities in MCH coverage and the determinants that contributed to the inequalities in Ethiopia	EDHS 2000, 2005, 2011 & 2016	Quantitative study	Women aged 15–49 years with their most recent children being 12–23 months of age	Modified composite coverage index	Inequality analyses, decomposition analyses
Chapter six	To conduct a systematic review of studies evaluating effective coverage of MCH services, quality measurement strategies, and disparities across wealth quantiles.	MEDLINE, EMBASE, CINAHL, Scopus, Web of Science, Maternity and Infant Care, and grey literature	Review of observational studies	Women aged 15–49 years, newborns, and under-five children.	Effective coverage	Systematic review
Chapter seven	To assess the level, inequality, and geographic distribution of the effective coverage of newborn PNC in Ethiopia	EDHS 2016	Quantitative study	Women aged 15-49 who had a birth in the two years preceding the survey	Effective coverage of newborn PNC	Inequality analysis, spatial analysis

3.3 Study setting and data source

The studies in chapters four, five and seven were based on secondary analyses of national data collected in Ethiopia. The EDHS provides a comprehensive overview of population, maternal, and child health issues in Ethiopia. Four large-scale DHS surveys were undertaken in the years 2000, 2005, 2011, and 2016 in the country. Additionally, two mini-DHS were conducted in 2014 and 2019. The 2019 mini-EDHS survey was the most recent survey conducted in Ethiopia, designed to collect data on a subset of indicators. As a smaller-scale survey, it did not capture information on several essential indicators, such as tetanus toxoid injection, which is a critical indicator for assessing maternal health (CSA [Ethiopia] and ICF, 2016, CSA [Ethiopia] and ICF International, 2012, CSA [Ethiopia] and ORC Macro, 2006, EPHI and ICF, 2021).

3.4 Overview of the Ethiopia Demographic and Health Surveys

3.4.1 Study design and sampling procedure

The EDHS 2000, 2005, 2011 and 2016 were cross-sectional household studies implemented by the Ethiopian Central Statistical Agency (CSA) as part of the worldwide MEASURE DHS project. These surveys targeted women aged 15-49 and men aged 15-59 in randomly selected households across Ethiopia. The sampling frame used for the 2000 and 2005 EDHS was the 1994 population and housing census, whereas the 2011 and 2016 EDHS used the 2007 population and housing census as a sampling frame. All the EDHS used samples representative of all the nine regions and two city administrations in Ethiopia and employed a two-stage stratified cluster sampling technique. In the first stage, enumeration areas (EA) were selected with probability proportional to EA size from census files and with independent selection in each sampling stratum. An EA is a geographic area consisting of dwelling units that served as counting units for the census.

In the second stage, sample households were selected from an updated list of households in each selected EA. Each region was stratified into urban and rural areas.

The 2000 EDHS was the first survey of its kind in Ethiopia to provide national and regional estimates on population and health. In this survey, 539 EA consisting of 138 urban and 401 rural areas were initially selected. Secondly, a systematic sample of 27 households per EA was selected in all the regions. In 2000 EDHS, interviews were completed for 14,072 households, 15,367 women aged 15-49, and 2,607 males aged 15-59 (CSA [Ethiopia] and ORC Macro, 2001).

The second survey, EDHS 2005, selected 540 EA (145 in urban and 395 in rural areas) initially, and then 27 to 32 households from each containing EA were selected in the second stage. The number of households who participated in the study were 13,721. Total samples of 14,070 women aged 15 to 49 and 6033 men aged 15-59 were interviewed (CSA [Ethiopia] and ORC Macro, 2006). The 2011 EDHS considered 624 EA, 187 from urban and 437 from rural areas. A representative sample of 16,702 households were successfully interviewed, and 16,515 women aged 15-49 participated in the study. Similarly, complete interviews were conducted for 14,110 men aged 15-59 years (CSA [Ethiopia] and ICF International, 2012).

The fourth and most recent national survey, EDHS 2016, selected 645 EA (202 in urban and 443 in rural areas) initially, followed by a fixed number of 28 households per EA in the second stage. Complete interviews were conducted at 16,650 households. A total of 15,683 reproductive-aged women and 12,688 men aged 15-59 were interviewed (CSA [Ethiopia] and ICF, 2016).

Table 2: Summary of the enumeration areas, households and women interviewed in the Ethiopian Demographic and Health Surveys 2000-2016

Survey year	Enumeration areas		Households interviewed	Women interviewed (15-49)
	Urban	Rural		
2000	138	401	14072	15367
2005	145	395	13721	14070
2011	187	437	16702	16515
2016	202	443	16650	15683

3.4.2 Ethiopia Demographic and Health Surveys data collection tools

EDHS surveys used four different types of questionnaires to acquire primary data: the household questionnaire, the woman's questionnaire, the man's questionnaire, the biomarker questionnaire, and the health facility questionnaire. The household questionnaire was used to collect information on the housing unit of the household as well as the characteristics of regular inhabitants and visitors. It was also used to identify household members who were qualified for an individual interview. The individual woman's or man's questionnaire was then used to interview eligible responders. Biomarker data on children, women, and men were collected using the biomarker questionnaire. A Health Facility Questionnaire was incorporated in the 2016 EDHS to collect vaccination information for all children who did not have a vaccination card as determined by the Woman's Questionnaire. The EDHS questionnaires were adapted from the model questionnaires of the DHS program available at:

https://dhsprogram.com/publications/publication-search.cfm?type=35.

All EDHS surveys provided georeferenced Global Positioning System (GPS) datasets for EA (cluster locations). GPS coordinates of the EDHS clusters were randomly displaced up to two kilometres in urban clusters and up to 5-10 kilometres in rural clusters to ensure confidentiality of the respondents. Appropriate quality control procedures through pre-testing, provision of training to the data collection staff, and close supervision of data

collectors during the field work were undertaken in each EDHS survey. The detailed methodology for each survey can be found in the EDHS reports available at https://dhsprogram.com/.

3.4.3 Sampling weights in the DHS analysis

The goal of the DHS surveys was to provide representative data at the national and sub-national levels. In many countries, the population is not evenly distributed among different regions. To obtain data that are representative of Ethiopia and its 11 regions, the number of women surveyed in each region should contribute to the size of the total (national) sample in proportion to the size of the region. However, if certain regions have small populations, then a proportional allocation to each region may not generate an adequate sample size to produce reliable estimates in these regions. Due to resource constraints, increasing the overall sample size to ensure enough households are included may not be feasible as well. In order to get reliable statistics under controlled cost, regions with smaller population sizes were over-sampled, and regions with larger population sizes were under-sampled. However, the under-sampling and over-sampling may result in biased estimates that do not accurately represent the population (I.e., the total sample distribution may be different from the actual population distribution of Ethiopia). To restore the representativeness of the sample and to correct for this deliberate over-sampling and under-sampling, DHS applied sampling weights to the sample such that it resembled the true distribution in Ethiopia. When weights were calculated because of sample design, corrections for differential response rates have also been made. Sample weights were calculated by sampling experts and included in each DHS recode file (CSA [Ethiopia] and ICF, 2016). Different weights were computed for the different units of analysis (household, women, men). The detailed procedures to produce weighted estimates can be found in the DHS guides available at https://dhsprogram.com/.

In chapters four, five, and seven of the three quantitative studies, I considered the complex design of the survey by using the Stata 'SVY' command. This enabled me to consider the strata, cluster design, and sampling weights of the survey in all estimates. The application of sampling weights compensated for the unequal probability of sample selection across sub-national divisions (regions) and ensured that the sample reflected the actual population distribution of Ethiopia. Additionally, adjustment for study design was done to control for the effect of cluster sampling on the variance of the estimates.

3.5 Variables included in the study

Table 3. Variables included in this thesis

Variables	Description of variables
Antenatal care	The proportion of women aged 15-49 who received at least four antenatal care from a skilled provider
Birth protected against neonatal tetanus	Whether a woman received two or more doses of tetanus injections before birth
Facility delivery	Percentage of women who gave birth in a health facility
Skilled birth attendance	Births delivered with the assistance of doctors, nurse/midwives, health officers, and health extension workers.
Postnatal care for mothers	Percentage of women who had postnatal check during the first two days after birth.
Postnatal care for newborns	Percentage of newborns who have received a postnatal health check within the first two days after birth
Family planning	The percentage of women who were using any modern contraceptive method at the time of the survey.
BCG vaccination	The percentage of children aged 12-23 months who received one dose of BCG vaccine
DPT-HepB-Hib vaccination	The percentage of children aged 12-23 months who received three doses of DPT vaccines
Polio vaccination	The percentage of children aged 12-23 months who received three doses of polio vaccines
Measles vaccination	The percentage of children aged 12-23 months who received one dose of measles vaccine
Age-appropriate breastfeeding	The percentage of women who continued to breastfeed their children at the time of the survey and fed complementary foods in the 24 hours preceding the survey
Modified composite coverage index	A composite score of coverage of twelve essential MCH interventions along the continuum of care.
Effective coverage	The level of coverage of a service adjusted for its quality.

3.6 Statistical analysis

My research utilised various analytical techniques. These include: (1) a bivariable and multivariable quantile regression approach to identify the determinants of the continuum of care for MCH services; (2) inequality analyses to measure disparities in the coverage of MCH along the continuum; (3) decomposition analyses to identify the major contributors to the inequalities in coverage; and (4); spatial analysis to identify statistically significant spatial clusters (hot spots and cold spots) of effective coverage of newborn postnatal care. Additionally, I conducted a systematic review to explore studies evaluating the effective coverage of MCH services.

3.7 Statistical tools

The secondary analyses of the EDHS data for the three quantitative studies (chapters four, five and seven) were conducted using Stata statistical software version 17. On the other hand, Covidence and Endnote were used as screening and data extraction tools for conducting the systematic review (chapter six). In addition, I used ArcGIS 10.3 software to perform the spatial analysis.

3.8 Ethical approval

Ethical approval for the secondary data analysis of the Ethiopian Demographic and Health Survey (EDHS) was obtained from the Human Research Ethics Committee at the University of Technology Sydney. The authorization to use the publicly available EDHS data was obtained from the DHS program.

The EDHS surveys obtained ethical clearance from the ICF Institutional Review Board (IRB), the Centre for Disease Control (CDC), the National Research Ethics Review Committee (NRERC) at the Federal Democratic Republic of Ethiopia Ministry of Science and Technology, and the Ethiopian Health Nutrition and Research Institute (EHNRI)

Review Board. The identities of the participants in the survey were anonymised (CSA [Ethiopia] and ICF, 2016, CSA [Ethiopia] and ICF International, 2012, CSA [Ethiopia] and ORC Macro, 2006, CSA [Ethiopia] and ORC Macro, 2001).

3.9 Chapter summary

This chapter presented a general overview of the methodology used in this thesis. This research is based on a nationally representative survey of Ethiopia and a systematic review of evidence. Statistical techniques employed to address the research aims comprised quantile regression approach, inequality analysis and spatial analysis. In the following chapters four through to seven, the four studies including their results and detailed methodologies are provided.

CHAPTER FOUR

THE CONTINUUM OF CARE FOR MATERNAL, NEWBORN, AND CHILD HEALTH SERVICES IN ETHIOPIA

(STUDY I)

Chapter 4 Determinants of the continuum of care for maternal, newborn, and child health services in Ethiopia: Analysis of the modified composite coverage index using a quantile regression approach

4.1 Overview of study one

A comprehensive assessment of coverage using summary measures that incorporate appropriate and broader sets of indicators is essential to improve the continuum of MCH care. This chapter investigates the determinants of the continuum of care for MCH services in Ethiopia using a quantile regression approach. This chapter has been published in the journal PLoS One.

Citation

Gebremedhin AF, Dawson A, Hayen A. Determinants of continuum of care for maternal, newborn, and child health services in Ethiopia: Analysis of the modified composite coverage index using a quantile regression approach. PLoS One. 2023 Jan 20;18(1):e0280629. doi: 10.1371/journal.pone.0280629

4.2 Abstract

Maternal and child mortality remain unacceptably high in the Sustainable Development Goals era. Continuum of care has become a key strategy for improving the health of mothers and newborns. Previous research on the continuum of care in Ethiopia is often limited to maternal health services. Maternal and child health services are inseparably linked and an integrated approach to care is essential. This study assessed the continuum of maternal, newborn, and child health care and associated factors in Ethiopia. The analysis was based on the 2016 Ethiopian Demographic and Health Survey data. We restricted our analysis to women with their most recent children - alive and living with

their mother- aged 12-23 months at the time of the survey (n = 1891). The modified composite coverage index, constructed from twelve maternal and child health services, was calculated as an indicator of the continuum of care. Bivariable and multivariable quantile regression were used to analyse the relationship between the predictors and specific quantiles of the composite coverage index. The effect of each variable was examined at the 10th, 25th, 50th, 75th, and 95th quantiles. The results showed that the average composite coverage index value was 39%. The overall completion rate of the continuum of care was low (2%). Four % of the women did not receive any of the services along the continuum of care. Postnatal care for newborns had the lowest coverage (12%). This study provides evidence that factors such as the educational status of women, region, residence, socio-economic status, perceived distance to a health facility, pregnancy intention, mode of delivery, parity, and early antenatal care initiation influence the continuum of care differently across levels of the composite coverage index. The findings call for integrated and targeted strategies that aim to improve the continuum of care considering the determinants.

4.3 Introduction

Maternal and child health (MCH) is an important public health issue (Black et al., 2016). Between 2000 and 2017 there was a 38 percent reduction in the global maternal mortality ratio. However, pregnancy-related preventable morbidity and mortality remains unacceptably high with many countries facing challenges to achieve the Sustainable Development Goals target of fewer than 70 maternal deaths per 100,000 live births. In 2017, about 295,000 maternal deaths occurred due to pregnancy and childbirth-related causes (WHO, 2019b). The WHO estimated that in 2019, 5.2 million children under 5 years died, mostly from preventable and treatable causes (WHO, 2020a). Maternal and child mortality disproportionately affects women and children in low and lower-middle-income

countries. Sub-Saharan Africa lags behind all other regions globally in reducing child and maternal mortality (Hug et al., 2019, WHO, 2019a). While substantial progress has been made, the rate of maternal and child mortality in Ethiopia remains one of the highest in the world (WHO, 2019b).

Effective coverage of MCH interventions has an enormous potential to avert poor health outcomes. MCH interventions are closely related and must be provided through a continuum of care (COC) approach (Lassi et al., 2014). The COC is touted as an important component of a strong health system, needed to improve the health and survival of women, and children (Kerber et al., 2007). The COC at its time dimension denotes the continuation of care throughout the lifecycle and across levels of MCH service delivery (Graft-Johnson et al., 2006). Yet, there is no clearly defined and agreed upon measurement approach to assess it (Yeji et al., 2015).

Previous studies that have investigated the COC have considered the key elements of MCH services; antenatal care (ANC), skilled birth attendance (SBA), and postnatal care (PNC) as separate entities (Wang and Hong, 2015, Haile et al., 2020, Atnafu et al., 2020). Researchers have advocated using summary measures such as composite coverage index (CCI) that are better suited for providing an overall estimate of coverage based on combined coverage of several interventions (Wehrmeister et al., 2016, Barros and Victora, 2013). The CCI is a comprehensive summary measure for reproductive, maternal, newborn, and child health (RMCH) interventions derived from a weighted average of coverage of eight preventative and curative interventions. It gives equal weight to four stages in the COC: reproductive health, maternal and newborn care, immunisation, and management of child illness (Boerma et al., 2008). Previous studies have used modified CCI versions that use different measurement indicators (Boerma et al., 2017, Wehrmeister

et al., 2020a, Oh et al., 2020, Sakuma et al., 2019). A recent study assessed the COC by combining eleven essential RMCH interventions (Oh et al., 2020). The COC is influenced by a range of factors such as individual and community characteristics (Debie and Lakew, 2020, Chalise et al., 2019, Iqbal et al., 2017, Kothavale and Meher, 2021, Oh et al., 2020), reproductive characteristics (Tiruneh et al., 2022, Cherie et al., 2021, Iqbal et al., 2017, Sakuma et al., 2019, Singh et al., 2016, Sserwanja et al., 2021) and socio-economic characteristics (Shibanuma et al., 2018, Asratie et al., 2020, Tiruneh et al., 2022, Chaka et al., 2019b, Tizazu et al., 2021, Tsega et al., 2022).

The COC depicts a pathway from pre-pregnancy to postpartum and beyond, where each step adds value to ensure good pregnancy and child health outcomes. Understanding the COC is critical for developing and implementing effective strategies. In Ethiopia, completion of the maternal health COC is very low (Dadi et al., 2021). Previous research on the COC in Ethiopia is often narrow and focuses on maternal healthcare services (Sertsewold et al., 2021, Asratie et al., 2020, Emiru et al., 2020, Tsega et al., 2022). MCH services are inseparably linked and an integrated approach to care is essential (de Graft-Johnson et al., 2006).

Much research has been conducted across countries on understanding the COC and the factors associated with it (Wang and Hong, 2015, Kikuchi et al., 2018, Chalise et al., 2019, Akinyemi et al., 2016, Iqbal et al., 2017, Sserwanja et al., 2021). However, the set of interventions used for the coverage measure is small and limited to selected maternal health interventions. In addition, the available studies have used analytical techniques that throw light on the mean of the outcome. Hence, their results do not give a complete picture of the relationship between explanatory and outcome variables.

Overall, there is increasing emphasis on the need to incorporate appropriate and a broader set of indicators in summary indices for assessing coverage comprehensively (Boerma et al., 2008). In this regard, our study used the recently modified CCI formula and examined the predictors of the COC for maternal, newborn, and child health services in Ethiopia. In addition, the present study contributes to the existing literature by using a quantile regression approach to assess the effects of the determinants along the entire distribution of the CCI.

4.4 Methods

Data source

This study was based on the 2016 Ethiopia Demographic and Health Survey (EDHS) conducted in Ethiopia. Ethiopia is structured into nine regional states namely Tigray, Afar, Amhara, Oromia, Somali, Benishangul-Gumuz, Southern Nations Nationalities and Peoples' Region (SNNPR), Gambela, Harari and two city administrations, Addis Ababa and Diredawa. The EDHS provided data on a wide range of indicators relating to population, maternal, and child health issues at national and regional levels. The sampling frame used for the 2016 EDHS was a complete list of 84,915 enumeration areas (EAs) created for the 2007 Population and Housing Census. Samples were selected using two-stage stratified cluster sampling. First, 645 clusters or EAs (202 from urban and 443 from rural) were selected with probability proportional to EA size and with independent selection in each sampling stratum. Second, 28 households per cluster were selected with an equal probability systematic selection from the updated household list. A total of 15,683 women aged 15–49 and 12,688 men aged 15–59 were interviewed. The survey also included 10,641 children aged 0–5 from women who had given birth during the five years preceding the survey. The detailed information is presented in the 2016 EDHS report (CSA [Ethiopia] and ICF, 2016).

Study population

We considered the inclusion criteria of most recent children 12 to 23 months of age for our study, as it aligns with the Expanded Programme for Immunisation in Ethiopia, which recommends that children should receive BCG, polio, DPT (Diphtheria, Pertussis, Tetanus) and measles vaccinations before 12 months of age (FMOH, 2015). By selecting this age range, we ensured that the children in our study had received all these critical vaccinations. Additionally, the recommended indicators for postnatal care in the DHS were based on births in the two years preceding the survey, hence the upper limiting factor was set at 23 months. As the DHS recodes the original data into different databases (Croft et al., 2018), we used the children's recode in our study with the intention of focusing on children aged 12 to 23 months. Hence, out of the 10,641 women who had children under five years of age in the five years preceding the survey, 1820 women with their most recent children (alive and living with mother) aged 12-23 months were eligible. Eleven observations with missing values in receipt of care components were removed. After managing missing data, the analysis was restricted to a weighted sample of 1891 women (The unweighted sample size is 1809).

Study variables

Outcome variable

The outcome variable was CCI, a composite metric consisting of a set of indicators representing interventions along the continuum. We used the modified CCI formula from a recent study by Oh J, et al. (Oh et al., 2020). The modified CCI is a valuable tool for assessing MCH services, as it integrates WHO's recommended MCH care components and Kerber et al's definition of the continuum of care. This definition spans throughout the life cycle (pregnancy, birth, postpartum, infancy, childhood, and maternal health

period) and between places of caregiving (households and communities, outpatient and outreach services, and clinical care settings) (Kerber et al., 2007). The selected indicators in the modified CCI are relevant and crucial for assessing services in Ethiopia, and they align with the Ethiopian health system's recommendations (Ministry of Health, 2021). The modified CCI is composed of essential MCH interventions which are defined below:

$$\text{Modified CCI} = \frac{1}{6}\left(\frac{\text{ANC} + \text{TTN}}{2} + \frac{\text{FD} + \text{SBA}}{2} + \frac{\text{PNCM} + \text{PNCN}}{2} + \frac{\text{BCG} + 2\text{DPT3} + 2\text{PL} + \text{MSL}}{6} + \text{AABF} + \text{FP}\right)$$

ANC was defined as the use of at least four ANC visits of a woman during her pregnancy from a skilled provider. Birth protected against neonatal tetanus (TTN) was defined as whether or not women received two tetanus toxoid injections during pregnancy. Facility delivery (FD) was operationalised as delivered in a health facility by a skilled provider. Skilled birth attendance (SBA) indicates that births were delivered with the assistance of doctors, nurse/midwives, health officers, and health extension workers. To measure PNC for mothers (PNCM), we considered women who had a postnatal check during the first two days after birth. PNC for newborns (PNCN) was defined by newborns who had received a postnatal health check within the first two days after birth.

Family planning (FP) was defined as the percentage of women using any modern contraceptive method at the time of the survey. For the immunisation indicators, we assessed if a child took one dose of BCG vaccine, three doses of DPT-HepB-Hib (diphtheria, pertussis, tetanus- hepatitis B- haemophilus influenzae type B), three doses of polio vaccine (PL), and one dose of measles vaccine (MSL). Age-appropriate breastfeeding (AABF) denoted children who received breast milk and complementary foods. All indicators are equally weighted (except for the DPT and polio vaccines, which receive a weight of two because they require more than one dose. Women were asked

whether they received each service, and their answers were coded ‘yes’ or ‘no’. This was followed by entering one for yes and zero for no into the modified CCI formula for each intervention use. Two categories of the calculated index were constructed: “1” for women receiving all MCH interventions indicating full COC, and “0” for otherwise. To ascertain the internal consistency and validity of the items in relation to the underlying construct (CCI), Cronbach's reliability coefficient was computed. Cronbach's α reliability coefficient has a theoretical value of 0 to 1, and values greater than 0.7 are considered acceptable (Gliner et al., 2016). We found that Cronbach's α reliability coefficient was 0.84 for the full set of coverage indicators.

Independent variables

The independent variables included individual characteristics (women’s age, marital status, women’s educational status, region, health insurance membership, media exposure, residence - urban or rural- and perceived distance from the health facility), socioeconomic factors (wealth quintile and women’s employment status), and obstetric characteristics (parity, caesarean delivery (CS), pregnancy intention, sex of the child, ANC initiation and history of pregnancy termination).

To calculate the wealth index, the EDHS survey collected information on a range of indicators that reflect a household's economic status. These indicators include ownership of durable assets such as televisions, radios, cars, bicycles, and access to basic amenities like improved water sources, sanitation facilities and flooring materials. The collected indicators were then used to create a scoring system. This scoring system assigned weights or values to each indicator based on their relative importance in reflecting household wealth. The weights were determined through a statistical technique called Principal Component Analysis (PCA). National wealth quintiles were compiled by

assigning the household score to each usual household member, ranking each person in the household population by her or his score, and then dividing the distribution into five equal categories, each comprising 20% of the population (CSA [Ethiopia] and ICF, 2016).

Data analysis

The cleaned and recoded data were analysed using STATA 14. Frequencies and percentages were used to summarise the characteristics of variables. Data were presented using tables and graphs. We used quantile regression to analyse the relationship between the predictors and specific quantiles of the outcome variable (CCI). Quantile regression, first introduced by Koenker and Bassett in 1978, quantifies the association of explanatory variables with a conditional quantile of a dependent variable without assuming any specific conditional distribution (Koenker and Bassett Jr, 1978). Therefore, it models the quantiles instead of the mean as done in standard regression. In cases where the assumptions of mean regression are not met (i.e., linearity, homoscedasticity, independence, or normality), quantile regression can explain dependencies more accurately than classical methods (Jiang et al., 2020). Quantile regression provides a complete view of the effect of an independent variable on the outcome variable; therefore, it is possible to identify the more vulnerable groups and devise more effective interventions (Gadowski et al., 2019). In this study, the distribution of CCI was found to be non-normal and the Breusch-Pagan test indicated the possible existence of heteroskedasticity ($p = 0.02$), justifying the use of quantile regression.

First bivariable quantile regression was performed and variables with a P-value less than 0.05 in the bivariable analysis were entered into the multivariable quantile regression to identify the factors significantly associated with the outcome variable. The goodness of fit for the quantile regression model was indicated with pseudo-R^2. The P-value less than

0.05 was considered statistically significant. The coefficient (b), standard error (SE) and 95% CI were estimated for 10th, 25th, 50th (median), 75th, and 90th quantiles of CCI. Since the EDHS employed a complex sampling procedure, sampling weights were used in the analysis.

Ethics

This study used publicly available data sources and ethical approval was not required. The authorisation for using the data was granted from the DHS program. According to the EDHS 2016 report, all participant data were anonymised during the data collection (CSA [Ethiopia] and ICF, 2016).

4.5 Results

Socio-demographic characteristics

The median age of the mothers was 28 years (IQR 25,34). The majority (88.48%) of women lived in rural areas. Almost all (95%) were either married or in a union. About 55%, 63% and 25% of women were jobless, had no formal education and lived in the poorest wealth quintile, respectively. Other characteristics of the women are shown in Table 4.

Table 4. Background characteristics of the study population, Ethiopian Demographic Health Survey, 2016

Variable	*n*=1891 (Weighted)	Percentage
Women's age Median age = 28 years (IQR 25,34)		
15-24	466.4	24.7
25-34	989.6	52.3
35-49	434.8	23
Marital status		
Married/living with partner	1786.5	94.5
Not married /not in union	104.3	5.5
Residence		
Urban	217.9	11.5
Rural	1673	88.5
Region		
Tigray	145.9	7.7
Afar	19	1
Amhara	342.8	18.1
Oromia	836.0	44.2
Somali	66.7	3.5
Benishangul	20.3	1.1
SNNPR	393.4	20.8
Gambela	4.9	0.3
Metropolis	61.8	3.3
Mother's education		
No education	1187	62.8
Primary	548.1	29.0
Secondary and higher	155.8	8.2
Mother's occupation		
Not working	1037.3	54.9
Working	853.6	45.1
Wealth index		
Poorest	478.9	25.3
Poorer	376.6	19.9
Middle	414.1	21.9
Richer	342.7	18.1
Richest	278.6	14.7

Sixty-one per cent of the study participants had one to four pregnancies. Nearly 9% of the women had a history of termination of pregnancy. Additionally, 20% of the study participants had their first antenatal follow-up within 16 weeks of their pregnancy. Only 2% of women gave the most recent birth by CS. Most of the respondents (92%) reported having intended pregnancy. Approximately 96% of the women had no health insurance.

About 60% of women perceived that the distance to a nearby health facility was a big problem. The majority (66%) of the study participants did not have media exposure (Table 5).

Table 5. Reproductive characteristics of the study population, Ethiopian Demographic Health Survey, 2016

Variable	*n*=1891 (Weighted)	Percentage
Sex of child		
Male	874.9	46.3
Female	1016.0	53.7
Parity		
1-4	1148.2	60.7
5+	742.6	39.3
Pregnancy intention		
Intended	1731.1	91.6
Unintended	159.7	8.5
Delivered by caesarean section		
No	1847.3	97.7
Yes	43.6	2.3
Ever terminated pregnancy		
No	1726.7	91.3
Yes	164.2	8.7
Attended ANC <4 months of pregnancy		
No	1506.3	79.7
Yes	384.6	20.3
Exposure to media (TV, radio, newspaper)		
No	1253.4	66.3
Yes	637.4	33.7
Health insurance covered		
No	1811.3	95.8
Yes	79.5	4.2
Distance to a health facility		
Big problem	1130.7	59.8
Not a big problem	760.2	40.2

Overall use of maternal and child health services

Among the mothers included in the study 623 (33%) had four or more ANC visits and 787 (42%) received two doses of tetanus injection. Women who delivered in a health facility were 647 (34%). 671 women (36%) were attended by a skilled health provider.

For postnatal care, 298 (16%) women received a health checkup within two days of delivery while 223 (12%) newborns had a postnatal check within two days. 704 women (37%) used modern contraceptive methods. Among the four vaccinations, 1313 (69%), 1001 (53%), 1027 (54%) & 1067 (56%) women had children who received BCG, three doses of DPT, measles, and three doses of polio respectively. A total of 1408 (75%) children received age-appropriate breastfeeding (Figure 10).

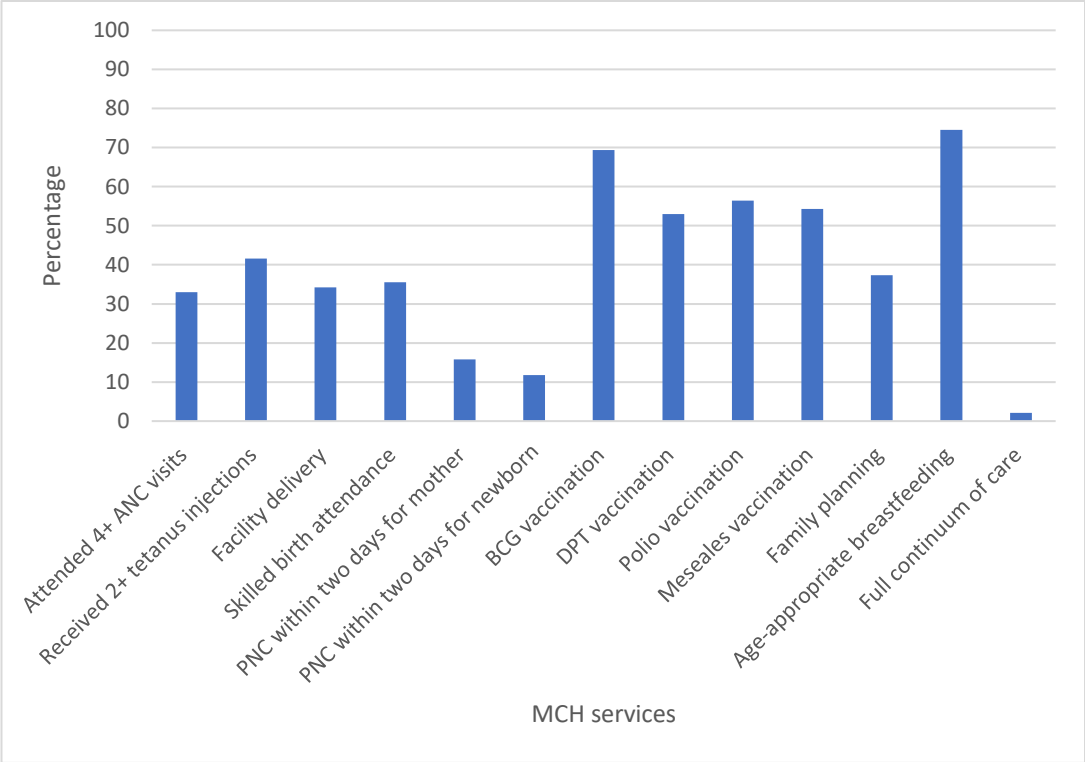


Figure 10: Components of the continuum of care (n=1891)

Composite coverage index

As an indicator of COC, the CCI was computed for each mother. The average CCI value was 39% (Median= 0.39, IQR 0.22, 0.58). Among all the sampled women, 40 (2%) had the full range of services for the COC, while 73 (4%) women did not receive any of the twelve services.

Determinants of the continuum of care

Bivariate analysis demonstrated that educational status, occupation, wealth index, residence, region, health facility distance, parity, pregnancy intention, caesarean delivery, attending ANC in less than four months of pregnancy and media exposure were associated with CCI. These variables were considered in the multivariable quantile regression analysis (see Table 6)

Table 6. The results of the multivariable quantile regression analysis

	(1)	(2)	(3)	(4)	(5)
Variables	**0.1 Est.(se)**	**0.25 Est.(se)**	**0.50 Est.(se)**	**0.75 Est.(se)**	**0.9 Est.(se)**
Primary education	0.0455***	0.0333*	0.0833***	0.0556***	0.0648**
	(0.0174)	(0.0197)	(0.0282)	(0.0194)	(0.0289)
Secondary or more	0.199***	0.128***	0.117***	0.0556	0.0370
	(0.0605)	(0.0277)	(0.0293)	(0.0352)	(0.0400)
Working	-0.0126	-0.00556	0.0222	0.0556***	0.0370
	(0.0145)	(0.0144)	(0.0170)	(0.0105)	(0.0227)
Poorest	-0.0505	-0.0333	-0.122***	-0.139***	-0.139**
	(0.0370)	(0.0342)	(0.0426)	(0.0410)	(0.0660)
Poorer	-0.0152	-0.0167	-0.0222	-0.0278	-0.0247
	(0.0331)	(0.0347)	(0.0474)	(0.0342)	(0.0770)
Middle	0.0202	0.0111	-0.0333	-0.0278	-0.00617
	(0.0358)	(0.0355)	(0.0443)	(0.0334)	(0.0773)
Richer	0.00253	0.0278	0.0111	0.0278	0.0432
	(0.0385)	(0.0365)	(0.0446)	(0.0318)	(0.0659)
Distance not a big problem	0.0379***	0.0444***	0.0222	0.0278	0.0556**
	(0.0142)	(0.0150)	(0.0194)	(0.0207)	(0.0249)
Parity 5+	0.0177	-9.93e-09	-0.0278	-0.0556***	-0.0463
	(0.0148)	(0.0147)	(0.0179)	(0.0188)	(0.0305)
Unintended pregnancy	-0.116***	-0.0444**	-0.00556	-0.0556*	-0.0432
	(0.0227)	(0.0218)	(0.0329)	(0.0286)	(0.0899)
CS delivery	0.124**	0.0722	0.133*	0.167***	0.167***
	(0.0580)	(0.0579)	(0.0753)	(0.0572)	(0.0501)
ANC within 4 months	0.129***	0.144***	0.139***	0.111***	0.102***
	(0.0304)	(0.0162)	(0.0191)	(0.0182)	(0.0259)
Tigray	0.136***	0.0722*	0.128***	0.139***	0.105***
	(0.0494)	(0.0386)	(0.0262)	(0.0307)	(0.0315)
Afar	-0.109**	-0.261***	-0.122***	-0.139***	-0.154***
	(0.0515)	(0.0393)	(0.0347)	(0.0313)	(0.0381)
Amhara	0.00758	-0.0833*	-7.45e-09	-0.0278	-0.0556
	(0.0515)	(0.0430)	(0.0337)	(0.0262)	(0.0429)
Oromia	-0.0126	-0.111***	-0.0444	-0.0556*	-0.0741**
	(0.0532)	(0.0400)	(0.0291)	(0.0292)	(0.0363)
Somali	-0.126**	-0.256***	-0.128***	-0.139***	-0.173***
	(0.0528)	(0.0400)	(0.0357)	(0.0303)	(0.0359)
Benishangul	0.0455	-0.0333	0.0444	0.0556**	-5.96e-08
	(0.0577)	(0.0458)	(0.0369)	(0.0277)	(0.0445)
SNNPR	-0.0404	-0.0944**	0.00556	0.0556*	0.0340
	(0.0491)	(0.0415)	(0.0321)	(0.0311)	(0.0365)
Gambela	-0.0808*	-0.122***	-0.0556*	0.0278	-0.0309
	(0.0433)	(0.0385)	(0.0314)	(0.0244)	(0.0317)
Rural residence	-0.111***	-0.111***	-0.144***	-0.139***	-0.0895*
	(0.0399)	(0.0376)	(0.0442)	(0.0391)	(0.0495)
Has media exposure	-0.00758	0.0167	0.0222	1.49e-08	-0.00309
	(0.0200)	(0.0174)	(0.0229)	(0.0188)	(0.0349)
Constant	0.242***	0.406***	0.511***	0.667***	0.781***
	(0.0550)	(0.0442)	(0.0388)	(0.0359)	(0.0512)
Observations	1,809	1,809	1,809	1,809	1,809
Pseudo R2	0.1734	0.2201	0.2506	0.2516	0.2126

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

Multivariable analysis demonstrated that educational status had differential effects at different quantiles of the CCI. Mothers who completed primary education tended to have a significantly higher level of COC, as evidenced in the 10^{th} (β = 0.05, *P* = 0.009), 50^{th} (β = 0.08, *P* =0.003), 75^{th} (β = 0.06, *P* =0.004), and 90^{th} quantile (β = 0.06, *P* = 0.025) as compared with those mothers who had no formal education. Women who completed secondary education or above also had increased levels of COC compared to women who had no formal education at the 10^{th} (β = 0.199, *P* = 0.001), 25^{th} (β = 0.13, *P* <0.001), and 50^{th} quantiles (β = 0.12, *P* < 0.001).

Region of residence was also shown to variably affect CCI across different quantiles. At the 10^{th} quantile, residence in Tigray (β = 0.14, *P* = 0.006) has a positive association with CCI, showing a high COC as compared to residence in the metropolis regions (referring to Addis Ababa, Harari and Diredawa), while residence in Afar (β = -0.11, *P* = 0.035) and Somali (β = -0.13, *P* = 0.017) was negatively related with CCI. Similarly, living in Tigray (β = 0.13, *P* < 0.001), Afar (β = -0.12, *P* < 0.001) and Somali (β = -0.13, *P* < 0.001) were significantly associated with COC, as compared to living in the metropolis, at the 50^{th} quantile. The CCI level of the 25% quantile was negatively associated with residence in Afar (β = −0.26, *P* < 0.001), Oromia (β = -0.11, *P* = 0.006), Somali (β = −0.26, *P* < 0.001), SNNPR (β = -0.09, *P* = 0.023), and Gambela (β = -0.12, *P* = 0.002) as compared to residence in the metropolis. At the 75^{th} quantile, women residing in Tigray (β = 0.14, *P* < 0.001) and Benishangul (β = 0.06, *P* = 0.045) had a high level of COC than women residing in the metropolis. In contrast, women residing in Afar (β = -0.14, *P* <0.001) and Somali (β =- 0.14, *P* < 0.001) had lower levels of COC compared with women residing in the metropolis. At the 90^{th} quantile, women who lived in Tigray

(β = 0.10, P = 0.001) had a high level of COC relative to people who live in the metropolis. Conversely, women who lived in Afar (β = -0.15, P < 0.001), Oromia (β = -0.07, P = 0.042) and Somali (β = -0.17, P < 0.001) had lower levels of COC compared with women from the metropolis.

The wealth quintile showed significant associations at the intermediate and higher quantiles. Women in the poorest quintiles had a lower COC at the 50^{th} (β = -0.12, P =0.004), 75^{th} (β = -0.14, P =0.001), and 90^{th} quantiles (β = -0.14, P =0.035) than women in the richest quintiles. Significant negative associations between rural residence and continuum-of-care were observed at the 10^{th} (β = -0.11, P =0.005), 25^{th} (β = -0.11, P =0.003), 50^{th} (β = -0.14, P =0.001), and 75^{th} (β = -0.14, P <0.001) quantiles of CCI. Occupational status was significant only at the 75^{th} quantile, where women who were working had significantly higher levels of CCI compared to their counterparts (β = 0.06, p < 0.001).

Regarding reproductive characteristics, attending ANC in less than four months of pregnancy was positively associated with a higher COC across all quantiles (10%: β = 0.13, P < 0.001; 25%: β = 0.14, P < 0.001; 50%: β = 0.14, P < 0.001; 75%: β = 0.11, P < 0.001; 90%: β = 0.10, P < 0.001). Moreover, delivery by CS increased COC and the increase was significant at the 10^{th} (β = 0.12, P =0.033), 75^{th} (β = 0.17, P=0.004), and 90^{th} (β = 0.17, P=0.001) quantiles. Compared to women who perceived distance as a significant problem, women who perceived distance to the nearby health facility was not a significant barrier were significantly associated with high levels of the COC at the lowest and highest quantiles. The estimates at the 10^{th}, 25^{th}, and 90^{th} quantiles were β = 0.04; P =0.008, β = 0.04; P =0.003, and β = 0.06; P =0.026, respectively. The association between pregnancy intention and CCI was maintained only in the lower quantiles. Unintended pregnancy was significantly associated with lower CCI levels at the 10^{th} (β =

-0.12, $P<0.001$) and 25th (β = -0.04, $P=0.042$) quantiles. Parity was significant only at the 75th quantile. Women with a parity of five or more had significantly lower levels of receiving the elements of the COC compared to women of less than five parity (β =- 0.06, $P = 0.003$).

4.6 Discussion

The COC has become a core principle to underpin strategies to save the lives of mothers and babies and promote health. An effective COC connects essential MCH packages throughout adolescence, pregnancy, childbirth, postnatal periods, and into childhood (Owili et al., 2016). This study assessed the COC and its predictors in Ethiopia using a quantile regression approach.

The finding of this study showed that the average CCI was 39%. A previous study reported higher estimates of average CCI for Ethiopia, ranging from 45% to 51% (Wehrmeister et al., 2020a). Similarly, another study from Lao People's Democratic Republic reported a higher estimate of average CCI (Sakuma et al., 2019). The possible explanation for the variation could be the difference in the MCH coverage indicators incorporated in the summary indices. Our study finds that the overall completion of the COC was two per cent which was lower than that reported in the previous studies (Atnafu et al., 2020, Asratie et al., 2020, Sertsewold et al., 2021, Cherie et al., 2021). This variation could be explained by the difference in the measurement of the COC as we used the recently modified and comprehensive coverage index.

Our study revealed that postnatal care for newborns has the lowest coverage along the continuum. In line with this finding, a study documented that coverage levels are particularly low around the time of birth and postnatal care consistently has among the lowest coverage of interventions on the COC (Victora et al., 2016). Even though the

majority of maternal and newborn deaths occur within the first week of the postnatal period, it is the most neglected period (Warren et al., 2006). Many women from low and middle-income countries and their newborns do not have access to health care during the early postnatal period (Langlois et al., 2015).

Our analysis found that educational status has a significant effect across different quantiles of the CCI. Having completed primary and secondary education or above were associated with a higher COC than having no formal education, which is consistent with prior studies (Asratie et al., 2020, Tizazu et al., 2021, Tsega et al., 2022). Maternal education is a very important social determinant often linked to MCH and healthcare utilisation (McNamee et al., 2009). It enhances women's decision-making power, economic independence, and empowerment thereby increasing their access to and use of services (Weitzman, 2017).

Our results show that compared to women from the metropolis, women who were from Afar and Somali had a lower COC in all quantiles. At the 25th and 90th quantiles, women from Oromia also had a lower COC compared to women from the metropolis. Moreover, having been from Gambela and SNNPR was negatively associated with the COC at the lower quantile. Contrariwise, women from Tigray have a higher COC in the 10^{th}, 50^{th}, 75^{th}, and 90^{th} quantiles compared with those who are from the metropolis. Women from Benshangul also have a higher COC at the 75^{th} quantile as compared to women from the metropolis. Variations in the completion of COC across the regions could be associated with geographical disparities in the country such as accessibility, infrastructure availability, health service quality, women's compliance with care and regional differences in socio-demographic characteristics, and religious or cultural beliefs. Individuals who live outside of metropolitan regions suffer from poor health outcomes attributed to multiple factors including less access to and use of care, financial hardships

and disadvantages associated with fewer work prospects, and less educational attainment (Strasser et al., 2016). According to the EDHS report, Afar, Somali, and Oromia had the lowest coverage of most of the RMCH services (CSA [Ethiopia] and ICF, 2016). Another study showed that the use of RMCH services in pastoralist regions of the country such as Afar and Somali, and SNNPR is extremely low (Hailegebreal et al., 2021). Ethiopia's pastoral communities occupy 61% of the total landmass and 97% reside in the low land areas of Afar, Somali, Oromia, Gambela, and SNNPR (Gebeye, 2016). Often, pastoralists and semi-pastoralists live in marginal, remote, conflict-prone, and food insecure areas that experience higher morbidities and mortalities. Pastoralist populations have limited access to public services due to their mobile lifestyle, and the limited infrastructure in remote areas. They also face complex barriers to healthcare access due to their deep sense of tradition, preference for self-treatment or traditional healers, and misconceptions about health care seeking, and some harmful traditional practices (Ali et al., 2019).

Consistent with previous studies (Debie and Lakew, 2020, Oh et al., 2020), our findings indicate that living in a rural area was associated with low levels of the continuum at different quantiles. People from rural areas have limited access to health services due to distance, lack of transportation, and substandard facilities. Furthermore, the poor access to media, comparatively high level of poverty coupled with strong cultural beliefs extensively render the lower completion of COC in rural areas (Jacobs et al., 2017). The Health Extension Program is one of the most innovative community-based health programs launched in Ethiopia to make health services accessible to rural communities (Workie and Ramana, 2013). Despite the significant achievements in MCH, the program has been facing challenges related to the productivity and efficiency of health extension workers, working, and living conditions of health extension workers, resource gaps, and lack of supportive supervision. To improve the program, it is vital that health posts are

staffed with sufficient health workers having the right skills and motivation. Moreover, strengthening managerial supervision, allocating appropriate resources, and providing tailored intervention strategies play an important role in the successful implementation of the program (Assefa et al., 2019).

At the median and highest quantiles, women from the poorest wealth quintiles had a lower COC compared to those from the richest. In line with our finding, a study indicated that the COC is low for women from the poorest households (Tiruneh et al., 2022). The low COC among the poorest women implies that the policies in place are not sufficient to compensate for the disadvantages associated with poverty. This is concerning, as health outcomes tend to be worse for those in the poorest and most vulnerable groups (Mwase et al., 2018). It has been argued that countries making fastest progress towards coverage of MCH services were those that managed to reach the low socio-economic groups (Victora et al., 2012). While MCH services are provided for free in Ethiopia, economic gaps continue to contribute to observed discrepancies in health care utilisation (Memirie et al., 2016). Improving the COC among the poor requires coordinated action across different sectors so that women are educated and empowered, and poverty is reduced. Scaling up community-based services and primary health care facilities and implementing other pro-poor policies are also vital.

At the lowest and highest quantiles, mothers who did not perceive the distance to the nearest health facility as a problem had a higher COC compared to those who perceived the distance to the nearest health facility as a problem. Our finding is consistent with other studies (Sertsewold et al., 2021, Hamed et al., 2018). Accessibility is an important factor in health service utilisation. Prior studies showed that long distance from home to health

facilities coupled with poor transportation networks was associated with poor MCH outcomes (Yaya et al., 2018, Abegaz, 2019, Dahab and Sakellariou, 2020a).

Similar to other studies, we found that women of higher parity tended to have lower COC than those of lower parity (75th quantile) (Iqbal et al., 2017, Singh et al., 2016). Women of higher parity may face challenges accessing services due to childcare responsibilities or resource constraints. These women may also relay on previous pregnancy experiences. It has been argued that as the number of children a mother has increases, the need to utilise healthcare services may fall. Women of lower parity have less pregnancy and childbirth experience and may have more desire to receive all the MCH services (Tarekegn et al., 2014).

At the lower quantiles, women who didn't intend the recent pregnancy had a lower COC compared to their counterparts. Studies showed that the completion of maternity care was higher among mothers whose pregnancy was intended (Haile et al., 2020, Cherie et al., 2021). Women with an unintended pregnancy may experience associated psychological issues such as stress and fear stigma from their partners or family members. Such women may conceal their pregnancies and become less motivated to utilise services. Moreover, Problems related to work, education, or finances may prevent them from taking up MCH services (Khan et al., 2019).

In our study, caesarean delivery was positively associated with the COC at different quantiles. Likewise, a study reported that women who had caesarean delivery had a higher level of COC compared to their counterparts (Tiruneh et al., 2022). Such findings reinforce the hypothesis that increased risk perception encourages the use of essential services (Belayneh et al., 2014, Worku et al., 2013).

Our finding also re-affirms the noteworthy effect of early initiation of ANC visit for subsequent MCH services. Receiving ANC in less than four months of pregnancy was positively associated with COC across all quantiles. In line with this, a study stated mothers who initiated ANC visit early had a higher COC than those who initiated late (Haile et al., 2020, Emiru et al., 2020, Sserwanja et al., 2021). The timing of the first ANC contact is an important entry point to a continuation through the COC. It makes women better informed about pregnancy and the subsequent use of MCH services (Moyer and Mustafa, 2013, Geda et al., 2021, Fekadu et al., 2019).

This study adds to the current literature by assessing the COC using a comprehensive approach incorporating a range of essential services. This is the first study, to our knowledge, that used quantile regression to explore the effects of variables at different points of the conditional distributions of CCI. Investigating the effect of covariate at different response quartiles is important as relationships may vary at different levels of the response. Quantile regression is a specific analysis used to determine whether relationships between a predictor and an outcome variable differ across levels of the outcome variable. It is an innovative method that provides a more nuanced interpretation of between-variable associations than the classical methods. Therefore, it is possible to identify the more vulnerable groups and devise more effective interventions.

The findings of this study clearly point to the need for targeted interventions that should adopt a multilevel approach to overcome the constraints in the COC. Effective public health interventions, especially strategic plans that stimulate PNC uptake for babies are essential. Given the effect of unintended pregnancy on the COC completion, early preventive strategies such as strengthening family planning services to assist women in having their desired number of children are required. In addition, more emphasis needs to be placed on the importance of early initiation of ANC. The findings also reinforce the

need for new programmatic strategies that aim to reach illiterate and poor women. Moreover, government and other stakeholders should put more effort into scaling up the COC in rural areas and disadvantaged regions. Our study also highlights that Improving women's socio-economic position can promote the utilisation of MCH services and hence improve the COC. Finally, strengthened collaborations between health and other sectors to increase access to health services may address critical leverage points in improving the COC. This study has some limitations. DHS data are cross-sectional, and so cannot affirm any causal inference. In addition, recall bias is inherent in these surveys due to the nature of self-reported responses. However, our study population included women who had a live birth (most recent) in the two years preceding the survey.

4.7 Conclusion

The COC is key to improving MCH through integrated service delivery. CCI is an important indicator of the COC. We used a quantile regression model to identify the factors that affect the COC at different points of the conditional distributions of CCI. The overall completion rate of the COC was low, implying that women and children were not receiving the maximum possible health benefit from existing health services. PNC for newborns had the lowest coverage along the continuum. This study provides evidence that factors such as the educational status of women, region, residence, socio-economic status, perceived distance to a health facility, pregnancy intention, mode of delivery, parity, and early ANC initiation influence the COC differently across levels of the CCI. Understanding the predictors of the COC across the entire distribution of CCI will facilitate the development of targeted and focused evidence-based strategies to achieve better continuity of care and MCH outcomes.

4.8 Chapter summary

This chapter examined the continuum of care for MCH services in Ethiopia by using the CCI as a summary measure of coverage. The factors associated with the continuum of care were identified by using a quantile regression approach. The inequalities in maternal, newborn, and child health coverage in Ethiopia and their contributors are discussed in the following chapter.

CHAPTER FIVE

INEQUALITIES IN MATERNAL, NEWBORN, AND CHILD HEALTH COVERAGE IN ETHIOPIA

(STUDY II)

Chapter 5 Inequalities in maternal, newborn, and child health coverage in Ethiopia: A decomposition analysis using 2000, 2005, 2011, and 2016 Demographic and Health Surveys

5.1 Overview of study two

Research in LMICs shows that progress in MCH is hindered by high levels of disparities in the coverage of key services. This chapter explores inequalities in maternal, newborn, and child health coverage in Ethiopia using a comprehensive coverage measure and also presents the contributors to inequality.

5.2 Abstract

Background: Maternal, newborn, and child health indicators have considerably improved in Ethiopia. However, the progress is not uniform across different population subgroups. This study aimed to assess inequalities in maternal, newborn, and, child health coverage and the determinants that contributed to inequalities in Ethiopia.

Methods: This study used data from four rounds of Demographic and Health Surveys conducted in Ethiopia in 2000, 2005, 2011, and 2016. We included 7580 women – whose children were aged 12-23 months – in the analysis. We calculated the modified composite coverage index, a weighted average of essential maternal and child health intervention parameters. We stratified coverage data by asset-based wealth quintiles, and concentration indices were estimated. We used concentration curves and equiplots to demonstrate inequalities. Finally, we decomposed the concentration indices to inequalities in composite coverage index. We accounted for the survey design characteristics in analyses.

Results: The composite coverage index increased from 24% in 2000 to 42% in 2016. We noted positive concentration indices and concentration curves below the line of inequality for the coverage indices indicating a pro-rich distribution across all survey years. The composite coverage index and most of its constituents also showed a top-inequality pattern in all rounds of the survey. The decomposition analyses revealed that wealth quintile accounted for the largest contribution to inequalities in coverage index in all survey years, explaining 52%, 39%, 57%, and, 48% of the inequalities in 2000, 2005, 2011, and 2016 respectively. Place of residence, mother's education level, and region were also important contributors to the inequalities in coverage index.

Conclusions: Despite the increase in composite coverage index, there were socioeconomic inequalities in all survey years. Scaling up efforts to reduce the observed inequalities is required to address the contributors to poor coverage. Drafting policies and programs that target the poorest and marginalized groups will contribute to achieving universal health coverage.

5.3 Introduction

Universal Health Coverage is a global health priority and central to the health-related targets of the Sustainable Development Goals (SDGs) (Wagstaff and Neelsen, 2020). Ensuring that everyone who needs health care services can access them without incurring financial hardship is an ultimate healthcare objective for all countries aiming to achieve Universal Health Coverage (Yaya and Ghose, 2019). Despite promising efforts toward achieving SDG targets in low and middle-income countries, accelerated improvement is restricted by huge inequalities in access to and uptake of many preventive and curative health services (Amouzou et al., 2020). Evidence shows that reproductive, maternal, newborn, and child health services (RMCH), particularly in Sub-Saharan Africa, are

unevenly distributed across different subgroups of the population (Barros et al., 2020). Maternal and child health (MCH) service uptakes are highest for the better-off, while the poorest remain behind. Inequalities by other sociodemographic factors such as education, urban-rural residence, and geographical regions also account for differentials in the uptake of such services (Jat et al., 2011, Agunwa et al., 2017). Ethiopia has implemented a set of effective MCH interventions. Over the past 15 years, maternal and child mortality has been reduced by half and progress has been notable with the uptake of MCH services. However, there are increasing concerns regarding high levels of disparities in the coverage of key services (Ambel et al., 2015).

The continuum of care is a recommended framework for comprehensive health service delivery as this approach can more successfully identify and avert MCH complications than individual service provision (Kerber et al., 2007). The composite coverage index (CCI) is one indicator of the continuum of care. It is among the reliable and meaningful summary indicators for monitoring universal coverage of RMCH care (Wehrmeister et al., 2016). Previous studies in developing countries including Ethiopia assessed coverage of MCH services using CCI and explored disparities across groups (Faye et al., 2020, Wehrmeister et al., 2020a, Wehrmeister et al., 2020b, Victora et al., 2012). Those studies used the original CCI that provided an overall estimate of coverage based on eight MCH interventions and highlighted that there were huge inequalities in coverage between the richest and the poorest women and children in most countries. Evidence shows that in order to assess coverage comprehensively, it is important to incorporate a broader set of appropriate interventions in summary indices (Barros and Victora, 2013). A reliable, modified CCI that integrates Kerber et al. definition of the continuum of care and the WHO's recommended MCH care components has become available (Oh et al., 2020, Kerber et al., 2007). We used the modified CCI formula as a summary measure to express

coverage levels of MCH across the continuum of care (Oh et al., 2020). The aim of our study was to assess the coverage and inequalities in MCH services using the Ethiopian Demographic and Health Surveys between 2000 and 2016. Furthermore, we sought to identify the major contributors to inequalities in coverage index for each survey year using decomposition analysis.

5.4 Methods

This study used data from 2000, 2005, 2011, and 2016 rounds of the Ethiopian Demographic and Health surveys (EDHS) which are national cross-sectional surveys publicly available via Measure DHS. The surveys employed a stratified, multistage, and random sampling design. Enumeration areas or clusters from 1994 and 2007 population and housing censuses were the sampling units for the first stage of sampling. The selected enumeration areas included 540 in the 2000 and 2005 surveys, 624 in 2011, and 645 in the 2016 EDHS. In the second stage of selection, a systematic random sampling technique was used to select households after the complete household listing was conducted in each enumeration area. Detailed survey techniques and methods of sampling used to collect data have been recorded elsewhere (CSA [Ethiopia] and ICF, 2016, CSA [Ethiopia] and ICF International, 2012, CSA [Ethiopia] and ORC Macro, 2006). A representative sample of 15,367, 14,070, 16,515 and 15,683 illegible women aged 15-49 with a high overall response rate (95-98%) were interviewed from 2000, 2005, 2011 and 2016 DHS, respectively. The DHS recodes the original survey data into different databases. In the 2000 DHS, the children recode (which contains information related to the child's pregnancy and PNC and immunization, health and nutrition data) comprised 10,873 women who had children under five years of age in the five years preceding the survey. In 2005, 2011 and 2016 EDHS surveys the children recode consisted 9861, 11,654, and 10,641women respectively.

Study population

This study examined reproductive-aged women with their most recent children of 12 to 23 months, considering the usual age range for vaccine indicators. Our sample sizes from the four EDHS were 1765 women in 2000 (2059 weighted cases), 1612 in 2005 (1800 weighted cases), 1810 in 2011(1830 weighted cases), and 1809 in 2016 (1891 weighted cases). These were obtained after removing observations with missing values in the receipt of care components.

Study variables

We used the wealth index variable as an estimate of socioeconomic position. The DHS computed wealth index through principal component analysis, considering several household assets, building materials used for housing construction, and types of water access, and sanitation facilities. The wealth index, categorized into five quintiles, was used to rank households from the poorest (Q1) to the richest (Q5).

Our primary measure of interest was CCI defined as a weighted average of essential MCH interventions along the continuum of care. We examined the continuum of care using a modified CCI formula proposed by Oh , et al., which incorporated Kerber et al.'s definition of the continuum of care and WHO'S recommended MCH care (Oh et al., 2020). The modified CCI is an aggregate estimate of indicators with binary response data indicating whether a woman had received four or more antenatal care (ANC), received two or more doses of tetanus toxoid (TTN), delivered in a health facility (FD), delivered with the assistance of a skilled provider (SBA), had postpartum check during the first two days after birth (PNCM), had postnatal check during the first two days after birth (PNCN), used any modern contraceptive method (FP), and whether a child took one dose of Bacillus Calmette- Guérin vaccine (BCG), three doses of DPT-HepB-Hib (diphtheria,

pertussis, tetanus- hepatitis B- haemophilus influenzae type B), three doses of polio vaccine (PL), one dose of measles vaccine (MSL), and, a child received breast milk and complementary foods (AABF). The indicators have equal weight, except for DPT and polio, which receive a weight of two because they require more than one dose. For the years 2000 and 2005, data on postnatal care within two days for the newborn were not available, so PNC for newborns was not involved in the index.We computed the reliability of the modified CCI formula through Cronbach's alpha and the resulting Cronbach's α reliability coefficients were 0.795, 0.803, 0.785, and 0.841 for 2000, 2005, 2011, and 2016 survey years, respectively. It has been shown that Cronbach's α reliability coefficient has a theoretical value of 0 to 1, and values greater than 0.7 are considered acceptable (Gliner et al., 2016). The following formula was used to compute the modified CCI.

$$\text{Modified CCI} = \frac{1}{6}\left(\frac{\text{ANC} + \text{TTN}}{2} + \frac{\text{FD} + \text{SBA}}{2} + \frac{\text{PNCM} + \text{PNCN}}{2} + \frac{\text{BCG} + 2\text{DPT3} + 2\text{PL} + \text{MSL}}{6} + \text{AABF} + \text{FP}\right)$$

Analytical approach

We estimated socioeconomic-related inequalities in the CCI using the concentration index. Concentration curves were also drawn to display the degree of inequality by plotting the cumulative percentage of CCI on the Y-axis against the cumulative percentage of the population ranked by household socioeconomic status (starting from the poorest and ending with the richest) on the X-axis. If the health outcome is perfectly equally distributed across the population, the concentration curve will be a 45-degree (diagonal) line, known as the line of equality. The further the curve is from the line of equality the higher the degree of health inequality. If the concentration curve lies below the line of inequality, the value of CCI is high among the rich (pro-rich). If, by contrast,

the concentration curve lies above the line of inequality, the value of CCI is high among the poor (pro-poor). The concentration index is twice the area between the concentration curve and the line of inequality with a range from -1 to +1. A negative concentration index value indicates that the outcome is disproportionately concentrated among the poorest quintiles. Conversely, a positive concentration index value indicates that the outcome is more concentrated in wealthier quintiles. Where there is no socioeconomic inequality, the concentration index is equal to zero. To aid in the illustration of inequalities in CCI and its components, we present the results using equiplots for each survey year. Each dot in the equiplot presents coverage in a given quintile, and a horizontal line connects the poorest and wealthiest quintiles.

Victoria et al. described three types of patterns of inequality by inspecting the distance between groups in an inequality graph (Victora et al., 2005). Top inequality pattern indicates disproportionately higher coverage among those in the upper quintiles than among those in the other group. Conversely, bottom inequality pattern denotes disproportionately lower coverage among those in the poorest group, while linear inequality pattern denotes similar distance between groups. The patterns of inequality portrayed in our study include linear (even distribution), top (when the widest gap exists for the wealthiest quintile), and bottom inequality (when the widest gap exists for the poorest quintile).

In order to achieve socioeconomic-related health equality, it is vital to determine the causes of socioeconomic-related health inequality. Decomposing socioeconomic-related health inequality can help to uncover specific factors that are potentially modifiable by policy decision-makers. The dominant decomposition approach, the Wagstaff decomposition method can be used to identify which factors are the most important contributors to health inequality and to estimate the relative contributions of each factor.

The method involves estimating a regression model that relates the health outcome or healthcare utilisation measure to various socioeconomic and demographic variables, such as income, education, age, and ethnicity. The decomposition analysis then calculates the contribution of each factor to overall health inequality, based on the regression coefficients and the distribution of the factors across the population. The contribution of each factor is expressed as a percentage of the total observed inequality, which can help to identify the most important sources of inequality (Wagstaff et al., 2007).

For each survey year, we performed further analysis to decompose the concentration index with the aim of quantifying the individual contribution of explanatory variables (age, residence, educational status, employment status, region, and wealth index) to the overall inequality. Each contribution was the product of the elasticity of the determinant and its concentration index. This would give the absolute contribution of each determinant. Then, we computed the percentage (adjusted) contribution of each determinant by dividing its absolute contribution by the concentration index of CCI and multiplying by 100. Data analysis were performed using STATA, taking the complex sampling design into account.

Ethics approval and consent to participate

This study used secondary data from publicly available EDHS, thus there was no direct risk to the survey participants. The authorisation to use the data was obtained from the DHS program. The identities of the participants were anonymised during data collection.

5.5 Results

Characteristics of the sample

The total number of women included in each survey in 2000, 2005, 2011, and 2016 were 2059, 1800, 1830, and 1891, respectively. **Table 7** summarises the characteristics of the

study population between 2000 - 2016 EDHS. In all four surveys, the percentage of women aged 25 to 34 years was 46.8% in 2000, 49% in 2005, 53.1% in 2011, and 52.3% in 2016. The majority in each survey lived in rural areas (90% in 2000, 92% in 2005, 86% in 2011, and 89% in 2016). The highest proportion of study participants in all surveys was in Oromia region. Across all surveys, study participants were predominantly not educated. In 2000, most women had agricultural/manual work. However, in the remaining survey years, the majority of the respondents reported that they were not employed.

Table 7: Background characteristics of the study population, Ethiopian Demographic Health Survey, 2000-2016

Variable	2000 (*n*=2059)		2005 (*n*=1800)		2011 (*n*=1830)		2016 (*n*=1891)	
Women's age (years)	Freq	%	Freq	%	Freq	**%**	Freq	**%**
15-24	633.7	30.8	523.3	29.1	493.9	27.0	466.4	24.7
25-34	964.2	46.8	881.6	49.0	971.5	53.1	989.6	52.3
35-49	461.6	22.4	395.7	22.0	364.8	19.9	434.8	23.0
Mother's education								
No education	1648.6	80.1	1400.8	77.8	1247.5	68.2	1187.0	62.8
Primary education	299.8	14.6	310.7	17.3	490.5	26.8	548.1	29.0
Secondary education	111.0	5.4	89.1	5.0	92.1	5.0	155.8	8.2
Employment status								
Not working	759.1	36.9	1238.4	68.8	827.3	45.6	1059.7	56.0
Professional	197.8	9.6	151.0	8.4	360.6	19.9	316.0	16.7
Agricultural/manual	1102.3	53.5	409.7	22.8	628.1	34.6	515.1	27.2
Residence								
Urban	206.0	10.0	140.9	7.8	253.8	13.9	217.9	11.5
Rural	1853.4	90.0	1659.5	92.2	1576.3	86.1	1673.0	88.5
Region								
Tigray	117.8	5.7	134.0	7.4	125.0	6.8	145.9	7.7
Afar	16.8	0.8	16.8	0.9	16.0	0.9	19.0	1.0
Amhara	557.5	27.1	466.1	25.9	433.3	23.7	342.8	18.1
Oromia	862.2	41.9	655.1	36.4	763.6	41.7	836.0	44.2
Somali	23.8	1.2	74.5	4.1	43.7	2.4	66.7	3.5
Benshangul	18.1	0.9	15.1	0.8	21.3	1.2	20.3	1.1
SNNPR	417.7	20.3	394.2	21.9	370.0	20.2	393.4	20.8
Gambela	5.0	0.2	4.9	0.3	7.0	0.4	4.9	0.3
Harari	4.5	0.2	3.8	0.2	4.8	0.3	4.4	0.2
Addis Ababa	29.40	1.43	29.6	1.6	39.0	2.1	48.3	2.6
Diredawa	6.8	0.3	6.4	0.4	6.3	0.3	9.1	0.5

n denotes weighted values

SNNPR- Southern Nations, Nationalities, and People's Region

Constructs of the modified composite coverage index

The proportion of age-appropriately breastfed children aged 12-23 months ranged from 84% in 2005 to 75% in 2016. The highest proportion of children who received BCG vaccine was seen in 2011 (81%). The coverages of maternal health services such as family planning, tetanus toxoid injection, ANC, facility delivery, SBA, and PNC were higher in 2016 compared to the preceding survey years. The highest proportions of polio and DPT vaccine coverage were reported in 2016 (**Figure 12**).

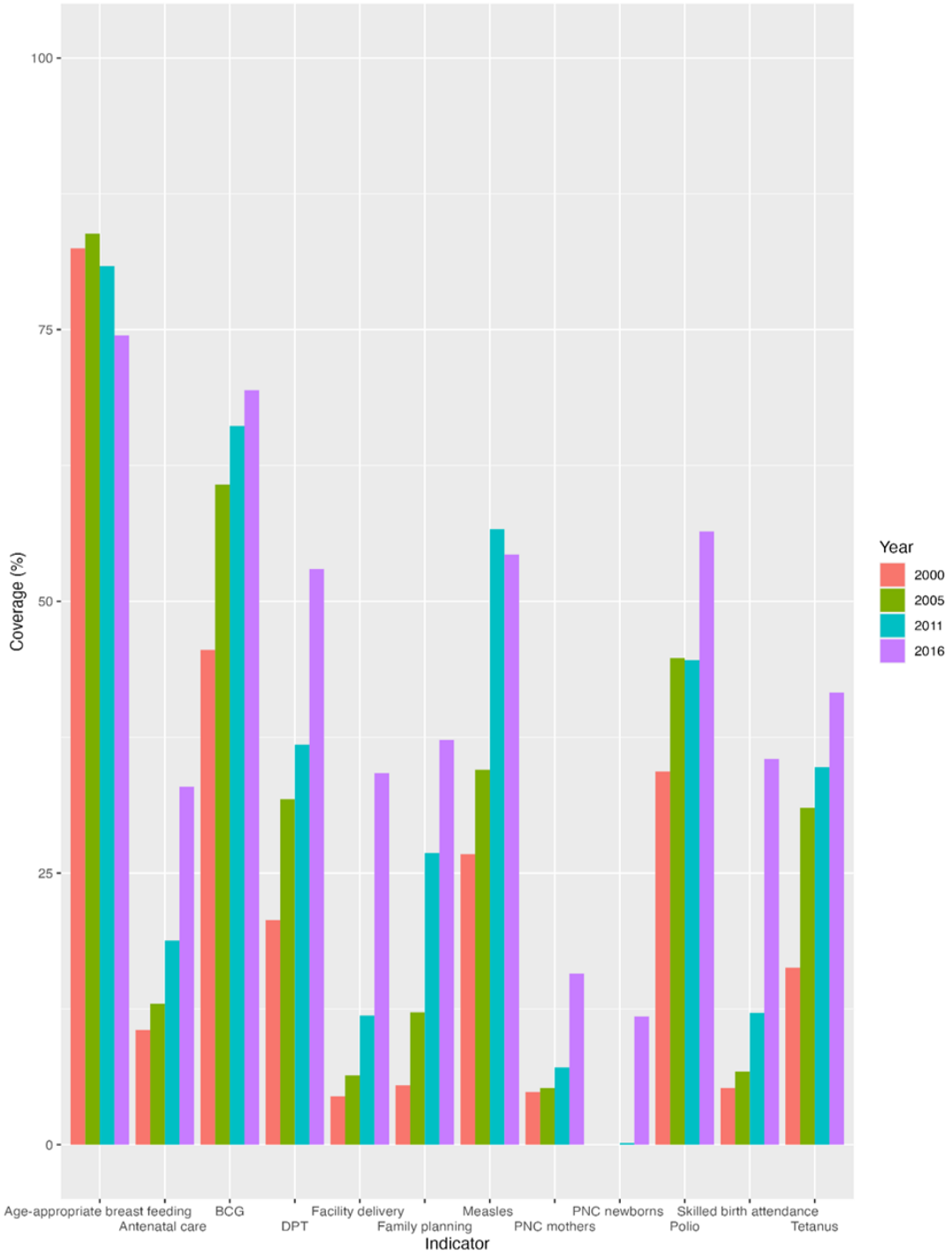


Figure 11: Coverage (percentage) of maternal and child health indicators, Ethiopian Demographic Health Survey, 2000-2016

The trend in the composite coverage index in Ethiopia from 2000 to 2016

Figure 13 shows the trend in the CCI in Ethiopia between the 2000 and 2016 survey years. The average CCI, along with their respective confidence intervals, was 23.6 (22.9-

24.2) in 2000, 28.5 (27.7-29.4) in 2005, 32.9 (32.1-33.8) in 2011, and 42.4 (41.3-43.6) in 2016.

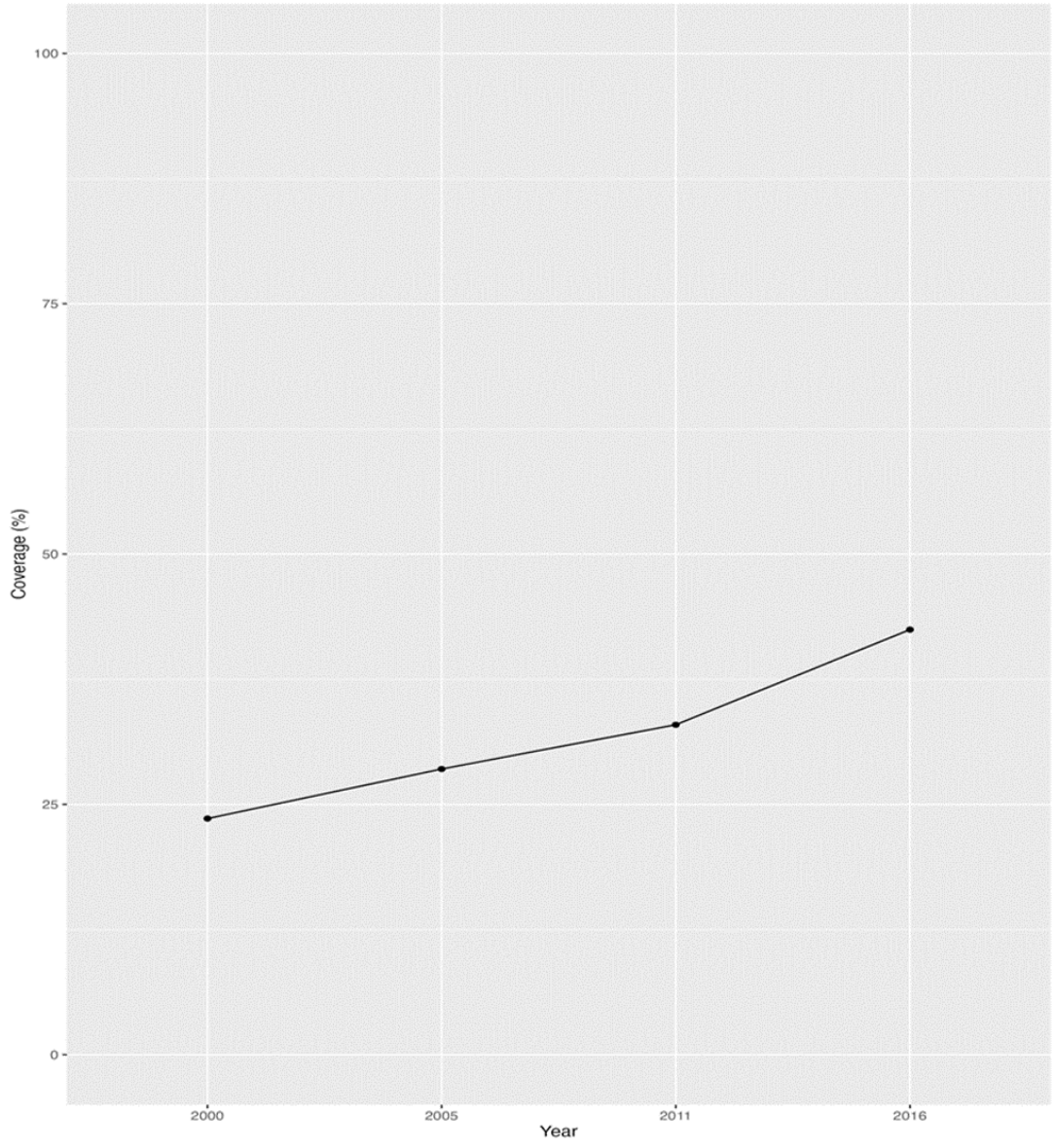


Figure 12: The trend in the composite coverage index in Ethiopia from 2000 to 2016

Socioeconomic inequalities in the composite coverage index in Ethiopia from 2000 to 2016

The concentration indices for CCI were 0.133, 0.142, 0.122 & 0.096 for the survey years 2016, 2011, 2005 and 2000, respectively. These results indicate that coverage, as

measured by CCI, was more concentrated among the wealthiest groups in each year. The magnitude of inequality was lower in 2000. (**Table 8**)

Table 8: Concentration indices of composite coverage index in Ethiopia from 2000 to 2016

	Concentration indices and 95 % confidence intervals			
Variable	**2016**	**2011**	**2005**	**2000**
Composite coverage index (confidence intervals)	0.133 (0.111-0.155)	0.142 (0.121-0.164)	0.122 (0.01-0.144)	0.096(0.075-0.117)

Figure 14 shows the concentration curve plotting the cumulative percentage of CCI against the cumulative percentage of women ranked by socioeconomic status across the four survey years. The concentration curves for all the survey years lie below the line of equality, indicating that the coverage index was concentrated among richer women (pro-rich). The degree of inequality during the year 2000 was relatively lower than in the years 2005, 2011, and 2016, since the concentration curve for the 2000 survey year lies closer to the line of inequality, while the inequality gap by wealth in 2011 seemed the greatest as shown in the figure.

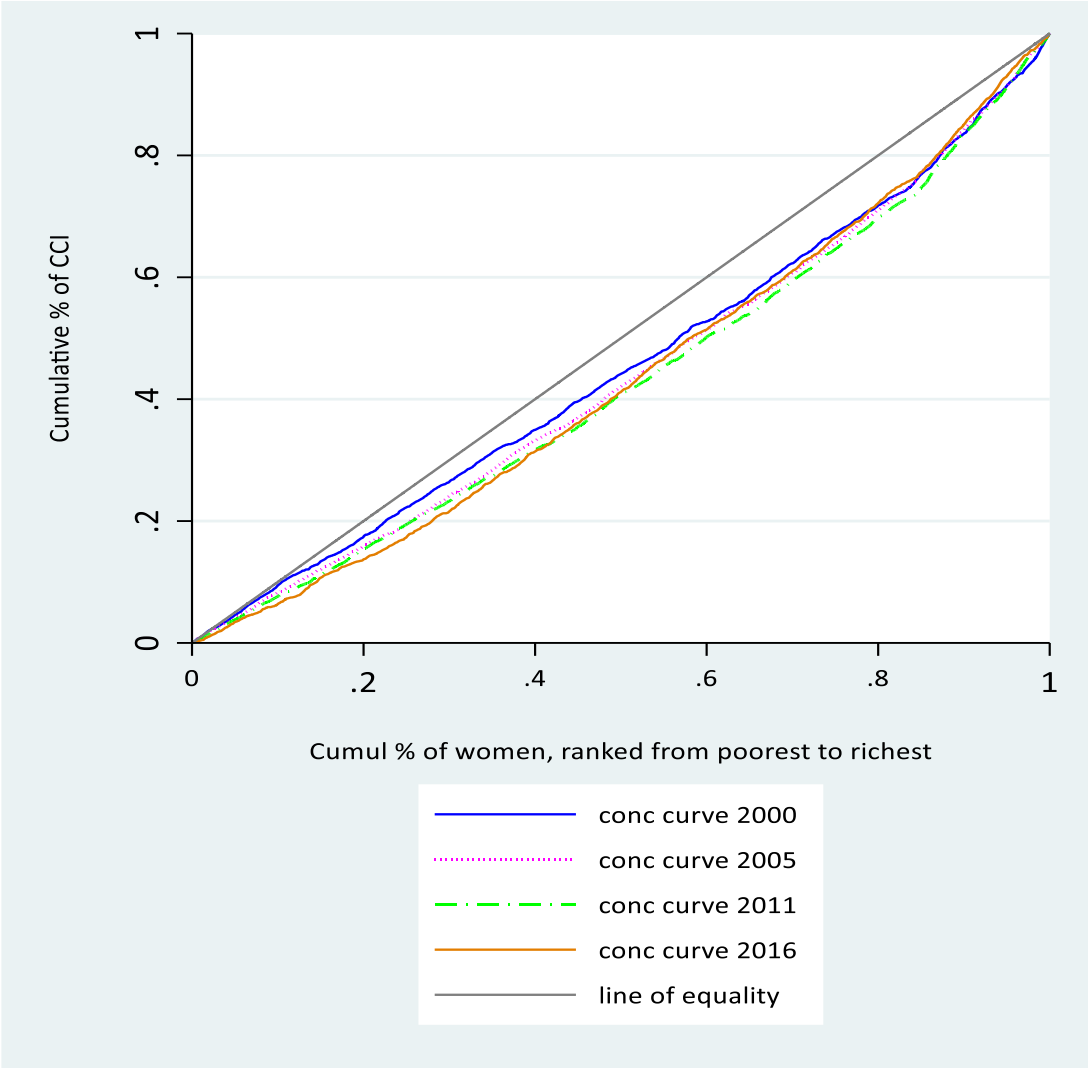


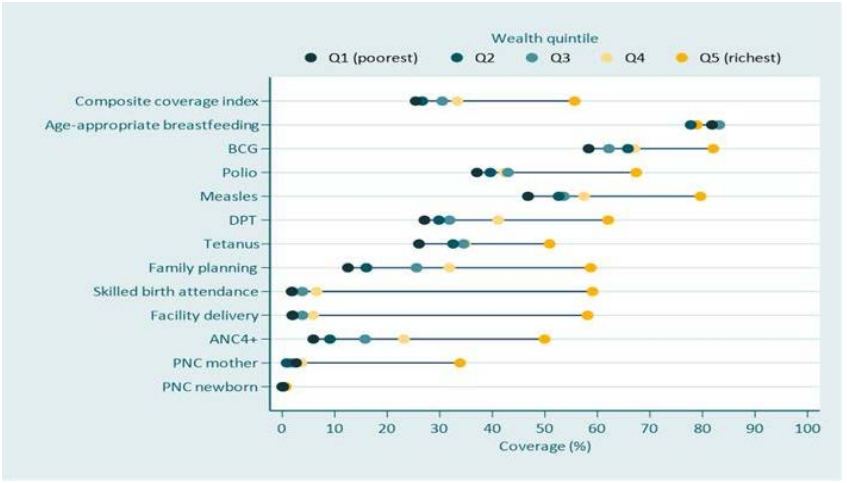
Figure 13: Concentration curves for composite coverage index, Ethiopia demographic and health survey 2000-2016

In **figure 15 (A-D)** we present equiplots, in which the CCI is a summary measure and coverage levels of indicators composing it, by wealth quintiles of the study populations for the survey years 2000 to 2016. In the equiplots, we show the poorest to the richest quintiles connected by a horizontal line. The widths of the solid line represent absolute wealth inequality. The average CCI tended to be higher as the economic status improved in all of the surveys, meaning populations in quintile 5 (the richest) had greater coverage than quintile 4, and so on to quintile 1 (the poorest). The average CCI in the poorest quintile ranged from 20.5% in 2000 to 29.9% in 2016. For the richest quintile, the average

CCI ranged from 36.5% in 2000 to 64.8% in 2016. For all survey years, a top inequality pattern was noted in the CCI.

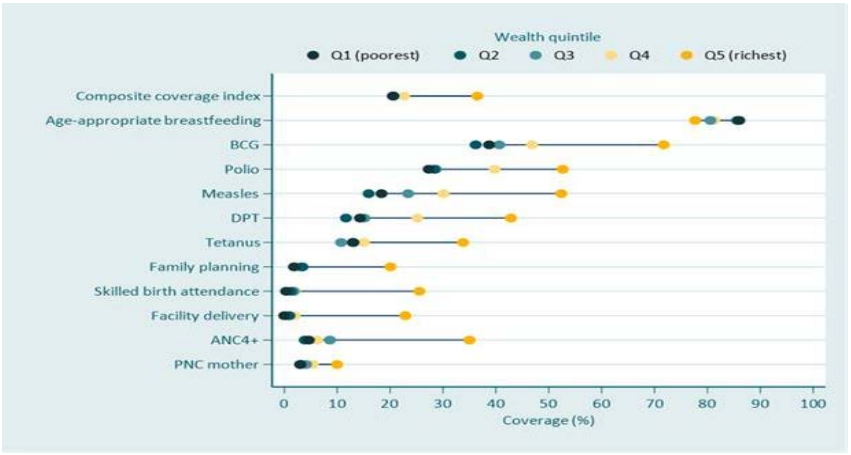
In 2016, a higher percentage of coverage was found among women belonging to the richest households across all indicators except age-appropriate breastfeeding. Interventions including PNC for mothers, PNC for newborns, ANC, facility delivery, SBA and measles, and polio coverage showed a top inequality pattern. Disparities were largest for maternal health services such as SBA, facility delivery, ANC, and family planning. In contrast, age-appropriate breastfeeding exhibited minimal inequality. Similar to 2016, in 2011, women from the wealthiest households had a higher percentage of coverage across all indicators with the exception of age-appropriate breastfeeding. For almost all interventions, a top inequality pattern was noted. SBA and facility delivery tended to have the most disparities. Furthermore, both age-appropriate breastfeeding and PNC for newborns demonstrated low inequality among the interventions examined, given PNC for newborns' lowest coverage overall. In 2000 and 2005, age-appropriate breastfeeding demonstrated a combination of high coverage and minimal inequality among all the interventions. For all indicators, coverage was higher in the wealthiest groups than the poorest groups, although in most cases an inverse pattern of inequality was observed in the coverage of age-appropriate breastfeeding such that the richest quintile presented lower coverage. In addition, a top inequality pattern was observed in the majority of the indicators that constructed the modified CCI (**Figure 15**).

A. EDHS 2016



B. EDHS 2011

C. EDHS 2005



D. EDHS 2000

Figure 14: Equiplots of the composite coverage index and its constructs by wealth quintiles from Ethiopia Demographic Health Surveys: A) 2016 B) 2011 C) 2005 and D) 2000

Decomposition analyses results

Tables 9-12 present the results from the decomposition analyses showing how respondents' various socioeconomic and demographic characteristics contribute to inequality in CCI. The tables present the elasticity of each regressor with respect to the CCI, the concentration index of each regressor, contributions to the overall concentration index as well as the percentage contribution of the regressors to the inequality of CCI. The percentage contribution refers to the adjusted contribution to inequalities of each factor. For instance, in 2016, the place of residence contributed about 23.6% of total inequality in CCI, which was obtained by dividing the absolute contribution of rural residence (0.0313) by the overall concentration index of CCI (0.133) and then multiplied by 100.

Disparities in household economic status as measured by wealth quintiles had the largest contribution to inequalities in CCI in all years and the contributions were 48%, 57%, 39%, and 52% for the years 2016, 2011, 2005, and 2000 respectively. Rural residence was the second largest contributor to inequalities in CCI in 2016 and 2005, showing a 24% and 28% contribution to the measured inequalities, respectively. Mothers' education status was the second largest contributor to the CCI inequality in 2011 (20.5%) and 2000 (22.1%). The third largest contributor in 2016 and 2005 was the mother's education status which contributed to 17% and 23% of the inequalities respectively, while rural residence contributed to 20% and 18% of the measured inequalities in 2011 and 2000 respectively. Geographic region contributed about 11%, 8%, and 4% to inequality in CCI in 2005, 2016, and 2011 respectively, but it showed minimal contribution in 2000. The contribution of maternal age to the inequality was small for all years. Likewise,

employment status had minimal contributions in 2016, 2011, and 2005, although it contributed to 7% of inequality in CCI in 2000.

Given the positive concentration indices of CCI in all survey years, any positive contributor to the inequality suggests that it favoured the well-off but disadvantaged the poor. This also implies that inequalities in CCI would have been less pro-rich if the concentration index of the contributing variable was zero (i.e. was evenly distributed among the poor and the rich). A variable that contributed negatively would have the opposite impact. The results of the decomposition analyses provide insights into the uneven distribution of socioeconomic factors between population subgroups (**Tables 9-12**).

Table 9:Decomposition of the concentration index for composite coverage index, Ethiopian Demographic Health Survey 2016

Variables	Elasticity	Concentration Index	Absolute contribution	Percent contribution (%)
Mother's age (15-24 (Reference))				
25-34	0.0112	0.0272	0.0003	0.2293
35-49	-0.0165	-0.0058	0.0001	0.0727
Subtotal				**0.3**
Mother's education (no education (Ref))				
Primary education	0.0522	0.1154	0.0060	4.5359
Secondary education	0.0244	0.6891	0.0168	12.6504
Subtotal				**17.2**
Employment status (not working (Ref))				
Professional	0.0147	0.2554	0.0038	2.8333
Agricultural/manual	0.0004	-0.0486	0.0000	-0.0141
Subtotal				**2.8**
Wealth quintile (poorest (Ref))				
Poorer	0.0317	-0.2945	-0.0093	-7.0317
Middle	0.0490	0.1240	0.0061	4.5738
Richer	0.0519	0.5243	0.0272	20.5203
Richest	0.0465	0.8530	0.0397	29.9122
Subtotal				**48**
Residence (urban (Ref))				
Rural	-0.3332	-0.0940	0.0313	**23.6**
Region (Tigray (Ref))				
Afar	-0.0069	-0.3941	0.0027	2.0529
Amhara	-0.0515	0.0316	-0.0016	-1.2266
Oromia	-0.2238	-0.0068	0.0015	1.1504
Somali	-0.0254	-0.4597	0.0117	8.7933
Benshangul	-0.0025	-0.2249	0.0006	0.4280
SNNPR	-0.0739	-0.0256	0.0019	1.4269
Gambela	-0.0012	0.0104	0.0000	-0.0092
Harari	-0.0007	0.3212	-0.0002	-0.1789
Addis Ababa	-0.0067	0.8306	-0.0055	-4.1651
Diredawa	-0.0012	0.3044	-0.0004	-0.2747
Subtotal				**8**

SNNPR- Southern Nations, Nationalities, and People's Region

Table 10:Decomposition of the concentration index for composite coverage index, Ethiopian Demographic Health Survey 2011

Variables	Elasticity	Concentration Index	Absolute contribution	Percent contribution (%)
Mother's age (15-24 (Reference))				
25-34	0.0018	0.0231	0.0000	0.0289
35-49	-0.0076	-0.0545	0.0004	0.2899
Subtotal				**0.3**
Mother's education (no education (Ref))				
Primary education	0.0412	0.1726	0.0071	4.9988
Secondary education	0.0307	0.7214	0.0221	15.5388
Subtotal				**20.5**
Employment status (not working (Ref))				
Professional	0.0102	0.2107	0.0021	1.5082
Agricultural/manual	0.0147	-0.1417	-0.0021	-1.4642
Subtotal				**0.04**
Wealth quintile (poorest (Ref))				
Poorer	-0.0020	-0.3208	0.0006	0.4406
Middle	0.0223	0.1048	0.0023	1.6433
Richer	0.0301	0.4975	0.0150	10.5199
Richest	0.0749	0.8434	0.0632	44.3975
Subtotal				**57**
Residence (urban (Ref))				
Rural	-0.2307	-0.1216	0.0281	**19.7**
Region (Tigray (Ref))				
Afar	-0.0053	-0.3488	0.0019	1.3048
Amhara	-0.0198	-0.0824	0.0016	1.1469
Oromia	-0.0819	0.0495	-0.0041	-2.8501
Somali	-0.0183	-0.0241	0.0004	0.3114
Benshangul	-0.0014	-0.0634	0.0001	0.0609
SNNPR	-0.0270	-0.0918	0.0025	1.7412
Gambela	-0.0005	-0.0879	0.0000	0.0301
Harari	-0.0002	0.4697	-0.0001	-0.0537
Addis Ababa	0.0037	0.8473	0.0032	2.2281
Diredawa	0.0000	0.3681	0.0000	0.0022
Subtotal				**3.9**

SNNPR- Southern Nations, Nationalities, and People's Region

Table 11:Decomposition of the concentration index for composite coverage index, Ethiopian Demographic Health Survey 2005

Variables	Elasticity	Concentration Index	Absolute contribution	Percent contribution (%)
Mother's age (15-24 (Reference))				
25-34	-0.0198	0.0151	-0.0003	-0.2470
35-49	-0.0072	-0.0177	0.0001	0.1043
Subtotal				**-0.1**
Mother's education				
Primary education	0.0351	0.2822	0.0099	8.1351
Secondary education	0.0239	0.7687	0.0183	15.0708
Subtotal				**23.2**
Employment status (not working (Ref))				
Professional	0.0162	0.2660	0.0043	3.5461
Agricultural/manual	0.0102	-0.0420	-0.0004	-0.3520
Subtotal				**3.2**
Wealth quintile (poorest (Ref))				
Poorer	0.0092	-0.3063	-0.0028	-2.3137
Middle	0.0207	0.1194	0.0025	2.0354
Richer	0.0237	0.5047	0.0119	9.8162
Richest	0.0425	0.8422	0.0358	29.4161
Subtotal				**39**
Residence (urban (Ref))				
Rural	-0.4804	-0.0708	0.0340	**28**
Region (Tigray (Ref))				
Afar	-0.0047	-0.4062	0.0019	1.5646
Amhara	-0.0533	-0.0013	0.0001	0.0555
Oromia	-0.0876	-0.0440	0.0039	3.1688
Somali	-0.0234	-0.4965	0.0116	9.5320
Benshangul	-0.0024	-0.0059	0.0000	0.0115
SNNPR	-0.0445	0.1612	-0.0072	-5.9011
Gambela	-0.0005	-0.0890	0.0000	0.0345
Harari	-0.0005	0.5191	-0.0002	-0.1993
Addis Ababa	0.0033	0.8209	0.0027	2.2579
Diredawa	0.0000	0.3290	0.0000	-0.0036
Subtotal				**10.5**

SNNPR- Southern Nations, Nationalities, and People's Region

Table 12:Decomposition of the concentration index for composite coverage index, Ethiopian Demographic Health Survey 2000

Variables	Elasticity	Concentration Index	Absolute contribution	Percent contribution (%)
Mother's age (15-24 (Reference))				
25-34	0.0019	0.0054	0.0000	0.0104
35-49	0.0005	-0.1517	-0.0001	-0.0817
Subtotal				**-0.1**
Mother's education				
Primary education	0.0329	0.1993	0.0066	6.8250
Secondary education	0.0238	0.6162	0.0147	15.2412
Subtotal				**22.1**
Employment status (not working (Ref))				
Professional	0.0161	0.3543	0.0057	5.9152
Agricultural/manual	-0.0047	-0.1619	0.0008	0.7995
Subtotal				**6.7**
Wealth quintile (poorest (Ref))				
Poorer	0.0006	-0.3554	-0.0002	-0.2206
Middle	-0.0014	0.0711	-0.0001	-0.1037
Richer	0.0132	0.4809	0.0063	6.5801
Richest	0.0525	0.8382	0.0440	45.7737
Subtotal				**52**
Residence (urban (Ref))				
Rural	-0.1914	-0.0922	0.0176	**18.3**
Region (Tigray (Ref))				
Afar	-0.0060	0.0461	-0.0003	-0.2891
Amhara	-0.0608	-0.2290	0.0139	14.4761
Oromia	-0.1459	0.0548	-0.0080	-8.3186
Somali	-0.0067	0.2497	-0.0017	-1.7425
Benshangul	-0.0023	0.1914	-0.0004	-0.4556
SNNPR	-0.0759	0.1105	-0.0084	-8.7214
Gambela	-0.0004	0.6143	-0.0003	-0.2826
Harari	-0.0001	0.5593	0.0000	-0.0464
Addis Ababa	0.0068	0.9821	0.0066	6.9083
Diredawa	0.0000	0.5355	0.0000	-0.0062
Subtotal				**1.5**

SNNPR- Southern Nations, Nationalities, and People's Region

5.6 Discussion

We found that composite coverage in Ethiopia of maternal and child health services increased from 24% in 2000 to 42% in 2016. However, while coverage improved overall,

we found that higher coverage of maternal and child services was disproportionately concentrated among the wealthiest households from 2000 to 2016. The concentration curves and concentration indices indicate that inequalities in CCI may have increased over time in Ethiopia, with the highest in 2011, followed by 2016, 2005 and the least inequality was in 2000. We also found that economic status was the major contributor to the inequalities in composite coverage.

Progress in MCH should be measured not only by overall rates of change but also by coverage of services among disadvantaged subgroups (WHO, 2011). Using the EDHS 2000-2016 data, we aimed to assess the inequalities in MCH coverage in Ethiopia by analysing the modified CCI as a summary measure. We also quantified the contributions of sociodemographic factors to the inequalities by performing decomposition analyses.

Our findings revealed that coverage indices were pro-rich. Although the magnitude of inequalities differs across countries, a study involving countries from Central, East, Southern, and West Africa subregions including Ethiopia revealed that the wealthiest quintile experienced much higher coverage than the poorest quintile (Wehrmeister et al., 2020b). Findings from studies based on data from low and middle-income countries are also in line with our results (Wehrmeister et al., 2020a, Wehrmeister et al., 2016). Wealth may play an important role in the coverage of MCH interventions. In many countries, MCH coverages usually tend to be disproportionately distributed favouring those from the better-off socioeconomic group (Barros and Victora, 2013). Our findings also revealed important inequalities in the indicators used to construct the modified CCI, pointing out that women/children in the wealthiest groups presented higher coverage than those from the poorest groups.

To ensure universal health coverage, Ethiopia has adopted pro-poor policies and strategies through various health initiatives that have shown significant advances in MCH care, such as the introduction of the health extension program, the health development army, and the scale-up of community-based health insurance schemes. There has been an encouraging expansion of health facilities and uptake of key MCH services (Admasu et al., 2016). Ethiopia has a three-tier health care delivery system, and public hospitals and private facilities play a major role as delivery care services outlets. At public health facilities, the majority of MCH services are provided free of charge. The fee-waiver system, which has been implemented for a long time has not brought all the desired results due to implementation challenges (Alebachew et al., 2015). MCH service coverages are typically higher for the wealthiest individuals, while health care benefits for the poor remain suboptimal (Wuneh et al., 2019, Ambel et al., 2015). It appears that regardless of how a country's health system is functioning, the richest parts of the population often have the means to overcome the most common barriers to access services and ensure fairly high levels of health care coverage (Barros et al., 2012). Disproportionately lower coverage of MCH services among women from a lower socioeconomic group can have multiple reasons such as direct or indirect health care costs including travel expenses and opportunity costs, health-seeking behavior, and perceived quality of care. In most low and middle-income countries, the poorest segments of the population remain marginalized and have suboptimal access to basic services, that places them in a vicious cycle of impoverishment and poor health (Peters et al., 2008).

The inequalities in CCI appear to have increased over time in Ethiopia, with the highest inequality in 2011, and the least inequality in 2000. The widened inequalities in the recent years might be due to the rapid population expansion in the country, which in turn might

be related to the increase in health care demand, uneven population to health facility ratio, and shortage of healthcare workers.

Along with being pro-rich, the modified CCI (and the majority of its constructs) demonstrated a top inequality pattern in all survey years. This is in line with a study, based in Sub-Saharan African countries, that has also shown a top inequality pattern in CCI (Faye et al., 2020). Considerable research attention has been paid to identifying the distinct patterns of inequality by wealth quintiles (Victora et al., 2018, Van Lerberghe, 2005, WHO, 2013). The patterns present major implications for policies and programs. Countries with low coverage of interventions tend to show a top inequality pattern, with the wealthiest quintile significantly ahead of the other quintiles (Victora et al., 2005). In top-inequality exhibiting countries, it may be more suitable to disseminate interventions throughout the whole population (Faye et al., 2020).

Across all the survey years examined, age-appropriate breastfeeding was relatively well-practised and had low levels of inequality. This may be related to cultural perceptions of acceptability and benefit to the child, the ease of practising breastfeeding, and the minimal out-of-pocket spending by households involved. Despite the minimal inequality, there were variations in the pattern of inequality in age-appropriate breastfeeding across each survey year. For instance, in 2005 and 2000, the wealthiest groups were the least to practice the intervention, a finding that is in accordance with the literature (Gatica-Domínguez et al., 2020).

The decomposition analyses results revealed that wealth status, place of residence, and maternal education were among the major contributors to the inequalities in CCI, while region and employment status showed minimal contributions. Across all survey years, inequalities in coverage index were largely due to household wealth status. The finding

that economic well-being had a positive and major contribution to the inequality reflected a more rapid increase in the coverage index in the more affluent groups. If inequality in household wealth status were eliminated for example in 2016, the inequality in the coverage index might have been reduced by 48%. Such disparity among different sub-population levels could be attributed to a maldistribution of benefits – not distributing to those who most need it – from the economic growth and basic services in the country between the poor and their wealthy counterparts (Peters et al., 2008). The better-off (people of higher socioeconomic status) are more likely to have a higher demand for health services than the worse-off because of their ability to pay and better awareness (Levesque et al., 2013). The other important factors that significantly increased pro-rich inequality in the coverage index were maternal education level and place of residence. These variables are associated with MCH service uptake and health-seeking behaviour (Mekonnen and Mekonnen, 2003). Evidence shows that better-educated women have better means to ensure access and high coverage levels of interventions compared to their counterparts (Worku et al., 2013). Studies also showed that women residing in urban areas have easier geographical access to health facilities (more health facilities with shorter travel distances to and from them), as well as comprehensive health services and skilled healthcare staff (Gebre et al., 2018, Bobo et al., 2017).

Overall, this study demonstrates the healthcare coverage some population groups is falling behind in Ethiopia, and that the efforts of the government to address inequity are insufficient. Given that improved MCH coverage is crucial to achieving national and global goals, efforts must be made to close the disparities in coverage, particularly by targeting the predominant contributors to the inequalities. Accordingly, reducing inequality due to wealth s would be the first step toward reducing inequality in coverage. Public health and social policy initiatives and programs aimed at reducing disparities in

coverage need to adjust focus and increasingly target the poorest segments of the population. Strategies should be adopted to scale-up reducing financial barriers and enhancing the social welfare of the poorest to achieve significant improvements in coverage. Programs that are sensitive to rural circumstances and address the barriers that prevent rural women from uptaking services must also be scaled-up. In addition, there is a need for public health policies and programs to focus on increasing women's education levels. As health sector interventions alone cannot reduce disparities, multisectoral collaboration is needed to attain equitable coverage of MCH services.

This study has some limitations. First, the data were collected based on women's self-report, which may lead to recall bias. Second, the cross-sectional nature of the data does not allow causal inference. Third, confounding factors that were not included in this analysis may have had a significant contribution to the widening of the observed inequality. Apart from these limitations, our study used a most recently used comprehensive summary measure – the modified CCI – to assess the inequalities in coverage of MCH interventions. Our study is also unique in that it decomposed the concentration indices to identify the major contributors to the inequalities. Information generated from this study may contribute to the design of policies and strategies to reduce inequalities in MCH coverage.

5.7 Conclusions

We used the modfied CCI as a summary measure of MCH coverage and examined inequalities using the EDHS data. We sought to identify the key factors that account for the inequalities in MCH coverage. We found pro-rich inequalities and a top-inequality patterns in CCI in all the survey years. Decomposition analysis showed that factors such as household wealth, place of residence, and mother's education level were important

positive contributors to the inequalities in coverage across all survey years. To reduce socioeconomic inequalities in coverage, health policies and strategies should focus more on the disadvantaged groups such as the poorest quantiles of the population and rural residents. Specific interventions that help overcome educational disadvantages are also important. As Ethiopia moves forward with the Sustainable Development Goals, innovative and evidence-based strategies with strong multi-sectoral efforts are required to overcome disparities.

5.8 Chapter summary

Chapter five investigated the disparities in maternal, newborn, and child health coverage along the continuum in Ethiopia and identified what contributed most to the inequalities. It was found that despite the improvements in coverage, there were inequalities in MCH coverage in Ethiopia. economic status, place of residence, and mother's education level accounted for the largest contribution to inequalities in coverage. According to the results, this chapter identified that newborn postnatal care had the lowest coverage. The next chapter presents a systematic review of evidence on the effective coverage of MCH services and disparities.

CHAPTER SIX

EFFECTIVE COVERAGE OF MATERNAL AND CHILD HEALTH SERVICES

(STUDY III)

Chapter 6 Evaluations of effective coverage of maternal and child health services: A systematic review

6.1 Overview of study three

Most coverage measures denote contact with a health care provider and do not consider the quality of care of interventions. This chapter presents a summary of existing evidence on the effective coverage of MCH interventions, quality measurement strategies and disparities. This chapter is published in Health Policy and Planning journal.

Citation

Gebremedhin AF, Dawson A, Hayen A. Evaluations of effective coverage of maternal and child health services: A systematic review. Health Policy and Planning. 2022 Aug;37(7):895 https://doi.org/10.1093/heapol/czac034

6.2 Abstract

Conventionally used coverage measures do not reflect the quality of care. Effective coverage assesses the extent to which health care services deliver potential health gains to the population by integrating concepts of utilization, need, and quality. We aimed to conduct a systematic review of studies evaluating effective coverage of maternal and child health services, quality measurement strategies, and disparities across wealth quantiles. A systematic search was performed in six electronic databases (MEDLINE, EMBASE, CINAHL, Scopus, Web of Science, and Maternity and Infant Care) and grey literature. We also undertook a hand search of references. We developed search terms having no restrictions based on publication period, country, or language. We included studies, which reported effective coverage estimates based on the World Health Organization framework of measuring effective coverage. Twenty-seven studies, all from

low and middle-income settings (49 countries), met the criteria and were included in the narrative synthesis of the results. Maternal and child health intervention(s) and program(s) were assessed either at an individual level or as an aggregated measure of health system performance, or both. The effective coverage ranged from 0% for postpartum care to 95% for breastfeeding. When crude coverage measures were adjusted to account for the quality of care, the effective coverage values turned lower. The gap between crude coverage and effective coverage was as high as 86%, and it signified a low quality of care. The assessment of quality of care addressed structural, process, and outcome domains, individually or combined. The wealthiest 20% had higher effective coverage of services than the poorest 20%, an inequitable distribution of coverage. More efforts are needed to improve the quality of maternal and child health services and to eliminate the disparities. Moreover, considering multiple dimensions of quality and the use of standard measurements are recommended to monitor coverage effectively.

Key messages:

- Effective coverage metrics, integrating both the conventional measurement of crude coverage and quality of care, is critical for monitoring progress towards the universal health coverage with high quality services.
- The effective coverage of maternal and child health interventions lagged substantially behind crude coverage indicating a low quality of care.
- The wealthiest quintile had higher effective coverage of services than the poorest quintile, showing an inequitable distribution of coverage.
- The results of the review also highlighted that the quality measurement strategies used often did not consider the multiple domains of quality of care, resulting over-estimated or underestimated coverage estimates.

6.3 Introduction

Universal health coverage aims to provide access to promotive, preventive, curative, and rehabilitative health services of adequate quality for people in need without financial hardship (Boerma et al., 2018). The term "coverage" defines the proportion of the population who require services that seek and receive these services (Bryce et al., 2013). Coverage data provide an opportunity to monitor progress towards the sustainable development goals. Improved coverage and access to maternal and child health (MCH) services have the potential to reduce mortality and morbidity substantially (Leegwater et al., 2015).

MCH remains a global health challenge. In 2017, the estimated maternal and infant mortality rates were 211 per 100,000 and 29 per 1000 live births, respectively (WHO, 2019b). There were approximately 5.5 million deaths among children under five years of age, in the same year (Hug et al., 2019, Hug et al., 2018). Maximising coverage is a key strategy to address these issues, but increasing coverage levels has not yet yielded the expected improvements and does not necessarily translate into better health gains (Marchant et al., 2016). The persistence of preventable maternal and child deaths calls for better measures beyond the conventional coverage. Research suggests that poor quality of care may reduce the effectiveness of services provided (Souza et al., 2013, Chou et al., 2019). Increased access to and use of interventions provided to mothers and children may not be followed by encouraging outcomes if the quality of services is suboptimal. Despite the availability of greater access to maternity services, there is no strong evidence that demonstrates reduced maternal and neonatal mortality rates, which can be largely explained by the poor quality of care. (Powell-Jackson et al., 2015) (Okeke and Chari, 2015). Therefore, better MCH outcomes require improvements in the quality of care. The concept of quality is heavily debated. Donabedian's quality framework is a widely

adopted model in health care that considers quality as the combination of structural, process, and outcome elements. A structural quality measure assesses characteristics of health care organizations or providers relevant to their capacity to provide optimal service to the population in need. Hence, it defines the environment in which health care is provided. Process elements of quality are defined by the activities or clinical actions that take place during the delivery of care to patients. The third component, an outcome measure, seeks to capture whether the goals of care were achieved. Each domain of quality measurement represents a piece of the complete picture, but may not be used as the sole measure of quality (Donabedian, 1988).

Expanding the scope of the concept of quality care beyond access has led to an increased interest in the use of effective coverage (EC) as a comprehensive measure of the performance of a health system in a given setting, based on recommendations by the World Health Organization (WHO) (WHO, 2018). Measuring the performance of a health system is essential for identifying problems and improvements, supporting decision-making efforts, and enabling successful policy formulation (Smith et al., 2009). In view of this, EC is a suitable metric to provide a more nuanced understanding of whether, and how well, a health system is delivering services to its populations (Ng et al., 2014). Quality-adjusted coverage, quality-adjusted contact, or high-quality contact can be used alternatively to denote EC because quality is a major component of the metrics (Joseph et al., 2020). The conventionally used measurement of crude coverage (CC), also called contact coverage, describes the utilization of services, but it does not consider the quality of care received. In contrast, EC integrates the concepts of need, use, and quality into a single measure (Shengelia et al., 2005). As a first framework, Tanahashi's model of health service coverage introduced five stages of service provision namely availability, accessibility, acceptability, contact or actual use, and quality (Tanahashi, 1978). In search

of a better integrating concept, the WHO's updated framework further explained EC as the product of utilisation and quality, conditional on the need for the service (Shengelia et al., 2005). EC can be applied for one or a group of interventions or for the health system as a whole (Laurell, 2007).

A scoping review conducted by Jannati et al. assessed the key elements and steps of EC measurement including the types of interventions covered and the strategies used to determine the constructs of EC (Jannati et al., 2018). MCH interventions and chronic conditions were discussed. However, the scoping review has not offered a complete account of the specific estimates of the EC of MCH services, as well as the gaps and distributions across socio-economic status. Scoping reviews, which may be helpful precursors to systematic reviews, do not aim to produce a critically appraised and synthesized result to a particular question. In contrast, systematic reviews undergo an assessment of methodological limitations or risk of bias of evidence and provide evidence to inform practice (Munn et al., 2018). Another comprehensive review of published literature on EC of reproductive, maternal, neonatal, child health, and nutrition used evidence from Pubmed to discuss the gap between CC and quality-adjusted coverage (Amouzou et al., 2019). In addition, this study developed a cascade framework with consecutive coverage steps to identify the potential losses of health benefits of interventions based on the Tanahashi framework (Tanahashi, 1978). Synthesizing evidence on the EC of MCH services systematically has a critical role in enhancing the foundation for assessing and improving progress. In this systematic review, we aimed to assess the EC of MCH interventions or programs based on the updated WHO framework of measuring effective coverage. We also investigated the gap between EC and CC, the quality measurement strategies used, and possible disparities across different socio-

economic groups. To our knowledge, this systematic review is the first to address these objectives.

6.4 Methods

Search strategy

This systematic review has been registered on the International Prospective Register of Systematic Reviews (PROSPERO CRD42020159384). Reporting has been done in accordance with the preferred reporting items for systematic reviews and meta-analyses guidelines (Moher et al., 2009).

We conducted a comprehensive search of peer-reviewed literature in multiple electronic databases, including MEDLINE, CINAHL, EMBASE, Scopus, Web of Science and Maternity and Infant Care. In addition, grey literature from sources, including ProQuest, Google search engine, Google Scholar, Maternal Health Task Force and WHO's official website, were searched for relevant reports and web-based publications. Moreover, the researcher manually searched the references of selected studies for relevant articles not identified in the initial search. Finally, we added new articles upon receiving search alerts from databases. Both free-text and Medical Subject Headings terms combined with Boolean operators, wildcards and truncations were included in the search strategy, including terms related to: mother, children, neonate, MCH services, antenatal care (ANC), post-natal care, family planning, delivery, management of childhood illnesses, immunization, neonatal care and EC. We developed the initial search strategy in OVID MEDLINE and adapted it for other databases (see **Appendix 4**).

Eligibility criteria

Studies retrieved by the search strategy developed were exported to a citation manager (EndNote software) to accumulate relevant articles and to remove duplicates. The

remaining articles were imported to Covidence where duplicates missed by the endnote were taken out. Next, we screened papers by reviewing the title and abstract and then by reviewing the full text.

All studies (prevalence studies, survey/national survey-based studies, and other observational studies) that reported estimates of EC using the WHO framework of measuring EC were included (Shengelia et al., 2005). During the search process, we identified no experimental or interventional studies. We considered both published and unpublished studies (grey literature) without restrictions based on publication period, country and language. Where studies were published in languages other than English, native language speakers were contacted for a translation. To be included in the review, the populations of interest should include at least one of the following: Women aged 15 to 49 years, children under five years of age, and neonates. We excluded qualitative studies, review articles, news items, commentaries, poster presentations, technical reports and editorials. In addition, we excluded studies that were not fully accessible after at least two-email contact with the primary authors due to the challenges to assess the quality of studies without full text. We excluded studies that used EC models other than the WHO model, such as the Tanahashi model, those that measured CC only (not adjusted for quality) or did not assess EC and studies that considered populations other than women aged 15 to 49 years and children under 5 years. The main outcome is EC, which is expressed as the product of CC (which consists of utilization and need components) and quality score.

Quality assessment, data extraction, and Data analysis

We used the Joanna Briggs Institute critical appraisal checklist for prevalence studies to evaluate the methodological quality of the included studies. The tool consists of nine

items that assess the internal and external validity of studies included in the qualitative analysis. During the quality appraisal, three authors were involved, ensuring each study was appraised by two authors, with any disagreements between authors resolved through discussion. Articles receiving a minimum score of 6 out of 9 were classified as having adequate quality. For each eligible article, information about author(s), the study setting, study period, aims, target population, intervention (programme) assessed, and measurement strategy used to determine quality were extracted on Microsoft Excel 2016. In addition, a summary of results including estimations of CC and EC, gaps between EC & CC, and distributions of EC measures across different socio-demographic characteristics, were put into a predesigned summary table (see **Appendix 1**). We used a qualitative approach to summarise the characteristics of included studies and to synthesise the relevant information based on the objectives of the study. We discussed EC and CC estimates descriptively. We did not perform a meta-analysis of the findings due to the considerable heterogeneity of the included studies in terms of measurement methods used.

6.5 Results

A total of 839 citations were identified, leaving 394 unique studies after duplicates were removed. Three hundred fifty-five articles were excluded based on title and abstract. The remaining 39 articles were reviewed using the full text. Subsequently, we included 27 studies in the review after applying the inclusion and exclusion criteria (see **Figure 19**)

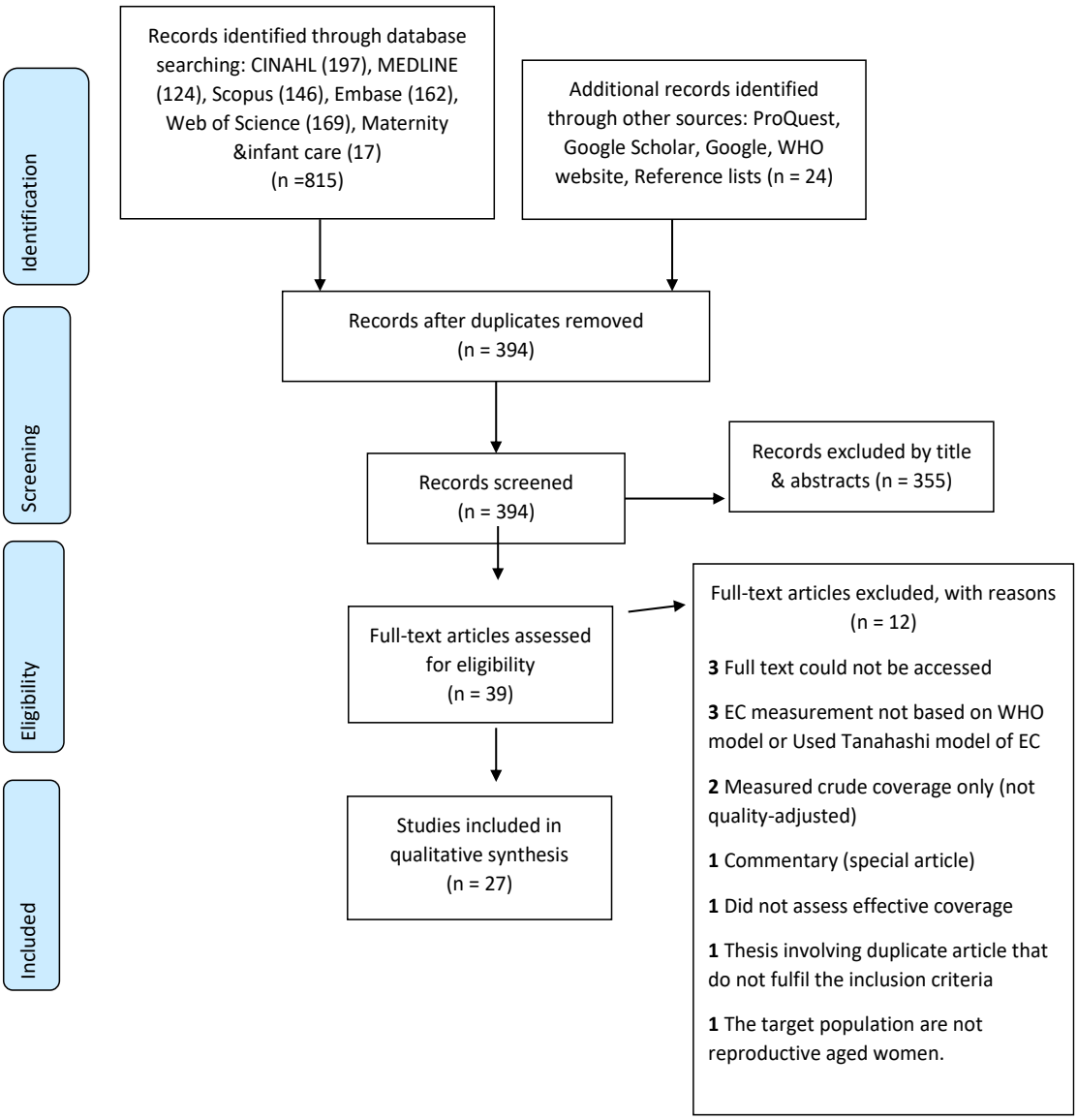


Figure 15. Preferred reporting items for systematic reviews and meta-analyses study selection flow diagram

Characteristics of included studies

The twenty-seven included studies were published between 2006 and 2021. Two of the studies (Gutiérrez, 2013, Martínez et al., 2011) were reported in Spanish, while the rest were reported in English. Although we did not restrict studies by country, all of the included studies were conducted in low and middle-income countries, where maternal and child mortality remains a major challenge to health systems. While the majority of studies were

conducted in Sub-Saharan Africa (*n*=14), 10 Latin-American countries (*n*=5), and 3 Asian countries (*n*=4) were represented. Four studies used data from multiple country settings (Wang et al., 2019, Leslie et al., 2017, Marchant et al., 2015, Hodgins and D'Agostino, 2014). The predominant data sources used by the studies were Demographic and Health Surveys solely or combined with Service Provision Assessments (*n*=9) (Nguhiu et al., 2017, Yakob et al., 2019, Wang et al., 2019, Martínez et al., 2011, Leslie et al., 2017, Hodgins and D'Agostino, 2014, Kyei et al., 2012, Hategeka et al., 2020, Nguyen et al., 2021). Demographic and Health Surveys are nationally representative household surveys that provide data for a wide range of monitoring and impact evaluation indicators in the areas of population, health, and nutrition. The Service Provision Assessment survey is a health facility assessment that provides a comprehensive overview of a country's health service delivery by collecting information on the overall availability of different facility-based health services and their readiness to provide those services. Two studies (Joseph et al., 2020, Munos et al., 2018) used Multiple Cluster Indicator Surveys, which were implemented by the United Nations Children's Fund to provide internationally comparable data on the situation of children and women. The other data sources used in the reviewed articles include: National Health and Nutrition Surveys (*n*=3) (Lozano et al., 2006, Gutiérrez, 2013, Leslie et al., 2019), surveillance data (*n*=1) (Nesbitt et al., 2013), baseline surveys of government-led evaluations (*n*=1) (Koulidiati et al., 2018), facility document reviews (*n*=2) (Murphy et al., 2018, Venkateswaran et al., 2019), household surveys (including health worker and facility assessments) (*n*=7) (Carter et al., 2018, Marchant et al., 2015, Willey et al., 2018, Larson et al., 2017, Engle-Stone et al., 2015, Colson et al., 2015, Okawa et al., 2019), immunization coverage surveys (*n*=1) (Travassos et al., 2016) and reports from international organizations such as the World Bank and UNICEF (*n*=1) (Idzerda et al., 2011).

Quality appraisal result

All studies (100%) described the study subjects and the setting in detail. The majority of studies (96%) used an adequate sample size and 93% measured the outcome in a standard, reliable way for all participants. Eighty-nine % of the studies used an appropriate sampling frame and 24 studies (89%) sampled participants in an appropriate way. It was also noted that all studies had an adequate response rate and 85% used appropriate statistical techniques. However, valid methods for the identification of the outcome were not followed in seven studies (26%). Five studies (19%) did not conduct data analysis with sufficient coverage of the identified samples (see **Appendix 2**).

Maternal and child health interventions assessed

Research on EC has been undertaken with the aim of evaluating health system performance to deliver MCH services or to assess specific intervention(s) or program(s). Four of the included articles calculated EC for key interventions at an individual level and combined these into composite metrics for health system assessment (Nguhiu et al., 2017, Leslie et al., 2017, Lozano et al., 2006, Leslie et al., 2019). The choice of indicators was based on a country's needs and set priorities. Lozano et al. used EC as a performance-benchmarking device across states in Mexico (Lozano et al., 2006). They created an overall EC score combining fourteen interventions, out of which eight were for MCH, at the national level. Similarly, Nguhiu et al. constructed an aggregated EC measure out of eight MCH interventions weighted by population need for the services (Nguhiu et al., 2017). Furthermore, Leslie et al. (Leslie et al., 2017) quantified EC for three essential primary care services namely; antenatal care (ANC), family planning, and care for sick children, across multiple countries and calculated primary care coverage by averaging these three services. A recent study by Leslie et al described the EC of multiple conditions within the

Mexican Institute of Social Security (IMSS), the largest health system in Mexico, using routinely collected data and focusing on metrics of potential health gain or loss (Leslie et al., 2019).

Papers that focused on the assessment of specific intervention(s) or program(s) evaluated EC of maternal health services at pre-pregnancy (Nguhiu et al., 2017, Yakob et al., 2019, Leslie et al., 2017, Leslie et al., 2019), during pregnancy (Nguhiu et al., 2017, Joseph et al., 2020, Lozano et al., 2006, Yakob et al., 2019, Leslie et al., 2017, Marchant et al., 2015, Gutiérrez, 2013, Okawa et al., 2019, Hodgins and D'Agostino, 2014, Venkateswaran et al., 2019, Kyei et al., 2012, Leslie et al., 2019, Munos et al., 2018), delivery (Nguhiu et al., 2017, Lozano et al., 2006, Wang et al., 2019, Gutiérrez, 2013, Martínez et al., 2011, Nesbitt et al., 2013, Marchant et al., 2015, Okawa et al., 2019, Willey et al., 2018, Larson et al., 2017, Hategeka et al., 2020, Leslie et al., 2019, Munos et al., 2018) and postnatal phases (Marchant et al., 2015, Okawa et al., 2019). Some articles reported the EC of individual elements of care during the delivery of interventions such as ANC (Hodgins and D'Agostino, 2014, Venkateswaran et al., 2019). The EC of child health interventions such as immunization (Travassos et al., 2016, Colson et al., 2015, Nguhiu et al., 2017), care-seeking for childhood illnesses (Hategeka et al., 2020, Nguhiu et al., 2017, Lozano et al., 2006, Gutiérrez, 2013, Koulidiati et al., 2018, Leslie et al., 2017, Carter et al., 2018, Idzerda et al., 2011, Leslie et al., 2019, Munos et al., 2018) and breastfeeding (Nguhiu et al., 2017, Martínez et al., 2011) was also the other area of focus. Moreover, adjusted coverage measures for neonatal and infant health interventions were identified (Nguhiu et al., 2017, Lozano et al., 2006, Martínez et al., 2011, Marchant et al., 2015, Okawa et al., 2019, Murphy et al., 2018, Leslie et al., 2019, Munos et al., 2018). Three studies estimated the EC of nutrition interventions delivered to women and children (Joseph et al., 2020, Engle-Stone et al., 2015, Nguyen et al., 2021). Overall, the large majority of included studies assess concerning to ANC and delivery care.

Drawing on EC framework, the reviewed studies calculated EC of MCH services as: effective coverage=*Quality* of MCH services × (*Utilisation* of MCH services divided by *Need* for MCH services). The following are some examples of how EC was defined. Okawa et al. defined the EC of ANC as the proportion of women receiving four or more visits (indicating coverage) and receiving 11-14 of the intervention items (indicating quality) (Okawa et al., 2019). (Nesbitt et al., 2013) defined EC of delivery care as the proportion of deliveries in facilities offering high-quality care in all four quality dimensions (Routine delivery, emergency obstetric care, emergency newborn care, and non-medical quality). (Koulidiati et al., 2018) defined EC of care-seeking for child illness as the proportion of all under-five-year-old children in need who actually sought care at a facility categorized as of high-quality. (Colson et al., 2015) defined EC of measles immunization as the proportion of children with a positive dried blood sample assay for measles-specific Immunoglobulin G antibodies. (Leslie et al., 2017) defined the EC of family planning as the proportion of women using modern contraceptive methods and receiving the essential clinical actions (16 items) within reproductive history, counselling, and history and physical examination domains. (Murphy et al., 2018) defined the EC of neonatal care as the proportion of newborns attending facilities providing high-quality care.

Effective coverage estimates and the gaps with crude coverage

The EC estimates extracted from the included studies ranged from 0% for post-partum care in Gombe in Nigeria, Ethiopia and Uttar Pradesh in India (Marchant et al., 2015) to 95% for breastfeeding in the Dominican Republic (Martínez et al., 2011). Studies that evaluated family planning showed that EC estimates lagged substantially behind the crude coverage for the same service due to low-quality care. Supporting this evidence

was the drop in EC from 68% to 41% in Kenya (Nguhiu et al., 2017), and 61% to 22% in Ethiopia (Yakob et al., 2019) when CC measures were adjusted with quality of care. Leslie et al. reported the average EC of family planning across eight countries that was estimated at 26%, ranging from 17% in Haiti to 38% in Rwanda (Leslie et al., 2017). In all these countries, crude coverage considerably overstated EC.

Twelve studies (Nguhiu et al., 2017, Joseph et al., 2020, Lozano et al., 2006, Yakob et al., 2019, Leslie et al., 2017, Marchant et al., 2015, Gutiérrez, 2013, Okawa et al., 2019, Kyei et al., 2012, Hategeka et al., 2020, Munos et al., 2018, Leslie et al., 2019) showed that estimates of ANC would also be lower if the quality of care at facilities was taken into account. The gap between EC and CC was as high as 86% in Zambia (Kyei et al., 2012). In this study, 94% of women had at least one ANC visit, while 60% had at least four visits. However, only 8% of mothers attended high-quality ANC and had their visit in the first trimester, hence denoting low EC.

In contrast to studies that assessed the provision of interventions at one time only, Venkateswaran et al. examined the appropriate number and timing of screening tests, simultaneously, for eight specific ANC interventions (such as screening for hypertension, anaemia, gestational diabetes) throughout the pregnancy period, as a proxy for EC (Venkateswaran et al., 2019). Accordingly, the EC of seven of these specific interventions was lower than the coverage of at least one screening and coverage of the appropriate number of screenings, both denoting CC measures. Hodgins et al. assessed population EC by taking the average coverage of specific interventions (a set of key antenatal services) among all pregnant women (Hodgins and D'Agostino, 2014). This contrasts with the measure of conventional coverage defined as the average coverage of specific interventions among those who had received four or more ANC visits. The results show

coverage for specific interventions was generally much lower among all pregnant women (as a proxy for EC) than among only those who had received ANC 4+ visits. The population EC ranged from 14% in Niger to 84% in the Dominican Republic.

For delivery and perinatal care, the highest gap between contact coverage and high-quality contact was 72% (in India, where the CC was 76% and the EC was 4%) (Marchant et al., 2015). Lozano et al. determined the EC of skilled birth attendance to be 93%, taking births that took place in hospitals as a quality-measuring indicator (Lozano et al., 2006). In the articles that reported both coverage measures, it was found that adjusting for quality of care substantially reduced crude coverage of delivery care (Nguhiu et al., 2017, Wang et al., 2019, Nesbitt et al., 2013, Marchant et al., 2015, Okawa et al., 2019, Willey et al., 2018, Larson et al., 2017, Hategeka et al., 2020).

When analysing the findings of a study on post-partum care coverage, it was found that quality-adjusted contact was considerably lower than the crude contact estimates. Seven per cent, 3%, and 54% of women received post-partum care in Gombe, Ethiopia, and Uttar Pradesh, respectively (Marchant et al., 2015). However, high quality post-partum care was zero in all these settings. In Myanmar, the coverage of peripartum care was 61%, but it dropped to 15% when quality was included in the metrics, denoting a 46% gap (Okawa et al., 2019).

Few studies discussed nutrition-related interventions as a health system performance indicator. Joseph et al. adjusted coverage measures of ANC and delivery for quality of nutrition interventions (Joseph et al., 2020). Results showed that after considering quality, women received nutrition interventions less often than they sought care. Related to this, a study in Cameroon (Engle-Stone et al., 2015) measured the EC of nutrition programs by taking the proportion of the population that had an inadequate nutrition intake at baseline

and achieved a sufficient level following a given intervention. The EC estimates were lower than raw coverage (a proportion that is deficient and had received a program) estimates almost by half. Nguyen et al. specifically examined nutrition interventions across the continuum of maternal and child care and found that coverage was 28% for ANC, 38% for institutional delivery, 35% for child growth monitoring, and 81% for sick child care (Nguyen et al., 2021). However, quality reduced the estimates to 18% for ANC, 23% for institutional delivery, 20% for child growth monitoring, and 52% for sick childcare. This indicates there was a 10-30 percentage gap between the two estimates.

Combined facility and household surveys evaluated the coverage of various child health interventions in diverse settings and found that EC estimates were lower than CC estimates. For immunization, the crude versus EC results were 80% Vs 56%, 83% Vs 68%, and 85% Vs 50% in Kenya (Nguhiu et al., 2017), Mexico and Nicaragua, (Colson et al., 2015) respectively. In contrast, Travassos et al. linked serosurveys (where specimens obtained from selected populations are tested for antibodies) to immunization coverage surveys to measure the proportion of children protected against vaccine-preventable diseases in three regions in Ethiopia (Travassos et al., 2016). Coverage measures from vaccination cards, immunization clinic records, and maternal recall were compared with serosurveys. They found inaccuracies in administrative estimates of vaccine coverage, which over-estimated coverage where immunization services were weak. The authors highlighted, by detecting protective serologic biomarkers, Serosurveys are able to monitor objectively the proportion of children that have received a vaccine. This approach can best determine the quality of the immunization services and provide critical insights into the effectiveness of vaccination programs.

CC for acute respiratory illnesses and diarrhea and the corresponding EC estimates were notably different across countries. EC ranged from 5.3% in Burkina Faso (Koulidiati et al.,

2018) (considering only those who received high-quality services) to 67% in Serbia (Idzerda et al., 2011), and among the studies that reported both estimates (Hategeka et al., 2020, Nguhiu et al., 2017, Koulidiati et al., 2018, Leslie et al., 2017, Carter et al., 2018, Idzerda et al., 2011), coverage values became lower when adjusted for quality. The difference between the two coverage estimates was as high as 64 percentage points (Koulidiati et al., 2018). Two of the included studies discussed breastfeeding. Nguhiu et al (Nguhiu et al., 2017) found that coverage dropped from 99.6% to 72 % when quality was taken into account, while Martinez et al (Martínez et al., 2011) described that EC ranged from 52% to 95%. Seven of the studies identified by this review have discussed infant and neonatal interventions (Lozano et al., 2006, Martínez et al., 2011, Marchant et al., 2015, Okawa et al., 2019, Murphy et al., 2018, Leslie et al., 2019, Munos et al., 2018). When quality was taken into account, postnatal care coverage decreased from 4%, 4%, and 19% in Gombe state (Nigeria), Ethiopia, and Uttar Pradesh (India), respectively, to 0% (Marchant et al., 2015). Whereas, in Myanmar, there was an eight-percentage difference between CC and EC (Okawa et al., 2019). It was noted that EC of newborn care was 81% in Mexico (Lozano et al., 2006), 25% in Kenya (Murphy et al., 2018), and 74% in another study from Mexico (Leslie et al., 2019), although they did not specify CC values. (**Appendices 5-9**)

Quality measurement strategies

Researchers used various methods and strategies to measure the quality component of EC across different types of interventions. The bulk of studies used measures assessing the process of care (Hategeka et al., 2020, Nguhiu et al., 2017, Joseph et al., 2020, Yakob et al., 2019, Gutiérrez, 2013, Leslie et al., 2017, Marchant et al., 2015, Okawa et al., 2019, Hodgins and D'Agostino, 2014, Idzerda et al., 2011, Venkateswaran et al., 2019, Kyei et al., 2012). In this case, a list of recommended clinical actions that are performed during contact between

health care users and a provider was used to measure quality. We identified themes under the process of care domain that were used to measure the quality of MCH interventions. These included a list of clinical and women/children centred activities conducted during history taking, physical examination, screening, preventive measures, and counselling. For immunization, questions related to the use of guidelines and documentation of service delivery represented the process of care domain. Assessing quality using a checklist of services provided during birth such as active management of the third stage of labour also characterized the process of care.

Four studies used the structural aspect of quality of care, which incorporated observations of the physical attributes of a health facility including infrastructure, equipment, supplies, commodities, and the availability of trained personnel (Wang et al., 2019, Carter et al., 2018, Willey et al., 2018, Nguyen et al., 2021). In other words, they assessed service or facility readiness to provide a particular intervention. Five of the included articles used combinations of structural and process domains (Nesbitt et al., 2013, Koulidiati et al., 2018, Murphy et al., 2018, Larson et al., 2017, Munos et al., 2018). In contrast, Lozano et al. combined process and outcome domains of quality metrics (Lozano et al., 2006). Other studies measured quality using an outcome domain such as risk-adjusted mortality (Lozano et al., 2006, Leslie et al., 2019). Three among the twenty-seven included articles have shown that the presence of biomarkers, which are indicators of a particular disease condition or some other physiological state, can provide objective insights on the quality of immunization and nutrition services (Colson et al., 2015, Travassos et al., 2016, Engle-Stone et al., 2015). Due to limitations presented on the estimation of the quality of interventions, some studies reported only CC values (Lozano et al., 2006, Martínez et al., 2011, Gutiérrez, 2013). However, these three studies were included because they have reported the results of EC at least for one MCH intervention. In this regard, (Lozano et al.,

2006) evaluated eight MCH interventions, but only four of them had EC values (Lozano et al., 2006). Similarly, (Gutiérrez, 2013) evaluated five MCH interventions, although only three had EC values reported (Gutiérrez, 2013). Out of six interventions, (Martínez et al., 2011) reported the EC of only breastfeeding (Martínez et al., 2011). Appendix 3 shows the quality measurement strategies used by the studies.

Effective coverage estimates across the wealth quintiles

Among the included studies, seven revealed that there were variations in EC estimates across different wealth quintiles (Hategeka et al., 2020, Nguhiu et al., 2017, Lozano et al., 2006, Gutiérrez, 2013, Larson et al., 2017, Nguyen et al., 2021, Nesbitt et al., 2013). Their finding indicated that the wealthiest quintile had a higher EC of services than the poorest quintile. Nguhiu et al. found that overall increases in EC of MCH services have occurred concomitantly with a drop in the levels of inequalities in EC over time (Nguhiu et al., 2017). Inequalities were highest for delivery care, where the wealthiest quintile had three times greater EC than the poorest quintile. Significant inequalities in the EC of immunization, ANC, and family planning have also been reported to the disadvantage of low-income people, showing that inequalities were particularly evident in maternal health services. The EC of management of diarrhea exhibited a pro-poor distribution. In Rwanda, the increases in EC of ANC and delivery care were associated with widening inequality. EC improvements were greatest amongst wealthier quintiles of the population. Conversely, sick childcare showed narrowing inequalities in EC (Hategeka et al., 2020). (Lozano et al., 2006) estimated the absolute gap in EC between quintiles to be 9% for MCH services. On the other hand, Larson et al. found that compared to the poorer 80% of women, the wealthiest 20% of women were more likely to deliver in a good quality facility and receive good quality care (Larson et al., 2017). Similarly, EC varied across

wealth quintiles, where 4% of skilled deliveries in the lowest wealth quintile were in high-quality facilities compared to 37% of deliveries in the highest quintile (Nesbitt et al., 2013). According to a recent study in Bangladesh, inequalities in nutrition input-adjusted coverage were large during ANC and institutional delivery as evidenced by the 28-34 percentage point difference between the highest and lowest wealth quintiles (Nguyen et al., 2021). A study in Mexico reported that care-seeking for acute childhood illnesses was greater among the wealthy compared to low-income people (Gutiérrez, 2013). In contrast to the above studies, Okawa et al. determined that household wealth was not associated with receiving high-quality care (Okawa et al., 2019).

6.6 Discussion

Evidence indicates that expanding health care coverage does not necessarily result in better outcomes (Marchant et al., 2016, Winter et al., 2017). The persistent problems of high maternal, newborn, and child morbidity and mortality require a functional health care system, which does not depend on the coverage of health services alone. CC estimates do not capture quality and hence do not show potential health gain. EC denotes the relationship between service utilization conditional on true need and the service quality received. It adjusts crude population-level coverage for quality of care thereby revealing gaps in the delivery of effective care (Colston, 2011). This systematic review revealed four major findings regarding EC of MCH services. First, most studies found lower EC estimates. Second, in all studies that reporteMCd both estimates, EC values were lower than the CC and there was a major difference between the two. Third, the quality component of EC was often measured using structure, process and outcome domains, but combinations of these have been used as well. Fourth, studies that compared EC across different socio-economic status found that the poorest quantiles had lower EC than the wealthiest quantiles.

EC was calculated for specific interventions and for a combination of interventions as an aggregate measure to highlight health system performance. There was a remarkable variability in EC estimates for different MCH services. Moreover, a substantial gap between CC and EC estimates was shown. This gap indicates that although women and children had adequate contact with health care providers through enhanced access to care, insufficient provision of important interventions limited the levels of care provided, as has been revealed in the high proportion of women and children not receiving good quality of care. CC of different interventions were much higher when compared to EC, as quality lagged coverage and hence undermined effective delivery of services. CC is a widely used indicator that takes into account the use of services and the population with a need, missing an important component indicating health gain, i.e. quality (Ng et al., 2014). Considering health care utilization or raw coverage measures solely can give misleading information regarding service delivery. Where quality of care is not considered, the results might be optimistic. For instance, high coverage of facility delivery or a pregnant woman visiting a health care provider does not necessarily mean women are getting a high standard of care (Austin et al., 2014). Hence, applying measurement techniques that link health care use to the quality of service provided reveals a more accurate picture of the health care received by women and children. It is also important to consider that in the study by Martinez, the quality measurement strategy used might contribute to the overestimated EC value noted (Martínez et al., 2011). Failure to choose the right indicators or to incorporate the multiple domains of measurement when assessing the quality of care in MCH may result in overestimated or underestimated EC values, eventually leading to wrong implications. Some of the included studies intended to calculate the EC of MCH interventions but reported only the CC measures due to difficulties in measuring the quality component.

The most challenging, but very important aspect of EC estimation, is measuring the quality component. The studies in this review measured quality through structural, process of care, and outcome dimensions. The measurement technique used or the quality dimension evaluated determines the value of the EC estimate. Structural measures of quality typically include the characteristics of the resources in the health care system, including the availability of medicines, equipment, and professionals. They provide a judgment on whether care is being provided under conditions that are either conducive or unfavourable to the provision of good care (Quentin et al., 2019). In this review, facility capacity and readiness to provide services that contain domains such as knowledge, availability of services, human resources, and basic commodities were used as structural attributes. Some authors argued that such structural measures might provide incomplete insight on the quality of care provided despite being relatively concrete and easy to measure (Rademakers et al., 2011).

Process of care indicates all the actions that makeup health care or what a provider delivers to maintain health, either for healthy people or those diagnosed with a disease. Hence, this reflects how the institution is meeting generally accepted standards of practice. Process measures are predominantly used by researchers and provide an objective measurement of quality (Lilford et al., 2007). The bulk of the studies included in our review used processes of care to measure quality. Few of the included articles reported research that used outcome metrics such as risk-adjusted mortality as a quality metric. Outcome measures demonstrate end results of services and reflect all of the effects of health care on the health status of people, including changes to health status, behaviour, satisfaction, and quality of life. They are important indicators of quality, as the primary goal of healthcare is improving health status. However, the measurements of outcomes are difficult to obtain and may take considerable time (Hanefeld et al., 2017). Some of the

papers in this review described the use of scores and indexes concerning structures that were combined with indicators relating to the process of care, providing a more comprehensive view of the quality of care. Studies indicate that the recognition of the multifaceted nature of the quality of care is critical (Hanefeld et al., 2017, Sixma et al., 1998). However, most measurement approaches used often fail to address the complexities involved in understanding the quality of care. Biomarker information was also used to assess the quality of care. Evidence shows that biomarker data may help evaluate the quality of vaccines and immunization programs thereby providing improved insights into public health problems (Boerma et al., 2001). Overall, the existence of multiple indicators to measure the quality of care may be related to the different processes involved in the development of protocols and guidelines for MCH services across countries. If the quality of interventions is not measured appropriately, coverage estimates may be overestimated or fail to show the true health gain by population.

Health care quality is multidimensional, and multiple indicators are used to measure constructs such as structure, process, and outcome. The selection of constituting indicators and weights could influence the results of quality (Hanefeld et al., 2017). To compare the gaps between CC & EC using the three quality domains, we considered articles that reported both CC & EC estimates. Studies examining family planning, ANC, and postpartum care relied only on the process of care domain to measure quality. For each service, there were variations in the process indicators used across studies. Rwanda (Leslie et al., 2017), Uganda (Leslie et al., 2017), and Ethiopia (Marchant et al., 2015) showed the narrowest gap between CC & EC for ANC, family planning, and postpartum care, respectively. This may be due to both the low service coverage and shortfall in quality in these countries. EC is a construct of both coverage and quality; lower levels of both may result in lower gaps between CC & EC. Regarding delivery care, studies that used a

combination of process and structure domains as a measure of quality (Larson et al., 2017, Nesbitt et al., 2013) exhibited higher gaps between CC & EC than those that used the structural domain only (Wang et al., 2019, Willey et al., 2018). This indicates that not considering the multiple domains of quality may underestimate the gap between EC & CC. A study in Burkina Faso (Koulidiati et al., 2018) that used combined domains of process and structure to measure the quality of childcare seeking showed the highest gap between CC & EC as compared to a study that assessed eight countries separately, using the process of care domain only (Leslie et al., 2017). Comprehensive measures of quality that involve multiple dimensions or undergo a detailed assessment of sets of numerous indicators may reveal higher gaps between EC & CC. There appears to be great heterogeneity in the way in which quality and the indicators that construct its three domains are measured, limiting comparability across studies and countries.

Increasing attention is being paid by research to the examination of socioeconomic inequality in MCH domains. So far, most of the work regarding inequities in health service delivery has been about access to care (WHO, 2015). Wealth status, education, and area of residence have a significant impact on access to and uptake of services. Studies show that the economically disadvantaged sections of society are the ones that face the greatest health problems (Ahmed et al., 2010). Pro-rich inequalities for MCH coverage indicators are common (Victora et al., 2016). Estimates of socioeconomic inequalities using CC measure generally underestimate the level of inequalities compared with EC measures (Arsenault et al., 2018). In Rwanda, as the EC increases, the socioeconomic inequalities were widening mainly due to widening inequalities in quality, which calls for the importance of equitable quality improvement (Hategeka et al., 2020). When efforts to increase coverage and quality are poorly monitored, an unbalanced benefit to the wealthier quintiles at the expense of the poorer quintiles may occur (Victora et al., 2000,

Victora et al., 2012). Evidence from other studies have noted a quality deficit in health services available to low-income groups (Sharma et al., 2017, Barber et al., 2007). The improvements in equity in the overall EC of MCH services observed in Kenya may possibly be linked to a range of interventions implemented over the study period (Mutua et al., 2011, Noor et al., 2007). Quality improvement can be a powerful tool to achieving equitable high-quality healthcare (Hirschhorn et al., 2021). Previous evidence found that socioeconomic inequities remain in most low-income countries when considering EC (Anindya et al., 2021). Some of our reviewed articles indicated that the EC of MCH services tended to be inequitably distributed favouring those from the better-off socio-economic groups. The poorest quintiles had lower EC levels of services than the wealthiest quintiles. This can be explained by the fact that low-income women and children are less likely to receive high-quality care than their counterparts. Hence, as the quality of care is reduced, so does the EC. Emerging data highlights that predominantly, low-income people tend to be less informed about the quality of care and mostly live in rural areas and regions with poorly functioning health systems, where there is limited availability of quality facilities nearby and skilled professionals (Hardie and Landale, 2013). Other studies revealed that discriminatory treatment from health workers, cost of medical procedures, women's empowerment, and degree of patient activation to seek high-quality care appear to prevent women from low-income households to access high-quality services (McMahon et al., 2014, Shiferaw et al., 2013). Health system factors such as the disproportionate availability of services could also explain why low-income women get worse care (Bintabara et al., 2019). The evidence we reviewed showed that the wealthiest women were usually more likely to report good quality ANC, delivery care, family planning, and child health services such as immunization than the low-income women. The general trend in the literature is that maternal health indicators are particularly prone to such inequalities, with

the rich-poor ratio reaching over fourfold in some countries (Barros et al., 2012, Boerma et al., 2018). Prior research has documented pro-rich distribution of quality-adjusted coverage of maternal and child health services (Sharma et al., 2017, Rani et al., 2008). In countries with adequate coverage of services, the richest quintiles are privileged to attain greater coverage than the poorest quintiles because they pick up the services first. According to (Victora et al., 2012) and (Victora et al., 2018) when the national coverage is very low, the services may not be available in both wealthy and least wealthy groups, resulting in lower levels of inequality. Some indicators and disease episodes tend to be higher among low-income people, and there tend to be more than 20% of the mothers and children in the lowest quintile of household wealth and fewer than 20% in the richest quintile. Such indicators that are often based on a much larger sample in the poorest than in the wealthiest quintile may reveal a pro-poor distribution. Consistent with the finding in Kenya (Nguhiu et al., 2017), pro-poor inequality in the coverage of MCH services have been reported by other studies (Neal et al., 2015, Joseph et al., 2018).

Overall, it is notable that the gap between EC and CC is due to the poor quality of care at MCH services. This implies the need to devote greater attention to improving quality, along with expanding coverage. It is also important to prioritize improvement efforts to target vulnerable groups first, including low-income people, since they have the worst quality of care and health outcomes. The low EC of MCH interventions or programs highlighted in the review have implications for designing improved approaches that will contribute to achieving high EC. Previous studies have documented strategies such as the pathway approach to high EC, which facilitates systems thinking to better understand EC and health impacts. The Pathway approach consists of six key components: national readiness, system structures, management capacity, implementation strength, EC, and impact. The first two components are applicable at a national level, whereas the third and

the fourth pertain to the subnational level and the intervention delivery point, respectively. Various countries have used the pathway approach to guide strategic planning, monitoring, and evaluation (Vaz et al., 2020). It is increasingly recognised that health systems need to focus on achieving quality care for health gains in populations. Where there are better levels of access to maternal and child health care, quality becomes even more evident as a critical factor for improved health outcomes (Kruk et al., 2017). High-quality care should be the core of the health system (Busse et al., 2019). A recent review of the evidence highlighted several approaches, which sought to improve the quality of maternal and childcare services. Among them were health promotion activities, health facility renovations and improvements, health provider training, incentives for service users, provision of outreach services, development of maternal and newborn health action plans, reviews of national clinical policies and standards, and the formation of Public-Private Partnerships at regional and national levels. These approaches targeted the patient, health care provider, organizational, and the broader health system levels (Wilson et al., 2020). Based on past frameworks like Donabedian's, authors proposed a new conceptual framework for high-quality health systems (Kruk et al., 2018). The framework focused on three key domains: foundations, processes of care, and quality impacts. Quality impacts include better health, confidence in system, and economic impact. The process of care includes competent care and positive user experience, which are complementary elements necessary for achieving high-quality care. Foundations refer to the facilities and people required for care and include population, governance, platforms, workforce, and tools. The authors argued that processes and outcomes provide a better measure of quality of health systems than structures. With regard to improvement strategies, governing for quality, redesigning service delivery, transforming the health workforce and raising demand for quality are key elements to achieve the highest quality of care.

The WHO established a framework that outlines the core components of quality services for the mother and the infant as one of the initiatives aimed at enhancing the quality of maternal and neonatal care. The framework identifies two key dimensions of quality: 'provision of care'—including evidence-based practices, efficient information and referral systems and 'experience of care'—including effective communication, respect, dignity, and emotional support. The cross-cutting areas of the framework include the availability of competent, motivated human resources and of the physical resources, identified are prerequisites for good quality of care in health facilities (Tunçalp et al., 2015). In 2016, based on this framework, a list of WHO 'Standards for improving maternal and newborn care in health facilities' was released (WHO, 2016a).

Among the other approaches for promoting the uptake of quality care, interventions have been designed to support health financing on the demand and supply sides. One example is the performance-based financing programme on maternal and child health services (James et al., 2020). Evidence showed a favourable impact of Results Based Financing (RBF) on structural, process, and outcome quality indicators in low- and middle-income countries (Andrew, 2020, Friedman et al., 2016, Zeng et al., 2018b, Zeng et al., 2018a, Tawfiq et al., 2019, De Brouwere et al., 2010). Malawi introduced the RBF to enhance obstetric care provision at emergency obstetric care facilities. This health system reform improved EC of maternal and neonatal health by improving quality and allowing a large group of women to receive more effective care (Brenner et al., 2018). Securing equitable access to quality health services is a key to realize the benefits of quality health care. Countries like Mexico implemented important maternal health-care policies such as *Prospera* (formerly *Progresa or Oportunidades*) and *Seguro Popular de Salud.* These policies aimed to improve the provision and quality of basic social services, including reproductive health, ultimately contributing to reducing gaps in EC. Positive synergies between these two

policies in transforming public health efforts into greater EC and better MCH outcomes has been assessed. These successful initiatives specifically targeted the economically and socially disadvantaged population (Serván-Mori et al., 2019).

Although there is a substantial body of research on the EC of MCH services, the literature is varied and scattered. This is the first systematic review to examine the EC of MCH services, the gaps between CC and EC, quality measuring methodologies, and the distribution of EC across wealth quintiles. Our research adds to the current literature by demonstrating the disparity between crude and EC and the reliability of EC in determining actual service coverage while taking quality into account. Our review also revealed how rigorous and extensive analyses of quality indicators, including the specific components of quality domains, can lead to significant differences between CC and EC. Moreover, this study has pointed out inequalities in the EC of MCH services, favouring wealthy groups. No studies were located in high-income countries, which might be because access to quality MCH services is well established in high-income countries making it a less area of concern.

6.7 Conclusion

MCH services need to ensure a combined focus on both accessibility of services and the provision of high-quality care for better outcomes. The results of the review underscore the importance of looking beyond raw coverage measures or health care utilization indicators. Comparing crude and quality-adjusted coverage of MCH interventions portrayed the existing gap between these estimates. In addition, the findings demonstrate that the effectiveness of MCH interventions is low. Ineffective care indicates missed opportunities to achieve better outcomes and such findings underpin the importance of prioritizing quality of care alongside efforts to improve MCH problems. The results also

suggest that better measurement, as well as greater consensus on the metrics of quality of services will be needed to ensure appropriate monitoring and evaluation of health system performance. Hence, EC estimates adjusted with appropriate quality measures provide a powerful mechanism for revealing gaps in the delivery of effective care. This, in turn, contributes to the efforts to overcome the burden of maternal and newborn death. Also highlighted by our results, EC remains disproportionately lower among low-income groups. This necessitates the call for evidence-based approaches to reduce inequalities in MCH service provision and quality. Generally, as the global community turns its attention toward UHC, it will be crucial to improve quality, close the gap between CC and EC, use standard quality measurement strategies, and ensure equitable distribution across all levels of care.

6.8 Chapter summary

The chapter provided insights into the evaluations of the effective coverage of MCH interventions and quality measurement strategies. It also presented the summary of findings on the inequality in effective coverage of MCH services. This comprehensive summary of evidence highlighted the importance of incorporating quality into coverage and inequality measures. The next chapter explores the effective coverage of newborn postnatal care, its inequality and spatial distribution in Ethiopia.

CHAPTER SEVEN

EFFECTIVE COVERAGE OF NEWBORN POSTNATAL CARE IN ETHIOPIA

(STUDY IV)

Chapter 7 Effective coverage of newborn postnatal care: measuring inequality and spatial distribution of quality-adjusted coverage

7.1 Overview of study four

Postnatal period is a critical phase in determining the health and survival of newborns. The persistence of preventable newborn deaths emphasises the significance of quality of care as a critical component of coverage interventions, which is not reflected in crude coverage measures. In this chapter, the findings on effective coverage of newborn postnatal care, its inequality and spatial distribution in Ethiopia are presented in detail.

7.2 Abstract

Neonatal health remains among the greatest global public health concerns. The first two days of life are critical for newborn survival. Most of the studies conducted on newborn postnatal care focused on crude coverage measures. This study aimed to assess the quality-adjusted coverage of newborn postnatal care in Ethiopia using a nationally representative survey. The inequalities in and the spatial distribution of quality-adjusted coverage of newborn postnatal care were also assessed. A total weighted sample of 4169 women were included in the study. Crude coverage and effective coverage of newborn postnatal care were computed. Quality of care was measured based on the content of care that newborns received during their contact with health care providers. Concentration index and concentration curves were used to estimate the socioeconomic-related inequalities in quality-adjusted newborn postnatal care. The spatial statistic was analysed by using Arc-GIS. The crude coverage of newborn postnatal care was found to be 13.2%, while the effective coverage was 9%. High-quality postnatal care was disproportionately concentrated among the rich. A spatial variation was found in quality-adjusted coverage

of newborn postnatal care at regional levels. Systematic increases in the quality of care delivered are necessary to progress universal health coverage. Targeted interventions for regions with low effective coverage of postnatal care are also needed.

7.3 Introduction

In the global health system, neonatal health is a critical issue illustrating progress and challenges on both the national and global levels. Reducing neonatal mortality is a critical component of the third sustainable development goal to end preventable deaths in children (Chou et al., 2015). Despite substantial progress, an estimated 2.4 million neonates died in 2020 (WHO, 2022b). Neonatal deaths constitute an increasing share of global under-five deaths, indicating a generalised need to strengthen neonatal programs (GBD 2019 Under-5 Mortality Collaborators, 2021). Most neonatal deaths occur in the first two days of life-from conditions and diseases associated with lack of quality care- which makes the postnatal period critical to improving child survival. Interventions targeted at the first week of life are likely to have the greatest impact on neonatal survival. It is essential that newborns receive high-quality postnatal care (WHO, 2014).

Crude coverage measures, often used in MCH studies, are the tip of the iceberg as they focus only on contact between women or children and health care providers. They provide no indication of the extent of adherence to care standards, the way services are provided, and the quality of care delivered. In contrast, effective coverage combines utilisation of health services with the quality of care received, providing a proxy measure of potential health gains from using the services (Ng et al., 2014). Although assessing quality is the most challenging aspect of estimating effective coverage, integrating content of care into crude coverage measures has been proposed as one approach to determining quality-adjusted coverage (Ferede Gebremedhin et al., 2022). While data collected through DHS do not contain the full recommended list of services or important clinical actions, they provide an indication of care provided at service delivery sites (content of care), at a basic level, as a proxy for quality of care. Hence, DHS data provide information that can assist

in the assessment of whether the minimum expected services are received by women or children (Moran et al., 2013).

Most of the studies conducted in Ethiopia concerning newborn postnatal care focused on crude coverage (Chaka et al., 2019a, Ayele et al., 2019, Woldegiorgis et al., 2017, Tiruneh et al., 2020). Peven et al., 2021 assessed the gap between postnatal contact coverage and content coverage using survey data from low and lower-middle-income countries (Peven et al., 2021). Furthermore, Marchant et al. 2015 estimated the coverage of high-quality contacts in three study sites including Ethiopia (Marchant et al., 2015). However, the populations sampled in this study represented only a program of work at baseline. None of the above-mentioned studies examined the inequality and spatial distribution of quality-adjusted newborn postnatal care in Ethiopia. In this study, we assessed the crude and quality-adjusted coverages of newborn postnatal care in Ethiopia using a nationally representative survey. We then examined the inequalities in and the spatial distribution of quality-adjusted coverage of newborn postnatal care.

7.4 Methods

This study was based on the Ethiopian Demographic and Health surveys (EDHS) 2016 data. It is the fourth nationally representative survey publicly available via Measure DHS. The EDHS survey used a two-stage stratified sampling technique to select households. Data on demographic characteristics and population health service use were collected. A total of 15,683 women were interviewed in the 2016 EDHS survey (CSA [Ethiopia] and ICF, 2016).

Study population

All reproductive-aged women (15-49) who had a birth in the two years preceding the survey were the study populations. One hundred thirty-one (131) missing values were

excluded from the final analysis. A total weighted sample of 4169 women were included in the study.

Study variables

Crude (contact) coverage was defined as the proportion of newborns born alive in the previous two years whose mothers reported that they had a post-natal check within 48 hours of birth. Quality of care was measured based on the content of care that newborns received during their contact with health care providers. We selected 11 newborn intervention items: a woman reported her baby receiving the following services: BCG vaccination, the first polio vaccine, not given prelacteal feed, early initiation of breastfeeding, temperature measured, counselling on danger signs, cord examined, counselling on breastfeeding, observation of breastfeeding, newborn weighted, and skin to skin contact. The response to each question/item was coded as '1' if a particular service was received and as '0' otherwise. An index of newborn postnatal care quality was created by adding all "yes" responses for each woman. Based on previous evidence (Fisseha et al., 2019), we classified the quality of care as "high quality" if the women scored above 5 of the 11 interventions corresponding to the 75th percentile. To ascertain the internal consistency and validity of the 11 items in relation to the quality construct, Cronbach's reliability coefficient was computed. We found that Cronbach's α reliability coefficient was 0.77 for the full set of coverage indicators. The outcome variable of this study was quality-adjusted newborn postnatal care coverage (effective coverage). It was defined as the percent of newborns who had a postnatal check within 48 hours of birth and for whom all six or more contents of care were met (high-quality care).

Analytical approach

The cleaned and recoded data were analysed using STATA 14. Frequencies and percentages were used to summarise the characteristics of variables. Data were presented using tables and graphs. We calculated the proportions of crude coverage, receipt of high-quality care, and quality-adjusted coverage of newborn postnatal care. We used the concentration index to estimate the socioeconomic-related inequalities in quality-adjusted newborn postnatal care. Concentration curves were used to display the degree of inequality by plotting the cumulative percentage of quality-adjusted coverage on the Y-axis against the cumulative percentage of the population ranked by household socioeconomic status (starting from the poorest and ending with the richest) on the X-axis (Wagstaff et al., 2007). If the health outcome is perfectly equally distributed across the population, the concentration curve will be a 45-degree (diagonal) line, known as the line of equality. A curve that is farther from the line of equality indicates a greater degree of health inequality. A concentration curve that falls below the line of inequality indicates that quality-adjusted coverage is high among the rich (pro-rich); a curve that falls above the line of inequality indicates that coverage is high among the poor (pro-poor). The concentration index, which ranges from -1 to +1, is twice the area between the concentration curve and the line of inequality.The concentration index value will be negative when the outcome is disproportionately concentrated among the poorest quintiles. In contrast, the concentration index will be positive when the outcome is more concentrated in wealthier quintiles. If there is no socioeconomic inequality, the concentration index will be zero (Wagstaff et al., 2007).

The spatial statistic was analysed by Arc-GIS version 10.3 software. We used the Getis-Ord Gi* statistic to identify hot-spots and cold-spots of effective coverage of newborn postnatal care. This method calculates the z-scores of local clustering of high and low values and identifies areas that are significantly different from their surrounding areas at

a 95% confidence level. The threshold for statistical significance was set at a p-value of less than 0.05, and only areas with a statistically significant z-score were considered as hot-spots or cold-spots.

7.5 Results

Sociodemographic characteristics

The study included a total weighted sample of 4169 women. Nearly half 2127 (51%) of the respondents were 25-34 years old. The majority of the respondents (96%) were married or living with their partners. Three thousand six hundred and seventy-four (88%) of the women were rural residents. Furthermore, 60% and 58% of the women had no formal education and were jobless, respectively. The highest number of participants 1841(44%) were from Oromia region (**Table 13**).

Table 13. Background characteristics of the study population, Ethiopia Demographic and Health Survey 2016

Variable		*n=4169* (Weighted)	Percentage
Women's age			
	15-24	1,219.1	29.2
	25-34	2,126.6	51.0
	35-49	823.1	19.7
Marital status			
	Not married /not in union	187.1	4.5
	Married/living with partner	3,981.8	95.5
Residence			
	Urban	494.7	11.9
	Rural	3,674.2	88.1
Region			
	Tigray	306.9	7.4
	Afar	41.0	1.0
	Amhara	768.9	18.4
	Oromia	1,840.9	44.2
	Somali	170.2	4.1
	Benishangul	44.1	1.1
	SNNPR	852.4	20.5
	Gambela	9.7	0.2
	Harari	9.9	0.2
	Addis Ababa	107.3	2.6
	Dire Dawa	17.6	0.4
Mother's education			
	No education	2,514.5	60.3
	Primary	1,284.2	30.8
	Secondary and higher	370.1	8.9
Mother's occupation			
	Not working	2,426.8	58.2
	Professional work	671.6	16.1
	Non-professional work	1,070.5	25.7
Wealth index			
	Poorest	971.8	23.3
	Poorer	927.0	22.2
	Middle	861.1	20.7
	Richer	766.4	18.4
	Richest	642.6	15.4

Crude and effective coverage of newborn postnatal care

The crude coverage of newborn postnatal care as explained by the proportion of women whose newborns received a postnatal check within two days of birth was 13.2%.

Figure 20 shows the contents of newborn PNC. Among the women who gave birth in the two years preceding the survey, the proportion of women receiving specific interventions

during newborn PNC was 60%, 24%, 28%, and 18% for BCG vaccination, polio vaccination, skin-to-skin contact with the mother, and weight measurement, respectively. Three-fourths of the women (76%) initiated breastfeeding within one hour of birth. More than 90% of the newborns were not given prelacteal feeds. The proportion of women who reported that their newborn's cord was examined, temperature was measured, and breastfeeding was observed was 10%, 14%, and 30% respectively. About twelve percent of the women reported receiving counselling on danger signs, while 26% reported counseling on breastfeeding.

Overall, 22% of the newborns received six or more interventions. Three hundred seventy-seven (9.1%) of the newborns were judged to have received high-quality postnatal care, defined as a postnatal check for newborns within two days of birth and having received at least six postnatal care interventions.

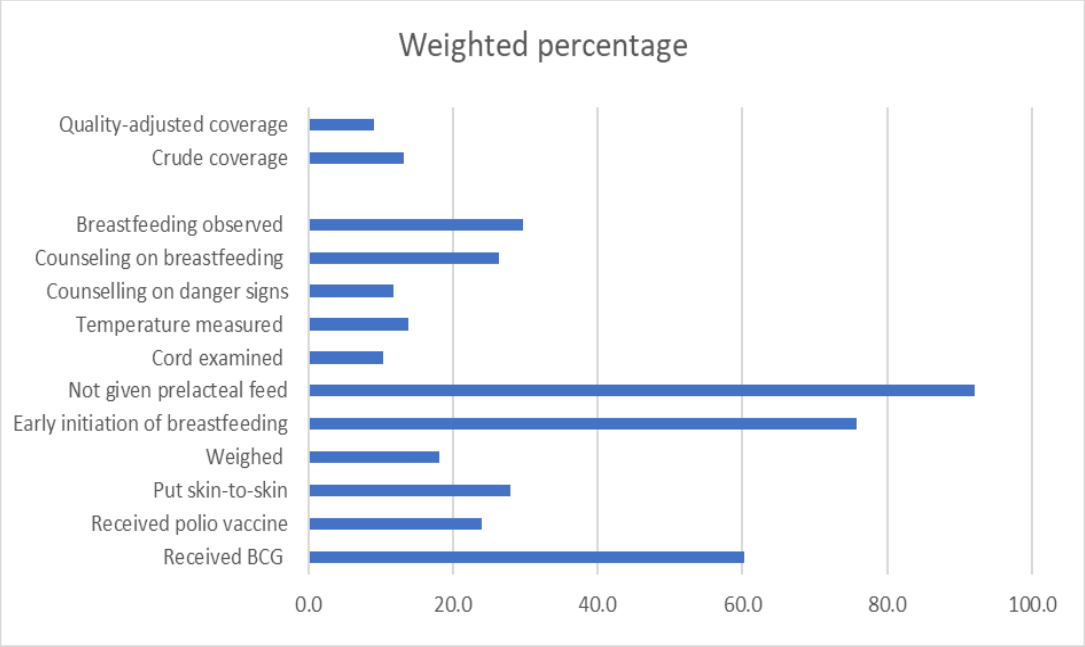


Figure 16. Contents, crude coverage and quality-adjusted coverage of newborn postnatal care, Ethiopia Demographic Health Surveys 2016

Socio-economic inequality in quality-adjusted newborn postnatal care

Figure 21 indicates that quality-adjusted postnatal care for newborns (high-quality postnatal contact) was disproportionately concentrated among the rich (pro-rich) as the concentration curve lies below the line of equality. The result of the concentration index also showed a pro-rich distribution (concentration index= 0.439, standard error= 0.0458).

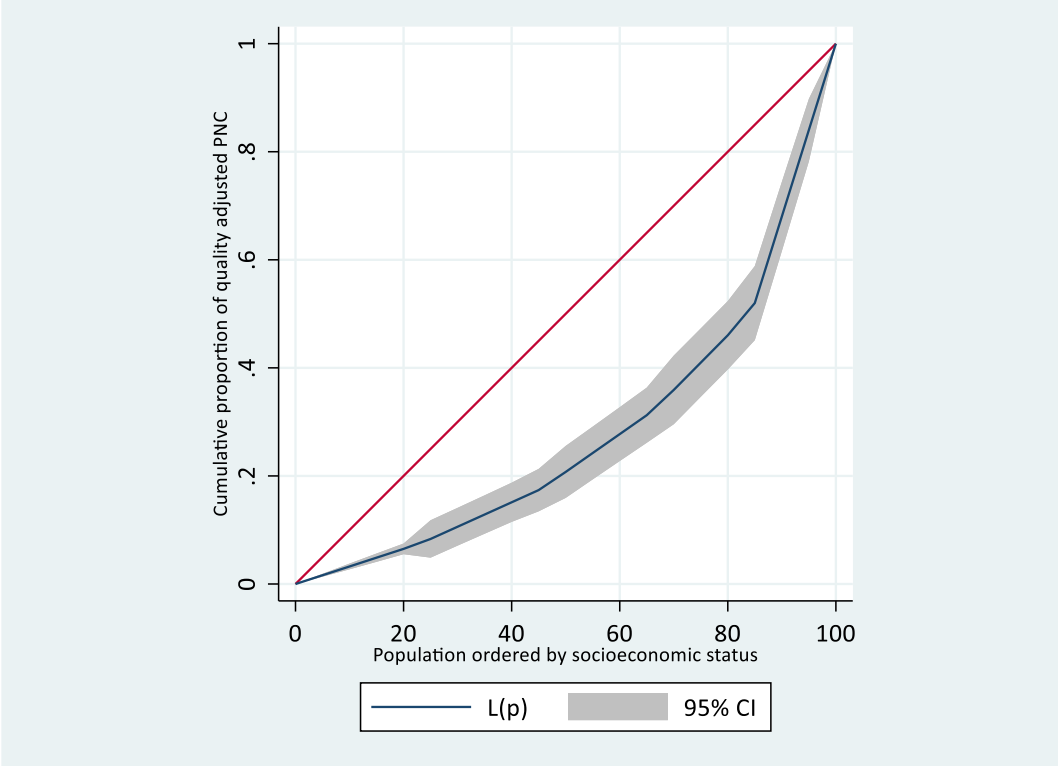


Figure 17. Concentration curve of quality-adjusted newborn postnatal care, Ethiopia Demographic Health Surveys 2016

Spatial distribution of quality-adjusted coverage of newborn postnatal care

Figure 22 showed that spatial variation was found in quality-adjusted coverage of newborn postnatal care at regional levels. A total of 622 clusters were considered for the spatial analysis of quality-adjusted coverage of newborn postnatal care. Each point on the map represents one enumeration area with the proportion of quality-adjusted coverage of newborn postnatal care in each cluster. The red colours indicate significant hot spot areas (areas with high-quality newborn postnatal care), which were detected in Tigray, Addis Ababa, central parts of Oromia, SNNPR (northern parts), Dire Dawa, and Harari regions.

In contrast, the blue colours indicate significant cold spot areas which were detected in central and southern parts of Amhara, central and southwestern Afar, eastern parts of Benishangul Gumuz, western parts of Gambela, northern parts of SNNPR, and western parts of Oromia.

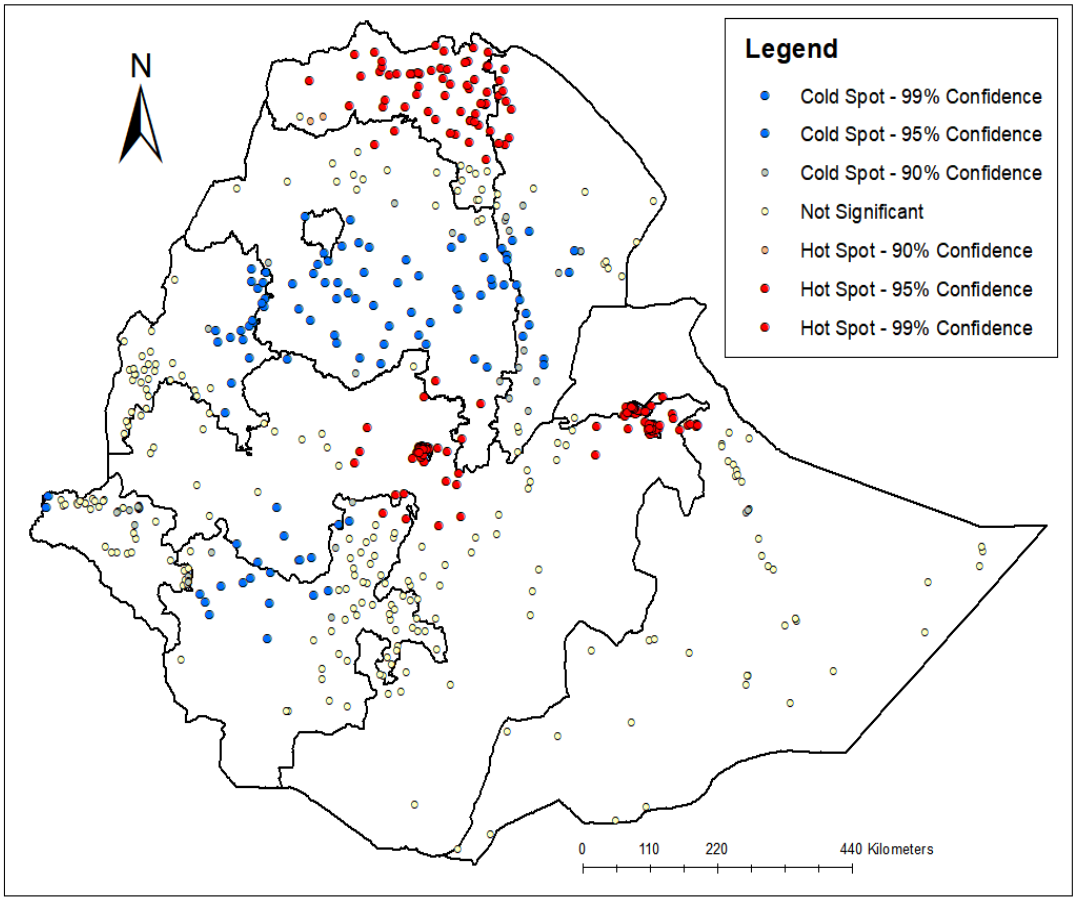


Figure 18. Hot spot analysis of quality-adjusted coverage of newborn postnatal care, Ethiopia Demographic and Health Survey, 2016

7.6 Discussion

We found that the coverage of newborn postnatal care was low in Ethiopia. In addition, high-quality contact for newborns was lower than the crude coverage estimate. We also found that socioeconomic inequalities exist in the quality-adjusted coverage of newborn postnatal care in favour the rich (pro-rich). Furthermore, this study provided a visually

powerful analysis of the spatial variation in quality-adjusted coverage of newborn postnatal care in Ethiopia.

Evidence shows measuring contact with a health service alone is not sufficient to assess the true population receipt of health services. Crude coverage indicators-often used in coverage metrics- may overestimate the health gains of interventions as they do not reflect the quality of the care delivered. As a result, adjusting crude coverage measures for quality of care has become a key area of interest in coverage metrics (Shengelia et al., 2005). We applied the concept of effective coverage metrics by incorporating contents of care (quality dimension) into the coverage estimate of newborn postnatal care. Our findings highlight that quality lagged coverage and there was a quality-coverage gap for newborn postnatal care. This gap indicates that along with the contact coverage of newborn postnatal care, there is a need to focus on the quality of care being delivered. Low quality of care undermines the effective delivery of essential health services (Akachi and Kruk, 2017). Our finding was consistent with other studies that noted a decline in the coverage of maternal and child health interventions on adding quality of care to their metrics (Hodgins and D'Agostino, 2014, Leslie et al., 2017). This means that women/children who sought care in health care facilities did not necessarily receive the standard quality of care they needed.

The quality-adjusted coverage estimate of the present study was higher than the coverage reported in the study by Marchant et al. 2015 (Marchant et al., 2015). This might be due to the difference in the study setting and sample selection. The study by Marchant et al., 2015 considered four regions of Ethiopia, Gombe state (Nigeria), and a state in India, and the study participants represented a program of work in each setting at baseline (Marchant et al., 2015). Similarly, our quality-adjusted coverage estimate is higher than the figure

reported in the Côte d'Ivoire study (Munos et al., 2018). The disparity could be attributed to the difference in methods used such as quality measurement. Munos et al. linked health provider assessment and care-seeking data and used process and structure dimensions to measure the quality of newborn care (Munos et al., 2018). Recent studies focus on effective coverage evaluation that depends on linking data on need and service utilization from population-based surveys, with data on service quality from health facility surveys such as the service provision assessment. In such cases, either the summary of the facility's capacity to provide high-quality care is linked with individual data, or individuals are linked to their reported source of care. Such methods overlook variation in the quality of care both within and between health facilities (Exley and Marchant, 2022).

In contrast, our estimate is lower than Mexico's study, which revealed a quality-adjusted coverage estimate of 74% (Leslie et al., 2019). The variation in the estimates might be attributable to differences in how crude coverage and quality were defined and measured. The Mexican study defined newborn care as the proportion of live newborns who were delivered in Mexican Institute of Social Security facilities in relation to live births in the previous year. This study used the proportion of live births reaching 28 days without death due to respiratory infection, nosocomial infection, or sepsis as a quality indicator that corresponds to an outcome dimension of quality (Leslie et al., 2019). Across maternal and child health studies, the approaches and strategies used to evaluate the quality component of effective coverage are different. The quality dimensions considered, or the selection of indicators determine the effective coverage estimate. Evidence suggests that quality of care measures are multidimensional and complex, requiring a comprehensive and holistic approach to capture the diverse aspects of healthcare quality (Ferede Gebremedhin et al., 2022).

The estimated concentration index and concentration curve suggest considerable socioeconomic inequality in the quality-adjusted coverage of newborn postnatal care and indicate that the use of high-quality newborn postnatal care was relatively higher among households with high socioeconomic status. This is in line with previous survey-based evidence from low and middle-income countries (Anindya et al., 2021). Inequalities in MCH coverage indicators favouring the rich are common. Often, women with high socioeconomic status have better access to quality care and can afford the medical, non-medical, and opportunity costs of newborn care. Such women are also considered to be more empowered and autonomous than their poorer counterparts (Daka et al., 2020, Bobo et al., 2017). Assessing socioeconomic inequality using contact coverage measures may not reveal disparity adequately. Evidence shows widening inequalities in the quality of MCH care may lead to widening socioeconomic inequalities in effective coverage. Hence, improving quality may contribute to attaining equitable high-quality health care (Hategeka et al., 2020).

According to the spatial statistics, hot spot areas of high-quality newborn postnatal care were detected in Tigray, Addis Ababa, central parts of Oromia, SNNPR (northern parts), Dire Dawa, and Harari. Most of these regions are relatively urban, where access to healthcare facilities and awareness of MCH services among women are improved. Evidence from spatial and multivariable analyses revealed that these regions had high postnatal care coverage (Sisay et al., 2019, Kebede et al., 2022). Our study also portrayed cold-spot areas which were clustered in Amhara, central and southwestern Afar, eastern parts of Benishangul Gumuz, western parts of Gambela, northern parts of SNNPR, and western parts of Oromia. The presence of such spatial variation in coverage might be due to the geographical variation that exists in the country. Variations in the distribution of health facilities, healthcare workers, and infrastructures in different regions as well as the

socio-cultural and socioeconomic differences between women in different regions may contribute to the variability in coverage distribution. Furthermore, cold-spot clusters exhibited in the remote or border areas of Ethiopia suggest that women from such areas might have limited access to MCH and other public services. Overall, the findings indicate that the distribution of effective coverage of newborn postnatal care is influenced by geographic and demographic factors, and interventions may need to be tailored to address these differences.

There is limited research on effective coverage of newborn postnatal care (Ferede Gebremedhin et al., 2022). Our study is the first, to our knowledge, to examine the spatial distribution of effective coverage of newborn postnatal care in Ethiopia using spatial analysis to identify hotspots and cold spots of high-quality care. This is a significant contribution to the literature, as it provides policymakers and healthcare providers with important information about where to target their resources and efforts to improve newborn postnatal care. In addition, our study employed a concentration curve to examine the inequality in the effective coverage of newborn postnatal care. This approach provides a clear visual representation of the distribution of coverage across different income or social groups, which can help identify whether coverage is concentrated among the poorest or richest sections of the population. The results presented align with SDG 17.18, which advocates disaggregating health indicators by dimensions of inequality (United Nations, 2016).

This study has some limitations. The DHS is based on self-reporting, and recall bias could affect the reported measures of the different services received by women and children. Additionally, due to limited information collected by the DHS, our measurement of the quality of care did not adjust for facility readiness and service provision and did not consider the multiple domains of quality of care that may further reduce the effective

coverage estimate. Thus, the quality coverage estimates only reflect the minimum conditions required for judging the quality of care and may lead to overestimation. It is also important to acknowledge that the categorisation of care quality based on a threshold has its limitations, as it is a relative measure within the specific context of our study. The threshold we applied, although derived from a previous study (Fisseha et al., 2019), does not reflect a universally accepted standard for high-quality care. A study conducted by Paven et al. provided insights into the inherent complexity and significant challenges involved in assessing the quality of newborn postnatal care, particularly when utilising household surveys and our study is not an exception (Peven et al., 2021).

7.7 Conclusions

This study shows that the effective coverage of newborn postnatal care in Ethiopia was low, and there was a quality-coverage gap. The study also revealed that high-quality newborn postnatal care is disproportionately concentrated among the rich. Hot spot areas of high-quality newborn postnatal care were detected in Tigray, Addis Ababa, central parts of Oromia, SNNPR, Dire Dawa, and Harari, while the cold spot areas were detected in Amhara, central and southwestern Afar, eastern parts of Benishangul Gumuz, western parts of Gambela, northern parts of SNNPR, and western parts of Oromia. The findings underscore the need for focused efforts and programs to improve the quality and coverage of newborn postnatal care. It is imperative for the government to prioritise regions with low effective coverage of newborn postnatal care and implement tailored interventions to boost coverage and quality in those areas.

7.8 Chapter summary

This chapter discussed newborn PNC coverage in Ethiopia. The crude and quality-adjusted coverages of newborn PNC were low. Further, inequality that favoured the

wealthiest and spatial variation across the regions in Ethiopia in the effective coverage of newborn PNC were demonstrated. The next chapter discusses the overall study findings and their implications.

.

CHAPTER EIGHT

DISCUSSION

Chapter 8 : Discussion

8.1 Overview

The overall objective of my research was to examine the coverage and disparities in MCH along the continuum of care in Ethiopia. Three secondary-analysis-based studies and a systematic review were included in this research. The first study, outlined in chapter four, described the determinants of the continuum of care for MCH services in Ethiopia. The Second study in chapter five examined the inequalities in MCH coverage along the continuum of care and the factors contributing to the inequality. The third study in chapter six presented a systematic review of studies on the evaluations of effective coverage of maternal and child health services. Finally, in chapter seven, the fourth study assessed the effective coverage of newborn PNC along with the inequality in and spatial distribution of high-quality PNC.

In this discussion chapter, I bring together the key findings from these four pieces of research (chapters 4-7) and relate the findings with the existing literature. I then outline the public health implications and recommendations for policy and practice, as well as future research priorities. Finally, I describe the strengths and limitations of the studies and provide some concluding remarks.

8.2 Main findings

Coverage in the continuum of reproductive, maternal, newborn and child health services and determinants in Ethiopia

The Ethiopian government in collaboration with international development partners has been making efforts to improve access to and utilisation of MCH services through different initiatives (Berhanu et al., 2021). According to the EDHS reports, utilization of individual MCH services has improved substantially over time (CSA [Ethiopia] and ICF,

2016). However, high coverage of the individual MCH interventions does not tend to show that no one is left behind from receiving all the essential services. As maternal health has long established links with child health, the continuum of care approach is a recommended strategy to achieve better MCH outcomes (Kerber et al., 2007). Study one in chapter four revealed that the level of continuum of care for MCH was low in Ethiopia. Evidence showed that in LMIC, especially in sub-Saharan Africa, the completion of the continuum of care has been low consistently and MCH outcomes remained poor requiring improvements in the provision of the continuum of care (Singh et al., 2016).

The findings of my study also exhibited a low coverage of newborn PNC. For mothers and children, the largest burden of morbidity and mortality occurs within the postnatal period, especially in the immediate period after birth. As newborn health depends on strong links between MCH interventions, it is an indicator of a functional continuum of care (Narayanan, 2006). In many low and middle-income countries, PNC ranks among the lowest coverage of interventions on the continuum of MCH care. This has been partly attributable to the perceived low value of postnatal care for healthy women and newborns, family pressure to leave after a normal delivery, shortage of health workers and resources, concerns around access and quality of care as well as increased prevalence of home deliveries (Pinheiro et al., 2021).

It is important to generate updated information on the determinants of the continuum of care to design effective strategies to increase it. The analyses detailed in chapter four demonstrates the effects of socioeconomic, individual and obstetrics-related factors in each composite coverage index quintile to determine the relationship between each variable and the continuum of care.

At the individual level, factors such as primary and secondary education levels, residence in Tigray and Benshangul Gumuz regions, being employed, and perceived distance to a facility were identified to positively influence the continuum of care at different quantiles of the composite coverage index. In contrast, region of residence (Afar, Somali, Oromia, Gambela, SNNPR), poorest wealth status, and rural residence were associated with lower continuum of care achievement. This association between individual level variables and the continuum of care for MCH has been consistently demonstrated in previous studies (Iqbal et al., 2017, Sserwanja et al., 2022b).

The educational level of women is an essential social determinant of health that positively impacts health service utilization. Education levels have a synergistic effect on the improvement of a woman's status within households and communities. Maternal education promotes better literacy and better health-seeking behaviour. Education empowers women to make decisions regarding their health (Khatri and Karkee, 2018). According to a study carried out in sub-Saharan Africa and Asia, women with autonomy were more able to make decisions concerning their healthcare and therefore were more likely to have a higher coverage across the continuum compared with women with less autonomy (Singh et al., 2016).

As discussed in chapter four, another social determinant of health associated with the continuum of care for MCH care is socioeconomic status. Previous studies have reported that the lower economic status of women was significantly associated with a lower level of continuum of care for MCH services (Alamneh et al., 2022, Chham et al., 2021). Women with low socioeconomic status are often the least connected to health services due to low health literacy and poor perceptions of health services resulting from unsatisfactory care experiences. While some studies suggest higher satisfaction with care among individuals lower in socioeconomic status, potentially due to lower expectations (Roder-DeWan et al.,

2019), other research has identified socioeconomic disparities in the utilisation and experiences of MCH care services, with women from low socioeconomic backgrounds perceiving lower quality of care (Dahab and Sakellariou, 2020a). Furthermore, women with low socioeconomic status frequently experience financial burdens associated with care, having to pay for expenses even when services are provided free of charge. Although healthcare services themselves may be offered free of direct charges, women frequently encounter various indirect costs when seeking care. These include transportation costs to reach healthcare facilities, the need to purchase medications and supplies not readily available at the facilities, and the responsibility of covering accommodation and meal expenses during extended hospital stays. These indirect costs impose a significant financial strain, hindering access to essential healthcare for disadvantaged women (Jebena et al., 2022, Dahab and Sakellariou, 2020b, Tibebe et al., 2012).

It is estimated that about 80% of women in Ethiopia reside in rural areas, most of whom have low socioeconomic status. I have found that rural residence was negatively associated with the continuum of MCH care. Previous studies in low and middle-income countries revealed that the level of maternal service uptake along the continuum was low in rural women compared to urban women (Mohan et al., 2017, Alem et al., 2022). Rural communities experience poor access to MCH services as a result of long travelling distances and poor transportation systems. Such communities also face challenges due to the lack of essential equipment and supplies, and a health worker shortage, uneven staff distribution, a poor skill mix, and high staff turnover in facilities. Thus, the quality of care in such areas is compromised which hinders women from completing the continuum of care (Jackson et al., 2017).

Previous studies conducted in LMICs have emphasised the effects of obstetric-related factors such as early initiation of ANC and unintended pregnancy on the continuity of

MCH care, reporting findings consistent with my study (Addisu et al., 2022). Early initiation of ANC allows mothers to gather important information about the type and timing of maternal health services, as well as become acquainted with the health facility environment. In addition, it is an excellent opportunity to discuss essential newborn and child health services with women. Overall, it is an important gateway to enabling women to receive comprehensive reproductive health services (Dewau et al., 2021).

Given the higher prevalence of unintended pregnancy in LMICs, evidence shows that women experiencing unintended pregnancy are at particular risk of not receiving a continuum of MCH care (Khan et al., 2020, Alem et al., 2022). Women with unintended pregnancies are more likely to be from low socioeconomic backgrounds, lack formal education, and exercise less autonomy. As a result, they find accessing the recommended MCH services challenging due to financial constraints or poor literacy. Moreover, these women are more likely to be affected by sociocultural customs and less favourable behaviour from their partners. Thus, this impacts health service utilization in general and among women who experience unintended pregnancy in particular (Khan et al., 2019).

Quality-coverage gap in newborn postnatal care in Ethiopia

Chapter six presents a systematic review of the effective coverage of maternal, neonatal and child health services from twenty-seven studies conducted in LMICs, including Ethiopia. This review assessed the crude coverage and effective coverage of MCH interventions, the gap between the two, and quality measurement strategies. The findings showed that effective coverage values were lower than crude coverage values, and there was a quality-coverage gap. Most studies reported lower effective coverage estimates. Further, the review found that the quality component of the effective coverage was measured using structure, process and outcome domains, out of which process measures

were used predominantly. While all domains of quality of care can be assessed objectively, process measures are often considered more objective because they focus on specific actions taken by healthcare providers. These measures can be assessed through methods such as observation or medical record review, which are generally considered more objective than patient self-reporting or other subjective methods (Lilford et al., 2007).

The review found limited evidence on the effective coverage of newborn postnatal care. Moreover, chapter five shows PNC for newborns had the lowest coverage in Ethiopia. Study four in chapter seven assessed the effective coverage of newborn postnatal care by using the most recent EDHS data. The study found that the effective coverage value was lower when the crude coverage estimate was adjusted to account for the quality of care. While the proportion of women whose newborns received a postnatal check within two days of birth was 13.2%, 9.1% of the newborns were found to have received high-quality postnatal care. Based on the quality measurement strategies outlined in study three, study four employed the process of care domain to measure the quality of newborn postnatal care. A study conducted in LMICs reported substantial gaps between crude and quality-adjusted coverages in PNC and other MCH interventions. These gaps reveal the missing opportunities in delivering health gains to the population due to the low quality of care (Anindya et al., 2021).

The socioeconomic and geographic disparity in maternal, newborn, and child health coverage

The SDGs and targets focus on reductions in health inequalities and call for efforts that prioritise marginalised groups. The agenda also entails addressing social determinants that contribute to inequalities in health such as gender equality, poverty elimination and education for all (Rasanathan and Diaz, 2016). In study two (chapter five), I examined

inequalities in a comprehensive set of interventions along the continuum of MCH care in Ethiopia. The focus was on inequalities by socio-economic measure as it predominantly accounts for differentials in the uptake of MCH services. Despite the overall increase in the coverage of MCH along the continuum over the years 2000-2016, significant improvements are still to be made. According to the findings, there exist wealth-related inequalities in coverage that seemed to have increased over time, with the highest in 2011 and the least in 2000. The inequality analyses showed that these inequalities were pro-rich implying the wealthiest segments of the population had a higher coverage of MCH compared to their poor counterparts. Along with this, top inequality patterns were shown. Furthermore, the study found that wealth status was the major contributor to the inequalities in coverage along the continuum of care, explaining 52%, 39%, 57%, and 48% of the inequalities in 2000, 2005, 2011, and 2016 respectively.

The result that composite coverage indices were pro-rich in all survey years is unsurprising as it speaks mainly to better accessibility of MCH services in the better off. Previous studies have found that the utilisation of MCH services is more concentrated among richer individuals and disadvantaged populations are less likely to have accessible health services (Ambel et al., 2017, Wuneh et al., 2019). The reason could be that the wealthiest people have more ability to afford the costs associated with healthcare access, which is a common healthcare barrier in low- and middle-income countries.

Analyses found that inequality patterns varied markedly with national coverage levels. Countries with a low national coverage of MCH interventions presented a top inequality pattern, that is, rich people had coverage levels well above the rest of the population. In contrast, a bottom inequality pattern was observed in countries with a high national coverage of interventions. The top inequality patterns in CCI in my research are consistent with previous studies that demonstrated coverage is markedly higher in the wealthiest

groups (Barros and Victora, 2013). In such cases, it is recommended that interventions should be disseminated widely across the population because coverage is low even in the richest groups. The decomposition analyses in study two demonstrated that economic status was the largest contributor to the inequalities in coverage index, while place of residence and mother's educational status also contributed to the inequalities. This finding suggests that these important determinants have the most influence on how inequalities in MCH coverage change. A systematic review of evidence from low-income countries, consistent with my research findings, showed that significant factors that explain socioeconomic inequalities in MCH services uptake are the social determinants of health (Adegbosin et al., 2019).

Most studies regarding disparities in MCH coverage (including study two in my thesis) have been about crude coverage measures. The estimates of socioeconomic inequalities using crude coverage measures may underestimate the level of inequalities or may not reveal disparity adequately. Hence, it is important to consider effective coverage measures. The systematic review (study three) assessed inequalities in the effective coverage of MCH interventions. It was found that in low and middle-income settings, the wealthiest quintile had higher effective coverage of services than the poorest quintile, showing an inequitable distribution of coverage. My research (study four) specifically examined the inequality in the effective coverage of newborn postnatal care in Ethiopia. The findings demonstrated that high-quality newborn postnatal care was disproportionately higher among the wealthiest groups. Study four further showed the geographical difference in the distribution of high-quality newborn postnatal care (effective coverage) in Ethiopia using spatial analysis. The hot spot areas (high-quality newborn postnatal care) were detected in the relatively urbanised regions characterised by improved access to healthcare facilities and awareness of MCH services among

women. In contrast, cold spot areas (low level of effective coverage of newborn postnatal care) were detected in regions characterised by limited access to MCH and other public health services and remote or border areas of Ethiopia. This finding is supported by an earlier study conducted in the country in which geographical variations have been observed in postnatal care coverage (Sisay et al., 2019).

Disparities in MCH care may be explained by demand factors, supply factors, or the nature of the service required and provided (Houweling et al., 2007). Compared to the wealthiest and urban residents, people from low socioeconomic status and remote areas tend to have less service uptake due to costs of access, lack of information/knowledge, perceived health gains and social and cultural barriers they face. For instance, some MCH services such as PNC may be viewed as a non-illness event where modern medicine has little to contribute (Thaddeus and Maine, 1994). On top of this, health care providers may not be aware of and sensitive to cultural beliefs and practices (Jaffre and Prual, 1994). Others argue that household power relations are closely linked to MCH service uptake. For example, women with decision-making power are more likely to access MCH services along the continuum of care. Whereas, in situations where family members - especially husbands or mother-in-law- play a significant role in the decision-making process, women may find it difficult to obtain the care they need (Byrne et al., 2013). The other reasons for inequality are that poor and rural households find it difficult to overcome barriers such as weak health systems. In such cases, uneven distribution and insufficient numbers of health workers, poorly functioning supply chains, and low-quality care remain a challenge. The absence of well-functioning referral and transportation services are also among the impediments (Singh, 2016).

8.3 Significance of the research findings

This thesis provides a national assessment of the determinants of the continuum of care from pregnancy to childhood and the maternal healthcare period in Ethiopia. The generated information is essential for successful program implementation to improve the continuum of care.

The research also set out to measure and explain inequalities in MCH coverage along the continuum of care and the factors that account for these inequalities. The findings provide empirical evidence for policy decisions to ensure equal access and utilization of MCH services and to improve the strategies to eliminate disparities.

Synthesising evidence on the effective coverage of MCH services, quality measurement strategies and disparities across wealth quantiles makes immense contributions to the body of literature, with important implications for policy and programs in LMICs. Specifically, understanding the level, inequalities, and spatial distribution of the effective coverage of newborn PNC in Ethiopia would help policymakers, programmers and partners in the health sector to formulate appropriate strategies and interventions that lead to a targeted and equitable high-quality PNC.

8.4 Recommendations and implications for program, policy, and research

I would like to highlight four main implications for policymakers from my findings. First, the coverage of MCH services along the continuum of care was low, indicating that women and children in Ethiopia are not receiving the maximum possible health benefit from existing MCH services and underscoring room for improvement. In addition, my study identified barriers and promoting factors involved in the continuum of care, suggesting the need for tailored interventions. Second, I found inequalities favouring the

least poor regarding MCH coverage along the continuum of care and economic status, place of residence and mother's education level contributed most to the inequalities. These demonstrate that efforts of the Ethiopian government to address inequity and policies in place are insufficient. Third, the low levels and inequalities of effective coverage of MCH services in LMICs, and in particular, newborn PNC in Ethiopia, imply that a combined focus on both accessibility of services and the provision of high-quality care, especially for the disadvantaged should be at the forefront of national policy and programming efforts. Finally, my key findings underscore the need to develop region-specific intervention programs and focus on the social determinants of health in Ethiopia.

Based on the findings of my study and their implications, some policy and program recommendations are suggested to improve the coverage of MCH services along the continuum of care, reduce socioeconomic and geographic disparities, and close the quality coverage gap. As gaps in one dimension impede possible improvements in health outcomes resulting from advancements and sufficient performance in other dimensions, it is crucial to address coverage and equity concurrently, while focusing particularly on quality improvement. The recommendations at different levels along with their success stories in LMICs are presented as follows.

Financial initiatives

Equitable access to maternal and child health services is a key principle at the heart of a strong health system due to its crucial role in improving maternal and child health outcomes (Talukder and Rob, 2010). Reducing social inequalities in health is a priority for health policy in many countries (Barreto, 2017). Health care inequality undermines all efforts to advance development and delays progress (Makate and Makate, 2017). Low and middle-income countries face major challenges achieving progress against maternal and

child health targets. Persistent inequalities remain a growing concern and uneven distribution in the use of MCH services favouring the wealthy in LMICs have been described (Arroyave et al., 2021). These countries must integrate measures to reduce disparities in health programs and services and adopt strategic measures to guarantee access to essential MCH services not based on socioeconomic position (Yaya and Ghose, 2019). Policy makers and health care planners also need to consider the health of disadvantaged groups who frequently have barriers to accessing services even when no fees are charged (Pieterse and Lodge, 2015).

Many interventions and policy measures have been implemented to reduce inequalities in maternal and child health (Yuan et al., 2014). The interventions can be characterised as either universal or targeted depending on the population they are intended to benefit. Universal approaches target the whole population. Even though they are described as promising approaches to tackling health inequalities, studies pointed out that they may widen inequalities between different social groups if their benefits are concentrated among the better-off (Thomsen et al., 2011). In contrast, targeted interventions are directed at specific groups, usually marginalised populations. In such cases, as the effects of interventions may vary between different subgroups, even within a disadvantaged group, it is important to examine the effects in different population strata (Målqvist et al., 2013).

Prior research provides evidence on the effects of supply and demand side interventions on reducing inequality in MCH. Supply-side interventions influence the health service actors, be they individual health personnel, health institutions or ministries of health and include interventions such as increasing the number, coverage, and training of health professionals (Rahman et al., 2017). Conversely, demand-side interventions- operating at the individual, household, or community level- target the demand for health care such as

reducing the cost of accessing healthcare and providing incentives for seeking care (Hurst et al., 2015). It has been argued that interventions on the supply and demand are likely to affect persons from different socioeconomic position differentially. A study in Senegal revealed that supply-side interventions can worsen service uptake inequity as the wealthiest who have lower demand-side constraints tend to benefit more than the poorest. Research has also shown that poorer households benefited more from the demand side interventions (Parmar and Banerjee, 2019).

On the demand side, cash transfers, vouchers, and short-term cash payments to offset costs are effective ways to increase the use of health services and promote equity (Målqvist et al., 2013). Such demand side mechanisms are designed to increase household income and encourage 'healthy behaviours' by providing beneficiaries cash or vouchers to help with some of the costs associated with travelling to or utilising healthcare services. Studies demonstrated that targeted incentive mechanisms successfully enabled the poorest and most marginalised women/children to access MCH services, but targeting was a major challenge (Bellows et al., 2011, Cruz et al., 2017, Jehan et al., 2012).

Other studies have shown that user fee reduction or removal is a widely practised equity-oriented strategy. Fee removal has been effective in benefiting the poorer segments of society in utilizing MCH services in low- and middle-income countries (Ridde et al., 2013). However, such intervention can have unintended negative consequences, such as increases in demand that strain existing healthcare systems and compromise the quality of care provided (Hatt et al., 2013). Alternative financial mechanisms such as social health insurance and community-based health insurance which are primarily based on pooling or prepayment mechanisms had been used to prevent catastrophic health expenditure, mainly among the underprivileged and the poorest. Evidence suggests that community

based health insurance schemes have the potential to be effective in improving poor peoples' access to and utilization of services (Spaan et al., 2012). However, significant contributions were demonstrated when the insurance scheme was used as a complementary mechanism linked with social funds or national health financing policy (Carrin et al., 2005). Studies revealed that the achievements of community-based health insurance are limited by enrolment challenges, difficulty in reaching the poorest of the population and challenges in financial and organisational sustainability (Fadlallah et al., 2018, Kigume and Maluka, 2021).

Taking healthcare to communities

Taking healthcare to communities through community participation and community-based interventions, is crucial for universal access to healthcare and for improving maternal and child health services, particularly for less privileged populations such as those who live in difficult-to-reach areas and who are also usually more disadvantaged in terms of socioeconomic status (Byrne et al., 2014). The implementation of the primary health care approach relies on health workers, including community health workers- who have great importance to overcome the increasing demand for healthcare services and the shortage of healthcare providers. Strengthening primary care with qualified health professionals and the health system through direct investments in primary health care, with a focus on community health workers has been shown to improve MCH coverage and reduce inequality (Blanchard et al., 2019). Further, health service interventions using community volunteers involving participatory women's groups have been used as a means to increase people's awareness, take services closer to the community and encourage service uptake (Woldie et al., 2018). Ethiopia's Health Extension Program is a grassroots approach that has been implemented to scale up the delivery of essential health

interventions. At the heart of this well-structured community health intervention is the production and deployment of frontline community health workers. Evidence shows that the Health Extension Program has contributed to improving health services coverage - including MCH- and narrowing the inequity among populations (Assefa et al., 2019, Assefa et al., 2017). Linked with the Health Extension program, the Women's development army contributed to improved coverage and linkage of the health facility to the community (Yitbarek et al., 2019). Despite government efforts to strengthen the Health Extension Program, there are major limitations in the program due to resource gaps, demotivated and poorly coordinated health extension workers and limited supportive supervision. In addition, community health workers lack the necessary knowledge and skills which impedes the delivery of quality MCH services. Furthermore, studies indicated that the performance of women development groups has been unsatisfactory and pointed the need for improvement (Fetene et al., 2016, Maes et al., 2018).

In LMICs, maternal waiting homes have been used as a strategy to help women who live in remote areas overcome physical and logistical barriers such as long distances, lack of infrastructures, high costs of transport and ineffective communication between referral points (Penn-Kekana et al., 2017). Maternity waiting homes have been identified as a critical link in the continuum of care for maternal and newborn health, potentially reducing inequities in access (Lori et al., 2019). IT has also been in use in Ethiopia for several years. However, various social and facility concerns were raised (Dereje et al., 2022). Designing programs to establish well-functioning maternity waiting homes integrated with comprehensive maternal health programs is of crucial importance.

Globally, an innovative approach like mHealth-based technological intervention has contributed to improvements in the coverage of MCH services across the continuum,

quality of care and referral care, in rural areas with limited resources (Atnafu et al., 2017, Balakrishnan et al., 2016). In Ethiopia, this initiative has benefited MCH services in underserved rural regions, where more than 80% of the population lives. The initiative also contributed to increased early initiation of ANC care, which is an important determinant in the continuum of MCH care. Moreover, the mHealth project has been used as a tool to foster equity as it enables disadvantaged groups to have access to the services they need. However, Infrastructural and technical challenges and lack of monitoring have limited the intended benefits of the intervention (Nigussie et al., 2021). A focused policy from the government and development actors in Ethiopia is needed to address the implementation challenges.

Improving facility and provider performance

A health system needs qualified human resources, a functional logistic and supply system, health information systems to aid in monitoring and evaluation, strong governance, and adequate resource allocation in order to successfully achieve UHC (Sambo and Kirigia, 2014). Strengthening health systems, which involves improving a system's performance to restore and maintain people's health, is considered a key pillar to achieving the SDGs (Kieny et al., 2017).

Healthcare systems in LMICs experience challenges in the supply, retention, distribution, and performance of the health workforce, with performance hampered by low wages, lack of supportive supervision and monitoring, inadequate training, uneven distribution of skills, and poor facility infrastructure. Consequently, these challenges perpetuate health inequities and produces low-quality health services (Gerein et al., 2006, Puchalski Ritchie et al., 2016, Homer et al., 2018).

Interventions that contribute successfully to addressing low coverage, inequality, and poor quality of care in MCH services take a variety of forms, including general health system capacity strengthening through activities like training of health care workers, developing and improving health infrastructure, and provision of equipment and medical supplies (Wekesah et al., 2016, Jaca et al., 2022, Lassi et al., 2016). The Ethiopian government implemented several sector-wide reforms, and innovative performance management and improvement interventions. Upgrading facilities with necessary equipment as well as guidelines and protocols accompanied by capacity-building of healthcare providers and supportive supervision, expanding the primary healthcare network, supply-side health financing initiatives are some of the commonly implemented strategies to improve the quality of MCH services and service uptake, particularly among disadvantaged population (Quaife et al., 2021). However, Ethiopia's MCH service provision still experiences issues such as disparity and gap in skilled professionals' distribution, lack of necessary trainings such as newborn care or weak and untargeted trainings, low health care workers motivation, high professional turnover and inadequate infrastructure, logistics and supplies (Kebede and Tilahun, 2021, Usman et al., 2019, Haileamlak, 2018).

The provision of poor compassionate care in health service delivery is a common challenge in Ethiopia due to resource shortages and poor governance (Amsalu et al., 2022). Professionals that provide MCH services may not be tolerant of cultural beliefs and practices or may treat women from low socioeconomic status, rural areas, and women with low levels of education with less consideration (Mordal et al., 2021, Adinew et al., 2021). In such cases, health-seeking behaviour, service coverage as well as continuity of care, and quality of care may be affected, particularly among disadvantaged people, as the wealthiest and urban residents may be able to access private or public health sectors with better services. The Ethiopian government took a national initiative toward creating

compassionate, respectful and caring health services as part of the Health Sector Transformation Plan, but the implementation had poor progress (Berhe and Berhe, 2019).

Prior research findings underpin that adopting good practices in human resource management and improving health facilities' capacity and readiness effectively improve the quality of MCH care, reducing the disparity in service uptake (Wekesah et al., 2016). Reducing resource gaps in Ethiopia, especially in rural and hard-to-reach areas where most people with lower socioeconomic status reside is critical. As such, adequate budget allocation to MCH care, ensuring the availability of adequately prepared, skilled, and motivated healthcare workers through better training, attractive salary packages, objective performance appraisal, and regular supportive supervision is needed to improve the quality and coverage along the continuum of care and narrow down inequalities. Due focus should be given to lower-level health practitioners that serve rural and remote communities. Incorporating compassionate and respectful care in health workforce development activities may also contribute to increasing service coverage. Strengthening logistic systems to equip health facilities with necessary medical supplies and adequate infrastructure, coupled with clinical audits is also crucial.

Regarding the key recommendation to develop region-specific intervention programmes, the Lancet Commission on high-quality health systems by Kruk et al emphasises the importance of meso-level interventions, specifically district-led learning, in improving healthcare performance (Kruk et al., 2018). This approach involves collaboration between district administrations and facility networks to create learning systems that can be scaled up. District-led learning brings together providers and administrators to solve problems, harmonise approaches, maximize resources, and enhance communication and referral processes among facilities. The Commission also highlights the use of formal quality improvement collaboratives. These are teams from various healthcare sites that focus on

enhancing performance on specific topics. They use data to test and implement ideas in cycles supported by coaching and learning sessions. This approach has shown modest improvements, particularly in addressing clear gaps between evidence and practice in straightforward aspects of care. However, the quality of evidence for quality improvement collaboratives from LMICs is scarce and inconsistent (Wells et al., 2018).

Improving the status of women

Education is a potent strategy for the empowerment of women. Improving the status of women through education and income generation may improve the coverage of MCH services along the continuum of care and enhance equity (Ahmed et al., 2010). Women's education in Ethiopia remains largely affected by poverty and social norms and traditional practices such as gender-based violence, early marriage and the burden of household chores (Tafere et al., 2022). Policies and programs -embracing all sectors of society, not just the health sector- to overcome these barriers and increase school enrolments among women may greatly impact women's health-seeking behaviour, thus improving service uptake (Marmot et al., 2008). However, as this requires a long-term investment, health programs need to focus on attracting women with a low level of education in the short term.

Knowledge and awareness-raising through community discussion and women's education -with a particular focus on the disadvantaged- sensitise women to use quality health services and can greatly improve coverage (Mian et al., 2018). Hence, government programs must focus on knowledge-transfer interventions. Given that unintended pregnancy and early initiation of ANC were associated with the continuum of MCH care in my study, increasing women's knowledge regarding the importance of attending maternal and family planning services may promote the uptake of continuum of care.

Multidimensional approaches that consider two or more of the recommended strategies listed above are indispensable for improving coverage and quality and reducing inequality. Finally, given the findings in chapter seven, a special focus on improving the coverage and quality of newborn PNC with particular attention to the people with low socioeconomic status and regions which had low effective coverage of newborn PNC is required. Overall, the government, policymakers and health planners need to commit to ensure that MCH coverage is optimal, equitable, and of high quality, and it requires a multisectoral collaboration.

Maternal, newborn and child health coverage in emergency situations

Globally, the COVID-19 pandemic and other humanitarian emergencies have posed a challenge to the health systems leading to unprecedented disruption in the provision of routine health services and often a health system collapse that embraces MCH care (Palo et al., 2022). The impact of humanitarian situations on health depends on the type, stage, and duration of the disaster condition, but in general, the greatest consequences are borne by the poorest populations with poor health status and underserved communities. Women and children are classified as an important subgroup of the population that is most at risk in the event of a humanitarian emergency (Zeid et al., 2015). In LMICs, ensuring accessible and quality health care to women and children has been an existing challenge, but humanitarian crises due to war, natural disasters, famine, and pandemics have made it even more difficult (Sahoo et al., 2021).

The WHO declared coronavirus disease 2019 (COVID-19) as a global public health emergency in early 2020 (Mahase, 2020). The pandemic has hampered access to and utilisation of healthcare, particularly in settings with limited resources and overburdened health systems (Okereke et al., 2021). Countries have been struggling to balance the

demands of responding directly to the COVID-19 pandemic with the need to maintain the delivery of other essential health services (Kingsley et al., 2021). Prior to COVID-19, many women in LMICs, particularly those having low socioeconomic status and residing in rural regions, already lacked access to high-quality and timely MCH services. These services have further deteriorated coupled with existing inequalities within population subgroups worsened as a result of the global responses that focused primarily on preventing and containing COVID-19 (Aranda et al., 2022). Some regular health services have been downscaled or discontinued. The diversion of resources and staff from their routine activities to test and provide treatment for COVID-19 cases, infection and deaths among healthcare workers coupled with non-conducive working environments, movement restrictions due to lockdowns/quarantines, suspension of public transport and associated disruptions in key supply chains, and the fear of catching COVID-19 among people have complicated MCH service provision and access (Akaba et al., 2022).

Conflict situations also have detrimental effects that go far beyond the area and period of active hostilities. The coverage of MCH services in conflict countries may be impacted by security, governance, health personnel, financing, supply, and monitoring changes. In addition, maintaining the quality of services is difficult (Jawad et al., 2021). Moreover, inequalities in coverage of RMCH interventions and geographic disparities are significantly worse due to shortages in health staff, financial and geographical barriers, reduced capacity and political will for equitable health policy as well as overall deterioration of the health system. Conflict-driven deteriorations in socioeconomic conditions may also exacerbate existing inequalities (Akseer et al., 2020).

Strategies to maintain the continuity of essential health services during humanitarian emergencies include adjusting governance and coordination mechanisms to support timely action, optimising service delivery platforms and health workforce capacity,

maintaining the availability of essential medications, equipment and supplies, funding public health, strengthening monitoring of services, and effective communication together with community engagement (WHO, 2020b). It may be essential to mobilise additional emergency medical personnel to deliver services, set up temporary health outposts adjacent to areas affected by crises or mobile health services, and create referral networks (Cooper, 2018).

In Ethiopia, the COVID-19 pandemic and its response caused significant disruptions in the delivery of RMCH services (Bekele et al., 2022). In addition, a full-scale humanitarian crisis has been unfolding since the war erupted in November 2020 in Northern Ethiopia, worsening the existing health system burdens (United Nations Population Fund, 2022). It is likely that the COVID-19 pandemic and the ongoing war and associated displacements will have a significant impact on the coverage of MCH services along the continuum of care. It is also likely that the overlapping crisis might further deteriorate the quality of MCH care. Moreover, the socioeconomic inequalities and regional disparities are also expected to be worsened. Hence, considering the current situation in the country, it is crucial to develop a resilient health system that is flexible enough to cope with such humanitarian emergencies and their effects while continuing to maintain focus on improving MCH coverage. Beyond the first and foremost requirement that hostilities end promptly, innovative strategies to reduce the negative consequences of the conflict and the pandemic on MCH -including catch-up campaigns -are critical and multi-sectoral humanitarian and development approaches are needed.

8.5 Strengths, limitations, and future research

One of the key strengths of my thesis is the use of a large de-identified national dataset. The use of multiple methods, consisting of a systematic review, and quantitative analyses

of national data to uncover the coverage gaps and inequalities in MCH is the other strength of my study. In addition, my study findings are based on comprehensive measures of MCH coverage along the continuum of care (modified composite coverage index reflecting a combination of indicators, and effective coverage integrating quality of care).

To my knowledge, this is the first study to employ a quantile regression approach to measure associations between the continuum of MCH care and predictors (chapter four). The use of a quantile regression analysis is an important methodological contribution as it shows a complete picture of the effect of different factors across the conditional distribution of the composite coverage index. Moreover, this study is unique in that it employed a spatial analysis to indicate hotspot areas of high-quality newborn PNC (chapter seven). Furthermore, the results presented in chapter five and chapter seven are in line with SDG17.18 which calls for the disaggregation of health and related indicators based on different dimensions of inequality, including socioeconomic status (United Nations, 2016).

Although the research reached its aims there are some limitations that must be considered. Coverage estimates in chapters four, five and seven are based on reanalysed data from EDHS with a cross-sectional design. Establishing a causal relationship was not possible in chapter four. In addition, recall bias, information bias or social desirability bias on the part of the women cannot be ruled out since the EDHS data were collected based on women's self-reports. Moreover, in chapters four and five, the coverage measures that used the modified coverage index to indicate continuity of MCH care did not use quality of care. Further, due to data limitations, the study did not address all the factors that may influence the continuum of care. In chapter seven, the data on newborn PNC may be

affected by women's misreport. Furthermore, the quality measurement strategy for newborn PNC did not consider the multiple domains.

Further research could expand the findings discussed in this thesis. It would be important to integrate quality of care when using the composite coverage index as a measure of the continuity of care for future research. Further exploration of barriers and facilitators of continuum of care using qualitative studies or mixed methods is also needed. Future research that focuses on the other aspects of health inequality might draw a holistic picture of the existing disparities in MCH coverage.

When investigating the effective coverage of MCH services, integrating the multiple domains of quality of care into the crude measures will give a better picture of the health gains. Moreover, future research needs to expand and investigate why high-quality newborn postnatal care remains low.

8.6 Summary and conclusion

This study provides evidence that the coverage of MCH services along the continuum of care was low in Ethiopia. The research has also showed that the factors affecting the continuum of care at different levels of the composite coverage index were the educational status of women, region, residence, socioeconomic status, perceived distance to a health facility, pregnancy intention, mode of delivery, parity, and early ANC initiation. Despite the increase in the coverage of MCH services from 2000 to 2016, there were socioeconomic inequalities favouring the rich and the main contributors to the inequalities were wealth status, place of residence, and mother's education level. Newborn PNC had the lowest coverage. The findings of the systematic review revealed that the effective coverage of MCH interventions lagged substantially behind crude coverage, indicating a low quality of care. It was also found that the wealthiest groups

had higher effective coverage of services than the poorest groups, showing an inequitable distribution of coverage. Moreover, the findings demonstrated that quality measurement strategies involved structural, process and outcome domains individually or combined. Finally, this research revealed that the crude coverage and effective coverage of newborn PNC were low in Ethiopia. High-quality newborn postnatal care was disproportionately concentrated among the rich and the spatial distribution was varied across the region.

To conclude, this project provided a comprehensive assessment of the coverage of MCH services along the continuum of care. The empirical evidence from the findings of this study will help Ethiopia design and restructure policies and programmes to increase coverage of MCH services along the continuum, address socioeconomic and geographic disparities, and improve the quality of care. These are important to achieve the UHC targets and other health-related SDGs, as well as improve the health and status of women and children.

References

ABEBE, G. F., BELACHEW, D. Z., GIRMA, D., AYDIKO, A. & NEGESSE, Y. 2022. Multilevel analysis of the predictors of completion of the continuum of maternity care in Ethiopia; using the recent 2019 Ethiopia mini demographic and health survey. *BMC Pregnancy Childbirth,* 22**,** 691.

ABEGAZ, S. T. 2019. *A Human Rights-Based Approach to Maternal and Child Health in Ethiopia: Does it Matter to Promote Health Equities?*, Education, Human Rights Peace in Sustainable Development.

ABEGUNDE, D., OROBATON, N., SADAUKI, H., BASSI, A., KABO, I. A. & ABDULKARIM, M. 2015. Countdown to 2015: Tracking Maternal and Child Health Intervention Targets Using Lot Quality Assurance Sampling in Bauchi State Nigeria. *PLoS One,* 10**,** e0129129.

ABOAGYE, R. G., SEIDU, A.-A., AHINKORAH, B. O., CADRI, A., FRIMPONG, J. B., HAGAN, J. E., KASSAW, N. A. & YAYA, S. 2022. Association between frequency of mass media exposure and maternal health care service utilization among women in sub-Saharan Africa: Implications for tailored health communication and education. *PLOS ONE,* 17**,** e0275202.

ADDISU, D., MEKIE, M., MELKIE, A., ABIE, H., DAGNEW, E., BEZIE, M., DEGU, A., BIRU, S. & CHANIE, E. S. 2022. Continuum of maternal healthcare services utilization and its associated factors in Ethiopia: A systematic review and meta-analysis. *Womens Health (Lond),* 18**,** 17455057221091732.

ADEGBOSIN, A. E., ZHOU, H., WANG, S., STANTIC, B. & SUN, J. 2019. Systematic review and meta-analysis of the association between dimensions of inequality and a selection of indicators of Reproductive, Maternal, Newborn and Child Health (RMNCH). *J Glob Health,* 9**,** 010429.

ADINEW, Y. M., HALL, H., MARSHALL, A. & KELLY, J. 2021. Disrespect and abuse during facility-based childbirth in central Ethiopia. *Glob Health Action,* 14**,** 1923327.

ADMASU, K., BALCHA, T. & GHEBREYESUS, T. A. 2016. Pro-poor pathway towards universal health coverage: lessons from Ethiopia. *J Glob Health,* 6**,** 010305.

AGUNWA, C. C., OBI, I. E., NDU, A. C., OMOTOWO, I. B., IDOKO, C. A., UMEOBIERI, A. K. & ANIWADA, E. C. 2017. Determinants of patterns of maternal and child health service utilization in a rural community in south eastern Nigeria. *BMC Health Services Research,* 17**,** 715.

AHMED, S., CREANGA, A. A., GILLESPIE, D. G. & TSUI, A. O. 2010. Economic status, education and empowerment: implications for maternal health service utilization in developing countries. *PLoS One,* 5**,** e11190.

AKABA, G. O., DIRISU, O., OKUNADE, K. S., ADAMS, E., OHIOGHAME, J., OBIKEZE, O. O., IZUKA, E., SULIEMAN, M. & EDEH, M. 2022. Barriers and facilitators of access to maternal, newborn and child health services during the first wave of COVID-19 pandemic in Nigeria: findings from a qualitative study. *BMC Health Serv Res,* 22**,** 611.

AKACHI, Y. & KRUK, M. E. 2017. Quality of care: measuring a neglected driver of improved health. *Bull World Health Organ,* 95**,** 465-472.

AKINYEMI, J. O., AFOLABI, R. F. & AWOLUDE, O. A. 2016. Patterns and determinants of dropout from maternity care continuum in Nigeria. *BMC Pregnancy Childbirth,* 16**,** 282.

AKSEER, N., WRIGHT, J., TASIC, H., EVERETT, K., SCUDDER, E., AMSALU, R., BOERMA, T., BENDAVID, E., KAMALI, M., BARROS, A. J. D., DA SILVA, I. C. M. & BHUTTA, Z. A. 2020. Women, children and adolescents in conflict countries: an assessment of inequalities in intervention coverage and survival. *BMJ Glob Health,* 5**,** e002214.

ALAMNEH, T. S., TESHALE, A. B., YESHAW, Y., ALEM, A. Z., AYALEW, H. G., LIYEW, A. M., TESSEMA, Z. T., TESEMA, G. A. & WORKU, M. G. 2022. Barriers for health care access affects

maternal continuum of care utilization in Ethiopia; spatial analysis and generalized estimating equation. *PLoS One,* 17**,** e0266490.

ALEBACHEW, A., YUSUF, Y., MANN, C., BERMAN, P. J. M., ADDIS ABABA: HARVARD TH CHAN SCHOOL OF PUBLIC HEALTH & BREAKTHROUGH INTERNATIONAL CONSULTANCY, P. 2015. Ethiopia's Progress in health financing and the contribution of the 1998 health care and financing strategy in Ethiopia. 95.

ALEM, A. Z., SHITU, K. & ALAMNEH, T. S. 2022. Coverage and factors associated with completion of continuum of care for maternal health in sub-Saharan Africa: a multicountry analysis. *BMC Pregnancy Childbirth,* 22**,** 422.

ALI, M., CORDERO, J. P., KHAN, F. & FOLZ, R. 2019. 'Leaving no one behind': a scoping review on the provision of sexual and reproductive health care to nomadic populations. *BMC Women's Health,* 19**,** 161.

AMBEL, A. A., ANDREWS, C., BAKILANA, A. M., FOSTER, E., KHAN, Q. & WANG, H. 2015. Maternal and child health inequalities in Ethiopia. *World Bank Policy Research Working Paper*.

AMBEL, A. A., ANDREWS, C., BAKILANA, A. M., FOSTER, E. M., KHAN, Q. & WANG, H. 2017. Examining changes in maternal and child health inequalities in Ethiopia. *Int J Equity Health,* 16**,** 152.

AMOUZOU, A., JIWANI, S. S., DA SILVA, I. C. M., CARVAJAL-AGUIRRE, L., MAÏGA, A. & VAZ, L. M. 2020. Closing the inequality gaps in reproductive, maternal, newborn and child health coverage: slow and fast progressors. *BMJ global health,* 5**,** e002230.

AMOUZOU, A., LESLIE, H. H., RAM, M., FOX, M., JIWANI, S. S., REQUEJO, J., MARCHANT, T., MUNOS, M. K., VAZ, L. M. & WEISS, W. 2019. Advances in the measurement of coverage for RMNCH and nutrition: from contact to effective coverage. *BMJ global health,* 4**,** e001297.

AMSALU, B., ARAGAW, A., SINTAYEHU, Y., SEMA, A., BELAY, Y., TADESE, G., KASSIE, N., GUTA, A., TIBEBU, A. & TIRUYE, G. 2022. Respectful maternity care among laboring women in public hospitals of Benishangul Gumuz Region, Ethiopia: A mixed cross-sectional study with direct observations. *SAGE Open Med,* 10**,** 20503121221076995.

ANDREW, R. 2020. *Effect of results-based financing on maternal health services: examining quality of care and patients' satisfaction.* The University of Dodoma.

ANINDYA, K., MARTHIAS, T., VELLAKKAL, S., CARVALHO, N., ATUN, R., MORGAN, A., ZHAO, Y., HULSE, E. S. G., MCPAKE, B. & LEE, J. T. 2021. Socioeconomic inequalities in effective service coverage for reproductive, maternal, newborn, and child health: a comparative analysis of 39 low-income and middle-income countries. *eClinicalMedicine,* 40.

ARANDA, Z., BINDE, T., TASHMAN, K., TADIKONDA, A., MAWINDO, B., MAWEU, D., BOLEY, E. J., MPHANDE, I., DUMBUYA, I., MONTAÑO, M., CLISBEE, M., MVULA, M. G., NDAYIZIGIYE, M., CASELLA JEAN-BAPTISTE, M., VARNEY, P. F., ANYANGO, S., GRÉPIN, K. A., LAW, M. R., MUGUNGA, J. C., HEDT-GAUTHIER, B. & FULCHER, I. R. 2022. Disruptions in maternal health service use during the COVID-19 pandemic in 2020: experiences from 37 health facilities in low-income and middle-income countries. 7**,** e007247.

ARROYAVE, L., SAAD, G. E., VICTORA, C. G. & BARROS, A. J. D. 2021. Inequalities in antenatal care coverage and quality: an analysis from 63 low and middle-income countries using the ANCq content-qualified coverage indicator. *International Journal for Equity in Health,* 20**,** 102.

ARSENAULT, C., JORDAN, K., LEE, D., DINSA, G., MANZI, F., MARCHANT, T. & KRUK, M. E. 2018. Equity in antenatal care quality: an analysis of 91 national household surveys. *The Lancet Global Health,* 6**,** e1186-e1195.

ASRATIE, M. H., MUCHE, A. A. & GEREMEW, A. B. 2020. Completion of maternity continuum of care among women in the post-partum period: Magnitude and associated factors in the northwest, Ethiopia. *PLOS ONE,* 15**,** e0237980.

ASSEFA, Y., DAMME, W. V., WILLIAMS, O. D. & HILL, P. S. 2017. Successes and challenges of the millennium development goals in Ethiopia: lessons for the sustainable development goals. *BMJ Glob Health,* 2**,** e000318.

ASSEFA, Y., GELAW, Y. A., HILL, P. S., TAYE, B. W. & VAN DAMME, W. 2019. Community health extension program of Ethiopia, 2003-2018: successes and challenges toward universal coverage for primary healthcare services. *Global Health,* 15**,** 24.

ASSEFA, Y., HILL, P. S., GILKS, C. F., ADMASSU, M., TESFAYE, D. & VAN DAMME, W. 2020. Primary health care contributions to universal health coverage, Ethiopia. *Bull World Health Organ,* 98**,** 894-905a.

ATNAFU, A., KEBEDE, A., MISGANAW, B., TESHOME, D. F., BIKS, G. A., DEMISSIE, G. D., WOLDE, H. F., GELAYE, K. A., YITAYAL, M., AYELE, T. A., AZALE, T., DERSO, T., GEBREMEDHIN, T. & DELLIE, E. 2020. Determinants of the Continuum of Maternal Healthcare Services in Northwest Ethiopia: Findings from the Primary Health Care Project. *Journal of Pregnancy,* 2020**,** 4318197.

ATNAFU, A., OTTO, K. & HERBST, C. H. 2017. The role of mHealth intervention on maternal and child health service delivery: findings from a randomized controlled field trial in rural Ethiopia. *Mhealth,* 3**,** 39.

AUSTIN, A., LANGER, A., SALAM, R. A., LASSI, Z. S., DAS, J. K. & BHUTTA, Z. A. 2014. Approaches to improve the quality of maternal and newborn health care: an overview of the evidence. *Reproductive health,* 11**,** 1-9.

AYELE, B. G., WOLDU, M. A., GEBREHIWOT, H. W., GEBRE-EGZIABHER, E. G., GEBRETNSAE, H., HADGU, T., ABRHA, A. A. & MEDHANYIE, A. A. 2019. Magnitude and determinants for place of postnatal care utilization among mothers who delivered at home in Ethiopia: a multinomial analysis from the 2016 Ethiopian demographic health survey. *Reproductive Health,* 16**,** 162.

BALAKRISHNAN, R., GOPICHANDRAN, V., CHATURVEDI, S., CHATTERJEE, R., MAHAPATRA, T. & CHAUDHURI, I. 2016. Continuum of Care Services for Maternal and Child Health using mobile technology - a health system strengthening strategy in low and middle income countries. *BMC Med Inform Decis Mak,* 16**,** 84.

BARBER, S. L., BERTOZZI, S. M. & GERTLER, P. J. 2007. Variations In Prenatal Care Quality For The Rural Poor In Mexico: Indigenous women received fewer procedures than other women in private health facilities; disparities were much less prominent in public facilities. *Health Affairs,* 26**,** w310-w323.

BARRETO, M. L. 2017. Health inequalities: a global perspective. *Cien Saude Colet,* 22**,** 2097-2108.

BARROS, A. J., RONSMANS, C., AXELSON, H., LOAIZA, E., BERTOLDI, A. D., FRANÇA, G. V., BRYCE, J., BOERMA, J. T. & VICTORA, C. G. 2012. Equity in maternal, newborn, and child health interventions in Countdown to 2015: a retrospective review of survey data from 54 countries. *The Lancet,* 379**,** 1225-1233.

BARROS, A. J. & VICTORA, C. G. 2013. Measuring coverage in MNCH: determining and interpreting inequalities in coverage of maternal, newborn, and child health interventions. *PLoS Med,* 10**,** e1001390.

BARROS, A. J., WEHRMEISTER, F. C., FERREIRA, L. Z., VIDALETTI, L. P., HOSSEINPOOR, A. R. & VICTORA, C. G. 2020. Are the poorest poor being left behind? Estimating global inequalities in reproductive, maternal, newborn and child health. *BMJ global health,* 5**,** e002229.

BEKELE, C., BEKELE, D., HUNEGNAW, B. M., VAN WICKLE, K., GEBREMESKEL, F. A., KORTE, M., TEDIJANTO, C., TADDESSE, L. & CHAN, G. J. 2022. Impact of the COVID-19 pandemic on utilisation of facility-based essential maternal and child health services from March to August 2020 compared with pre-pandemic March–August 2019: a mixed-methods study in North Shewa Zone, Ethiopia. 12**,** e059408.

BELAYNEH, T., ADEFRIS, M. & ANDARGIE, G. 2014. Previous early antenatal service utilization improves timely booking: cross-sectional study at university of Gondar hospital, northwest Ethiopia. *Journal of pregnancy*.

BELLOWS, N. M., BELLOWS, B. W. & WARREN, C. 2011. Systematic Review: the use of vouchers for reproductive health services in developing countries: systematic review. *Trop Med Int Health,* 16**,** 84-96.

BERHAN, Y. & BERHAN, A. 2014. Antenatal care as a means of increasing birth in the health facility and reducing maternal mortality: a systematic review. *Ethiop J Health Sci,* 24 Suppl**,** 93-104.

BERHANU, D., ALLEN, E., BEAUMONT, E., TOMLIN, K., TADDESSE, N., DINSA, G., MEKONNEN, Y., HAILU, H., BALLIET, M., LENSINK, N., SCHELLENBERG, J. & AVAN, B. I. 2021. Coverage of antenatal, intrapartum, and newborn care in 104 districts of Ethiopia: A before and after study four years after the launch of the national Community-Based Newborn Care programme. *PLoS One,* 16**,** e0251706.

BERHE, H. & BERHE, H. 2019. Barriers Towards Implementation of Caring, Respectful and Compassionate Healthcare Practice in Tigray Regional State, Ethiopia: A Qualitative Study.

BHUTTA, Z. A., DAS, J. K., BAHL, R., LAWN, J. E., SALAM, R. A., PAUL, V. K., SANKAR, M. J., BLENCOWE, H., RIZVI, A., CHOU, V. B. & WALKER, N. 2014. Can available interventions end preventable deaths in mothers, newborn babies, and stillbirths, and at what cost? *Lancet,* 384**,** 347-70.

BINTABARA, D., ERNEST, A. & MPONDO, B. 2019. Health facility service availability and readiness to provide basic emergency obstetric and newborn care in a low-resource setting: evidence from a Tanzania National Survey. *BMJ open,* 9**,** e020608.

BIRHANE, B. M., BAYIH, W. A., MEKONEN, D. K., CHANIE, E. S., DEMIS, S., SHIMELIS, H., ASFERIE, W. N., ABEBE, E., ADDISU, D., NIBRET, G., ENDALAMAW, A., MUNYE, T., JEMBER, D. A., NEBIYU, S., TIRUNEH, Y. M. & BELAY, D. M. 2022. Level of Postnatal Checkup in Ethiopia - Implications for Child Health Services. *Front Pediatr,* 10**,** 895339.

BLACK, R. E., LEVIN, C., WALKER, N., CHOU, D., LIU, L. & TEMMERMAN, M. 2016. Reproductive, maternal, newborn, and child health: key messages from Disease Control Priorities 3rd Edition. *The Lancet,* 388**,** 2811-2824.

BLANCHARD, A. K., PROST, A. & HOUWELING, T. A. J. 2019. Effects of community health worker interventions on socioeconomic inequities in maternal and newborn health in low-income and middle-income countries: a mixed-methods systematic review. *BMJ Glob Health,* 4**,** e001308.

BLENCOWE, H., LAWN, J., VANDELAER, J., ROPER, M. & COUSENS, S. 2010. Tetanus toxoid immunization to reduce mortality from neonatal tetanus. *Int J Epidemiol,* 39 Suppl 1**,** i102-9.

BOBO, F. T., YESUF, E. A. & WOLDIE, M. 2017. Inequities in utilization of reproductive and maternal health services in Ethiopia. *International Journal for Equity in Health,* 16**,** 105.

BOERMA, J. T., BRYCE, J., KINFU, Y., AXELSON, H. & VICTORIA, C. G. 2008. Mind the gap: equity and trends in coverage of maternal, newborn, and child health services in 54 Countdown countries. *The Lancet,* 371**,** 1259-1267.

BOERMA, J. T., HOLT, E. & BLACK, R. 2001. Measurement of biomarkers in surveys in developing countries: opportunities and problems. *Population and Development Review,* 27**,** 303-314.

BOERMA, T., REQUEJO, J. & VICTORA, C. 2017. Tracking Progress Towards Universal Coverage for Women's, Children's and Adolescents' Health, the 2017 Report. UNICEF & World Health Organization.

BOERMA, T., REQUEJO, J., VICTORA, C. G., AMOUZOU, A., GEORGE, A., AGYEPONG, I., BARROSO, C., BARROS, A. J., BHUTTA, Z. A. & BLACK, R. E. 2018. Countdown to 2030: tracking

progress towards universal coverage for reproductive, maternal, newborn, and child health. *The Lancet,* 391**,** 1538-1548.

BOSOMPRAH, S., RAGNO, P. L., GROS, C. & BANSKOTA, H. 2015. Health insurance and maternal, newborn services utilisation and under-five mortality. *Arch Public Health,* 73**,** 51.

BRENNER, S., MAZALALE, J., WILHELM, D., NESBITT, R. C., LOHELA, T. J., CHINKHUMBA, J., LOHMANN, J., MUULA, A. S. & DE ALLEGRI, M. 2018. Impact of results-based financing on effective obstetric care coverage: evidence from a quasi-experimental study in Malawi. *BMC health services research,* 18**,** 1-10.

BRIZUELA, V., LESLIE, H. H., SHARMA, J., LANGER, A. & TUNÇALP, Ö. 2019. Measuring quality of care for all women and newborns: how do we know if we are doing it right? A review of facility assessment tools. *The Lancet Global Health,* 7**,** e624-e632.

BRIZUELA, V. & TUNÇALP, Ö. 2017. Global initiatives in maternal and newborn health. *Obstet Med,* 10**,** 21-25.

BRYCE, J., ARNOLD, F., BLANC, A., HANCIOGLU, A., NEWBY, H., REQUEJO, J., WARDLAW, T. & MEASUREMENT, C. W. G. O. I. C. 2013. Measuring coverage in MNCH: new findings, new strategies, and recommendations for action. *PLoS Med,* 10**,** e1001423.

BRYCE, J., DAELMANS, B., DWIVEDI, A., FAUVEAU, V., LAWN, J. E., MASON, E., NEWBY, H., SHANKAR, A., STARRS, A. & WARDLAW, T. 2008. Countdown to 2015 for maternal, newborn, and child survival: the 2008 report on tracking coverage of interventions. *Lancet,* 371**,** 1247-58.

BUSSE, R., PANTELI, D. & QUENTIN, W. 2019. An introduction to healthcare quality: defining and explaining its role in health systems. *Improving healthcare quality in Europe.*

BYRNE, A., HODGE, A., JIMENEZ-SOTO, E. & MORGAN, A. 2013. Looking beyond supply: a systematic literature review of demand-side barriers to health service utilization in the mountains of Nepal. *Asia Pac J Public Health,* 25**,** 438-51.

BYRNE, A., HODGE, A., JIMENEZ-SOTO, E. & MORGAN, A. 2014. What works? Strategies to increase reproductive, maternal and child health in difficult to access mountainous locations: a systematic literature review. *PLoS One,* 9**,** e87683.

CAMARA, B. S., BENOVA, L., DELVAUX, T., SIDIBÉ, S., EL AYADI, A. M., GRIETENS, K. P. & DELAMOU, A. 2021. Women's progression through the maternal continuum of care in Guinea: Evidence from the 2018 Guinean Demographic and Health Survey. *Trop Med Int Health,* 26**,** 1446-1461.

CARRIN, G., WAELKENS, M. P. & CRIEL, B. 2005. Community-based health insurance in developing countries: a study of its contribution to the performance of health financing systems. *Trop Med Int Health,* 10**,** 799-811.

CARTER, E. D., NDHLOVU, M., EISELE, T. P., NKHAMA, E., KATZ, J. & MUNOS, M. 2018. Evaluation of methods for linking household and health care provider data to estimate effective coverage of management of child illness: results of a pilot study in Southern Province, Zambia. *Journal of global health,* 8.

CENTRAL STATISTICAL AGENCY (CSA) [ETHIOPIA] AND ICF 2016. Ethiopia Demographic and Health Survey 2016. Addis Ababa, Ethiopia, and Rockville, Maryland, USA: CSA and ICF.

CHAKA, E. E. 2022. Multilevel analysis of continuation of maternal healthcare services utilization and its associated factors in Ethiopia: A cross-sectional study. *PLOS Global Public Health,* 2**,** e0000517.

CHAKA, E. E., ABDURAHMAN, A. A., NEDJAT, S. & MAJDZADEH, R. 2019a. Utilization and Determinants of Postnatal Care Services in Ethiopia: A Systematic Review and Meta-Analysis. *Ethiop J Health Sci,* 29**,** 935-944.

CHAKA, E. E., PARSAEIAN, M. & MAJDZADEH, R. 2019b. Factors Associated with the Completion of the Continuum of Care for Maternal, Newborn, and Child Health Services in Ethiopia. Multilevel Model Analysis. *Int J Prev Med,* 10**,** 136.

CHALISE, B., CHALISE, M., BISTA, B., PANDEY, A. R. & THAPA, S. 2019. Correlates of continuum of maternal health services among Nepalese women: Evidence from Nepal Multiple Indicator Cluster Survey. *PLoS One,* 14**,** e0215613.

CHAN, G. J., DANIEL, J., GETNET, M., KENNEDY, M., OLOWOJESIKU, R., HUNEGNAW, B. M., UNNINAYAR, S., TADDESSE, L. & BEKELE, D. 2021. Gaps in maternal, newborn, and child health research: a scoping review of 72 years in Ethiopia. *Journal of Global Health Reports***,** 5.

CHERIE, N., ABDULKERIM, M., ABEGAZ, Z. & WALLE BAZE, G. 2021. Maternity continuum of care and its determinants among mothers who gave birth in Legambo district, South Wollo, northeast Ethiopia. *Health Sci Rep,* 4**,** e409.

CHHAM, S., RADOVICH, E., BUFFEL, V., IR, P. & WOUTERS, E. 2021. Determinants of the continuum of maternal health care in Cambodia: an analysis of the Cambodia demographic health survey 2014. *BMC Pregnancy Childbirth,* 21**,** 410.

CHOU, D., DAELMANS, B., JOLIVET, R. R., KINNEY, M. & SAY, L. 2015. Ending preventable maternal and newborn mortality and stillbirths. *Bmj,* 351**,** h4255.

CHOU, V. B., WALKER, N. & KANYANGARARA, M. 2019. Estimating the global impact of poor quality of care on maternal and neonatal outcomes in 81 low-and middle-income countries: A modeling study. *PLoS medicine,* 16**,** e1002990.

COLSON, K. E., ZÚÑIGA-BRENES, P., RÍOS-ZERTUCHE, D., CONDE-GLEZ, C. J., GAGNIER, M. C., PALMISANO, E., RANGANATHAN, D., USMANOVA, G., SALVATIERRA, B. & NAZAR, A. 2015. Comparative estimates of crude and effective coverage of measles immunization in low-resource settings: findings from Salud Mesoamérica 2015. *PloS one,* 10**,** e0130697.

COLSTON, J. 2011. the use of effective coverage in the evaluation of maternal and child health programs: a technical note for the IDB's social protection and health division. *Inter-American Development Bank*.

COOPER, R. 2018. Maternal, newborn and child health in emergency settings. University of Birmingham.

COUNTDOWN TO 2030 COLLABORATION 2018. Tracking progress towards universal coverage for women's, children's and adolescents' health: the 2017 Report. New York, NY: United Nations Children's Fund.

CROFT, N., MARSHALL, A. & ALLEN, C. 2018. Guide to DHS statistics (Version 2). Rockville, Maryland, USA: ICF International.

CRUZ, R. C. S., MOURA, L. B. A. & SOARES NETO, J. J. 2017. Conditional cash transfers and the creation of equal opportunities of health for children in low and middle-income countries: a literature review. *Int J Equity Health,* 16**,** 161.

CSA [ETHIOPIA] 2009. Statistical Abstract of Ethiopia. Addis Ababa, Ethiopia: Central Statistical Agency.

CSA [ETHIOPIA] AND ICF 2016. Ethiopia Demographic and Health Survey 2016. Addis Ababa, Ethiopia, and Rockville, Maryland, USA: CSA and ICF.

CSA [ETHIOPIA] AND ICF INTERNATIONAL 2012. Ethiopia Demographic and Health Survey 2011. Addis Ababa, Ethiopia and Calverton, Maryland, USA: Central Statistical Agency and ICF International. .

CSA [ETHIOPIA] AND ORC MACRO 2001. Ethiopia Demographic and Health Survey 2000. Addis Ababa, Ethiopia and Calverton, Maryland, USA: Central Statistical Authority and ORC Macro.

CSA [ETHIOPIA] AND ORC MACRO 2006. Ethiopia Demographic and Health Survey 2005. Addis Ababa, Ethiopia and Calverton, Maryland, USA: Central Statistical Agency and ORC Macro.

DADI, T. L., MEDHIN, G., KASAYE, H. K., KASSIE, G. M., JEBENA, M. G., GOBEZIE, W. A., ALEMAYEHU, Y. K. & TEKLU, A. M. 2021. Continuum of maternity care among rural

women in Ethiopia: does place and frequency of antenatal care visit matter? *Reprod Health,* 18**,** 220.

DAHAB, R. & SAKELLARIOU, D. 2020a. Barriers to Accessing Maternal Care in Low Income Countries in Africa: A Systematic Review. *Int J Environ Res Public Health,* 17.

DAHAB, R. & SAKELLARIOU, D. 2020b. Barriers to Accessing Maternal Care in Low Income Countries in Africa: A Systematic Review. *International Journal of Environmental Research and Public Health,* 17**,** 4292.

DAKA, D. W., WOLDIE, M., ERGIBA, M. S., SORI, B. K., BAYISA, D. A., AMENTE, A. B. & BOBO, F. T. 2020. Inequities in the Uptake of Reproductive and Maternal Health Services in the Biggest Regional State of Ethiopia: Too Far from "Leaving No One Behind". *Clinicoecon Outcomes Res,* 12**,** 595-607.

DE BROUWERE, V., RICHARD, F. & WITTER, S. 2010. Access to maternal and perinatal health services: lessons from successful and less successful examples of improving access to safe delivery and care of the newborn. *Tropical Medicine International Health,* 15**,** 901-909.

DE GRAFT-JOHNSON, J., KERBER, K., TINKER, A., OTCHERE, S., NARAYANAN, I., SHOO, R., OLUWOLE, D. & LAWN, J. 2006. The maternal, newborn and child health continuum of care. *Opportunities for Africa's newborns***,** 23-36.

DEAN, S. V., LASSI, Z. S., IMAM, A. M. & BHUTTA, Z. A. 2014. Preconception care: closing the gap in the continuum of care to accelerate improvements in maternal, newborn and child health. *Reprod Health,* 11 Suppl 3**,** S1.

DEBIE, A. & LAKEW, A. M. 2020. Factors associated with the access and continuum of vaccination services among children aged 12-23 months in the emerging regions of Ethiopia: evidence from the 2016 Ethiopian demography and health survey. *Italian journal of pediatrics,* 46**,** 28-28.

DENNIS, M. L., BENOVA, L., ABUYA, T., QUARTAGNO, M., BELLOWS, B. & CAMPBELL, O. M. R. 2019. Initiation and continuity of maternal healthcare: examining the role of vouchers and user-fee removal on maternal health service use in Kenya. *Health Policy Plan,* 34**,** 120-131.

DEREJE, S., YENUS, H., AMARE, G. & AMARE, T. 2022. Maternity waiting homes utilization and associated factors among childbearing women in rural settings of Finfinnee special zone, central Ethiopia: A community based cross-sectional study. *PLoS One,* 17**,** e0265182.

DEWAU, R., MUCHE, A., FENTAW, Z., YALEW, M., BITEW, G., AMSALU, E. T., AREFAYNIE, M. & MEKONEN, A. M. 2021. Time to initiation of antenatal care and its predictors among pregnant women in Ethiopia: Cox-gamma shared frailty model. *PLoS One,* 16**,** e0246349.

DONABEDIAN, A. 1988. The quality of care: how can it be assessed? *Jama,* 260**,** 1743-1748.

EMIRU, A. A., ALENE, G. D. & DEBELEW, G. T. 2020. Women's retention on the continuum of maternal care pathway in west Gojjam zone, Ethiopia: multilevel analysis. *BMC Pregnancy Childbirth,* 20**,** 258.

ENGLE-STONE, R., NANKAP, M., NDJEBAYI, A. O., VOSTI, S. A. & BROWN, K. H. 2015. Estimating the effective coverage of programs to control vitamin A deficiency and its consequences among women and young children in Cameroon. *Food and nutrition bulletin,* 36**,** S149-S171.

ENOS, J. Y., AMOAKO, R. D. & DOKU, I. K. 2021. Utilization, Predictors and Gaps in the Continuum of Care for Maternal and Newborn Health in Ghana. *Int J MCH AIDS,* 10**,** 98-108.

EPHI AND ICF 2021. Ethiopia Mini Demographic and Health Survey 2019: Final report. Rockville, Maryland, USA: EPHI and ICF.

ETHIOPIA NATIONAL PLANNING COMMISSION 2016. Growth and Transformation Plan II (GTP II)(2015/16-2019/20): Volume I: Main Text. National Planning Commission.

EXLEY, J. & MARCHANT, T. 2022. Inequalities in effective coverage measures: are we asking too much of the data? *BMJ Glob Health,* 7.

FADLALLAH, R., EL-JARDALI, F., HEMADI, N., MORSI, R. Z., ABOU SAMRA, C. A., AHMAD, A., ARIF, K., HISHI, L., HONEIN-ABOUHAIDAR, G. & AKL, E. A. 2018. Barriers and facilitators to implementation, uptake and sustainability of community-based health insurance schemes in low- and middle-income countries: a systematic review. *Int J Equity Health,* 17**,** 13.

FAYE, C. M., WEHRMEISTER, F. C., MELESSE, D. Y., MUTUA, M. K. K., MAÏGA, A., TAYLOR, C. M., AMOUZOU, A., JIWANI, S. S., DA SILVA, I. C. M., SIDZE, E. M., PORTH, T. A., CA, T., FERREIRA, L. Z., STRONG, K. L., KUMAPLEY, R., CARVAJAL-AGUIRRE, L., HOSSEINPOOR, A. R., BARROS, A. J. D. & BOERMA, T. 2020. Large and persistent subnational inequalities in reproductive, maternal, newborn and child health intervention coverage in sub-Saharan Africa. 5**,** e002232.

FEIKIN, D. R., FLANNERY, B., HAMEL, M. J., STACK, M. & HANSEN, P. M. 2016. Vaccines for Children in Low- and Middle-Income Countries. *In:* BLACK, R. E., LAXMINARAYAN, R., TEMMERMAN, M. & WALKER, N. (eds.) *Reproductive, Maternal, Newborn, and Child Health: Disease Control Priorities, Third Edition (Volume 2).* Washington (DC): The International Bank for Reconstruction and Development / The World Bank.

FEKADU, G. A., AMBAW, F. & KIDANIE, S. A. 2019. Facility delivery and postnatal care services use among mothers who attended four or more antenatal care visits in Ethiopia: further analysis of the 2016 demographic and health survey. *BMC Pregnancy Childbirth,* 19**,** 64.

FEREDE GEBREMEDHIN, A., DAWSON, A. & HAYEN, A. 2022. Evaluations of effective coverage of maternal and child health services: A systematic review. *Health Policy Plan,* 37**,** 895-914.

FETENE, N., LINNANDER, E., FEKADU, B., ALEMU, H., OMER, H., CANAVAN, M., SMITH, J., BERMAN, P. & BRADLEY, E. 2016. The Ethiopian Health Extension Program and Variation in Health Systems Performance: What Matters? *PLoS One,* 11**,** e0156438.

FISSEHA, G., BERHANE, Y. & WORKU, A. 2019. Quality of intrapartum and newborn care in Tigray, Northern Ethiopia. *BMC Pregnancy and Childbirth,* 19**,** 37.

FMOH 2010. Health sector development program IV (2010/2011–2014/2015). Addis Ababa: Federal Ministry of Health of Ethiopia.

FMOH 2015. Ethiopia national expanded programme on immunization comprehensive multi-year plan 2016-2020. Addis Ababa, Ethiopia FMOH.

FMOH 2020. Realizing Universal Health Coverage through Primary Health Care: A Roadmap for Optimizing the Ethiopian Health Extension Program 2020 – 2035. Addis Ababa, Ethiopia: Ministry of Health.

FMOH 2021. Health sector transformation plan II. Adis Ababa, Ethiopia: Federal Ministry of Health

FRIEDMAN, J., QAMRUDDIN, J., CHANSA, C. & DAS, A. K. 2016. Impact evaluation of Zambia's health results-based financing pilot project. *Washington, DC: World Bank Group*.

GADOWSKI, A. M., NANAYAKKARA, N., HERITIER, S., MAGLIANO, D. J., SHAW, J. E., CURTIS, A. J., ZOUNGAS, S. & OWEN, A. J. 2019. Association between Dietary Intake and Lipid-Lowering Therapy: Prospective Analysis of Data from Australian Diabetes, Obesity, and Lifestyle Study (AusDiab) Using a Quantile Regression Approach. *Nutrients,* 11**,** 1858.

GANDHI, S., MAHARATHA, T. M., DASH, U. & BABU, M. S. 2021. Level of inequality and the role of governance indicators in the coverage of reproductive maternal and child healthcare services: Findings from India. *PLoS One,* 16**,** e0258244.

GATICA-DOMÍNGUEZ, G., NEVES, P. A. R., BARROS, A. J. D. & VICTORA, C. G. 2020. Complementary feeding practices in 80 low- and middle-income countries: prevalence and socioeconomic inequalities in dietary diversity, meal frequency and dietary adequacy. 2020.12.01.20241372.

GBD 2019 UNDER-5 MORTALITY COLLABORATORS 2021. Global, regional, and national progress towards Sustainable Development Goal 3.2 for neonatal and child health: all-cause and

cause-specific mortality findings from the Global Burden of Disease Study 2019. *Lancet,* 398**,** 870-905.

GEBEYE, B. A. 2016. Unsustain the sustainable: An evaluation of the legal and policy interventions for pastoral development in Ethiopia. *Pastoralism,* 6**,** 2.

GEBRE, E., WORKU, A. & BUKOLA, F. 2018. Inequities in maternal health services utilization in Ethiopia 2000–2016: magnitude, trends, and determinants. *Reproductive Health,* 15**,** 119.

GEDA, N. R., FENG, C. X., HENRY, C. J., LEPNURM, R., JANZEN, B. & WHITING, S. J. 2021. Inequalities in adherence to the continuum of maternal and child health service utilization in Ethiopia: multilevel analysis. *Journal of health, population, and nutrition,* 40**,** 45-45.

GEREIN, N., GREEN, A. & PEARSON, S. 2006. The implications of shortages of health professionals for maternal health in sub-saharan Africa. *Reprod Health Matters,* 14**,** 40-50.

GLINER, J. A., MORGAN, G. A. & LEECH, N. L. 2016. *Research methods in applied settings: An integrated approach to design and analysis*, Routledge.

GRAFT-JOHNSON, J. D., KERBER, K. J., TINKER, A. G., OTCHERE, S., NARAYANAN, I., SHOO, R., OLUWOLE, D. & LAWN, J. E. 2006. The maternal , newborn , and child health continuum of care. *Opportunities for Africa's newborns. 2006***,** 23-36.

GULLIFORD, M., FIGUEROA-MUNOZ, J., MORGAN, M., HUGHES, D., GIBSON, B., BEECH, R. & HUDSON, M. 2002. What does 'access to health care' mean? *J Health Serv Res Policy,* 7**,** 186-8.

GÜLMEZOGLU, A. M., LAWRIE, T. A., HEZELGRAVE, N., OLADAPO, O. T., SOUZA, J. P., GIELEN, M., LAWN, J. E., BAHL, R., ALTHABE, F., COLACI, D. & HOFMEYR, G. J. 2016. Interventions to Reduce Maternal and Newborn Morbidity and Mortality. *In:* BLACK, R. E., LAXMINARAYAN, R., TEMMERMAN, M. & WALKER, N. (eds.) *Reproductive, Maternal, Newborn, and Child Health: Disease Control Priorities, Third Edition (Volume 2).* Washington (DC): The International Bank for Reconstruction and Development / The World Bank

GUTIÉRREZ, J. P. 2013. Gaps in effective coverage by socioeconomic status and poverty condition. *Salud publica de Mexico,* 55**,** S106-11.

HAILE, D., KONDALE, M., ANDARGE, E., TUNJE, A., FIKADU, T. & BOTI, N. 2020. Level of completion along continuum of care for maternal and newborn health services and factors associated with it among women in Arba Minch Zuria woreda, Gamo zone, Southern Ethiopia: A community based cross-sectional study. *PLoS One,* 15**,** e0221670.

HAILEAMLAK, A. 2018. How Can Ethiopia Mitigate the Health Workforce Gap to Meet Universal Health Coverage? *Ethiop J Health Sci,* 28**,** 249-250.

HAILEGEBREAL, S., GILANO, G., SEBOKA, B. T., AHMED, M. H. & SIMEGN, A. E. 2021. Spatial distribution and associated factors of antenatal care utilization in Ethiopia in 2019: Spatial and multilevel analysis. Available: https://assets.researchsquare.com/files/rs-537337/v1_covered.pdf?c=1631869065 [Accessed 19/04/2022].

HAILEMARIAM, T., ATNAFU, A., GEZIE, L. D. & TILAHUN, B. 2022. Why maternal continuum of care remains low in Northwest Ethiopia? A multilevel logistic regression analysis. *PLoS One,* 17**,** e0274729.

HAMED, A., MOHAMED, E. & SABRY, M. 2018. Egyptian status of continuum of care for maternal, newborn, and child health: Sohag Governorate as an example. *Int J Med Sci Public Health,* 7**,** 1.

HANEFELD, J., POWELL-JACKSON, T. & BALABANOVA, D. 2017. Understanding and measuring quality of care: dealing with complexity. *Bulletin of the World Health Organization,* 95**,** 368.

HARDIE, J. H. & LANDALE, N. S. 2013. Profiles of risk: maternal health, socioeconomic status, and child health. *Journal of Marriage and Family,* 75**,** 651-666.

HATEGEKA, C., ARSENAULT, C. & KRUK, M. E. 2020. Temporal trends in coverage, quality and equity of maternal and child health services in Rwanda, 2000–2015. *BMJ Glob health,* 5**,** e002768.

HATT, L. E., MAKINEN, M., MADHAVAN, S. & CONLON, C. M. 2013. Effects of user fee exemptions on the provision and use of maternal health services: a review of literature. *J Health Popul Nutr,* 31**,** 67-80.

HIRSCHHORN, L. R., MAGGE, H. & KIFLIE, A. 2021. Aiming beyond equality to reach equity: the promise and challenge of quality improvement. *bmj,* 374.

HODGINS, S. & D'AGOSTINO, A. 2014. The quality-coverage gap in antenatal care: toward better measurement of effective coverage. *Glob Health Sci Pract,* 2**,** 173-181.

HOMER, C. S. E., CASTRO LOPES, S., NOVE, A., MICHEL-SCHULDT, M., MCCONVILLE, F., MOYO, N. T., BOKOSI, M. & TEN HOOPE-BENDER, P. 2018. Barriers to and strategies for addressing the availability, accessibility, acceptability and quality of the sexual, reproductive, maternal, newborn and adolescent health workforce: addressing the post-2015 agenda. *BMC Pregnancy Childbirth,* 18**,** 55.

HOUWELING, T. A., RONSMANS, C., CAMPBELL, O. M. & KUNST, A. E. 2007. Huge poor-rich inequalities in maternity care: an international comparative study of maternity and child care in developing countries. *Bull World Health Organ,* 85**,** 745-54.

HUG, L., ALEXANDER, M., YOU, D. & ALKEMA, L. 2019. National, regional, and global levels and trends in neonatal mortality between 1990 and 2017, with scenario-based projections to 2030: a systematic analysis. *The Lancet Global Health,* 7**,** e710-e720.

HUG, L., DHARROW, D., ZHONG, K. & YOU, D. 2018. Levels and trends in child mortality: Report 2018. The World Bank.

HUNIE ASRATIE, M. & BELAY, D. G. 2022. Pooled Prevalence and Determinants of Completion of Maternity Continuum of Care in Sub-Saharan Africa: A Multi-Country Analysis of Recent Demographic and Health Surveys. *Front Glob Womens Health,* 3**,** 869552.

HURST, T. E., SEMRAU, K., PATNA, M., GAWANDE, A. & HIRSCHHORN, L. R. 2015. Demand-side interventions for maternal care: evidence of more use, not better outcomes. *BMC Pregnancy Childbirth,* 15**,** 297.

ICAI. 2018. *Assessing DFID's results in improving Maternal Health: An impact review* [Online]. Available: https://icai.independent.gov.uk/html-version/maternal-health/#section-1 [Accessed 15 August 2022].

IDZERDA, L., ADAMS, O., PATRICK, J., SCHRECKER, T. & TUGWELL, P. 2011. Access to primary healthcare services for the Roma population in Serbia: a secondary data analysis. *BMC international health and human rights,* 11**,** 1-14.

IQBAL, S., MAQSOOD, S., ZAKAR, R., ZAKAR, M. Z. & FISCHER, F. 2017. Continuum of care in maternal, newborn and child health in Pakistan: analysis of trends and determinants from 2006 to 2012. *BMC Health Serv Res,* 17**,** 189.

JACA, A., MALINGA, T., IWU-JAJA, C. J., NNAJI, C. A., OKEIBUNOR, J. C., KAMUYA, D. & WIYSONGE, C. S. 2022. Strengthening the Health System as a Strategy to Achieving a Universal Health Coverage in Underprivileged Communities in Africa: A Scoping Review. *Int J Environ Res Public Health,* 19.

JACKSON, R., TESFAY, F. H., GEBREHIWOT, T. G. & GODEFAY, H. 2017. Factors that hinder or enable maternal health strategies to reduce delays in rural and pastoralist areas in Ethiopia. *Trop Med Int Health,* 22**,** 148-160.

JACOBS, C., MOSHABELA, M., MASWENYEHO, S., LAMBO, N. & MICHELO, C. 2017. Predictors of Antenatal Care, Skilled Birth Attendance, and Postnatal Care Utilization among the Remote and Poorest Rural Communities of Zambia: A Multilevel Analysis. *Frontiers in public health,* 5**,** 11-11.

JAFFRE, Y. & PRUAL, A. 1994. Midwives in Niger: an uncomfortable position between social behaviours and health care constraints. *Soc Sci Med,* 38**,** 1069-73.

JAMES, N., LAWSON, K. & ACHARYA, Y. 2020. Evidence on result-based financing in maternal and child health in low- and middle-income countries: a systematic review. *Global health research and policy,* 5**,** 31-31.

JANNATI, A., SADEGHI, V., IMANI, A. & SAADATI, M. 2018. Effective coverage as a new approach to health system performance assessment: a scoping review. *BMC Health Services Research,* 18**,** 1-13.

JAT, T. R., NG, N. & SAN SEBASTIAN, M. 2011. Factors affecting the use of maternal health services in Madhya Pradesh state of India: a multilevel analysis. *International journal for equity in health,* 10**,** 1-11.

JAWAD, M., HONE, T., VAMOS, E. P., CETORELLI, V. & MILLETT, C. 2021. Implications of armed conflict for maternal and child health: A regression analysis of data from 181 countries for 2000–2019. *PLOS Medicine,* 18**,** e1003810.

JEBENA, M. G., TESFAYE, M., ABASHULA, G., BALINA, S., JACKSON, R., ASSEFA, Y., KIFLE, Y., TESFAYE, C., YILMA, M., HIRUY, A., TEKLU, A., BAHRU, B. A., ASSEFA, E., DEMISSIE, M., MITIKE, G. & TUSHUNE, K. 2022. Barriers and facilitators of maternal health care services use among pastoralist women in Ethiopia: Systems thinking perspective. *Pastoralism,* 12**,** 27.

JEHAN, K., SIDNEY, K., SMITH, H. & DE COSTA, A. 2012. Improving access to maternity services: an overview of cash transfer and voucher schemes in South Asia. *Reprod Health Matters,* 20**,** 142-54.

JIANG, S., MA, X., LI, M., YAN, S., ZHAO, H., PAN, Y., WANG, C., YAO, Y., JIN, L. & LI, B. 2020. Association between dietary mineral nutrient intake, body mass index, and waist circumference in U.S. adults using quantile regression analysis NHANES 2007-2014. *PeerJ,* 8**,** e9127-e9127.

JOSEPH, G., DA SILVA, I. C. M., BARROS, A. J. & VICTORA, C. G. 2018. Socioeconomic inequalities in access to skilled birth attendance among urban and rural women in low-income and middle-income countries. *BMJ global health,* 3**,** e000898.

JOSEPH, N. T., PIWOZ, E., LEE, D., MALATA, A., LESLIE, H. H. & GROUP, C. C. T. W. 2020. Examining coverage, content, and impact of maternal nutrition interventions: the case for quality-adjusted coverage measurement. *Journal of global health,* 10.

KANU, J. S., TANG, Y. & LIU, Y. 2014. Assessment on the knowledge and reported practices of women on maternal and child health in rural Sierra Leone: a cross-sectional survey. *PLoS One,* 9**,** e105936.

KEBEDE, O. & TILAHUN, G. 2021. Inventory management performance for family planning, maternal and child health medicines in public health facilities of West Wollega zone, Ethiopia. *J Pharm Policy Pract,* 14**,** 20.

KEBEDE, S. A., WELDESENBET, A. B. & TUSA, B. S. 2022. Determinants of Postnatal Care and Timing of the First Postnatal Care for Newborns in Ethiopia: Further Analysis of 2019 Ethiopian Demographic and Health Survey. *Front Pediatr,* 10**,** 809643.

KERBER, K. J., DE GRAFT-JOHNSON, J. E., BHUTTA, Z. A., OKONG, P., STARRS, A. & LAWN, J. E. 2007. Continuum of care for maternal, newborn, and child health: from slogan to service delivery. *Lancet,* 370**,** 1358-1369.

KHAN, M. N., HARRIS, M. L. & LOXTON, D. 2020. Assessing the effect of pregnancy intention at conception on the continuum of care in maternal healthcare services use in Bangladesh: Evidence from a nationally representative cross-sectional survey. *PLoS One,* 15**,** e0242729.

KHAN, M. N., HARRIS, M. L., SHIFTI, D. M., LAAR, A. S. & LOXTON, D. 2019. Effects of unintended pregnancy on maternal healthcare services utilization in low- and lower-middle-income countries: systematic review and meta-analysis. *Int J Public Health,* 64**,** 743-754.

KHATRI, R. B. & KARKEE, R. 2018. Social determinants of health affecting utilisation of routine maternity services in Nepal: a narrative review of the evidence. *Reprod Health Matters,* 26**,** 32-46.

KIENY, M. P., BEKEDAM, H., DOVLO, D., FITZGERALD, J., HABICHT, J., HARRISON, G., KLUGE, H., LIN, V., MENABDE, N., MIRZA, Z., SIDDIQI, S. & TRAVIS, P. 2017. Strengthening health systems for universal health coverage and sustainable development. *Bull World Health Organ,* 95**,** 537-539.

KIGUME, R. & MALUKA, S. 2021. The failure of community-based health insurance schemes in Tanzania: opening the black box of the implementation process. *BMC Health Services Research,* 21**,** 646.

KIKUCHI, K., ANSAH, E. K., OKAWA, S., ENUAMEH, Y., YASUOKA, J., NANISHI, K., SHIBANUMA, A., GYAPONG, M., OWUSU-AGYEI, S., ODURO, A. R., ASARE, G. Q., HODGSON, A. & JIMBA, M. 2015. Effective Linkages of Continuum of Care for Improving Neonatal, Perinatal, and Maternal Mortality: A Systematic Review and Meta-Analysis. *PLoS One,* 10**,** e0139288.

KIKUCHI, K., YASUOKA, J., NANISHI, K., AHMED, A., NOHARA, Y., NISHIKITANI, M., YOKOTA, F., MIZUTANI, T. & NAKASHIMA, N. 2018. Postnatal care could be the key to improving the continuum of care in maternal and child health in Ratanakiri, Cambodia. *PLOS ONE,* 13**,** e0198829.

KINGSLEY, J. P., VIJAY, P. K., KUMARESAN, J. & SATHIAKUMAR, N. 2021. The Changing Aspects of Motherhood in Face of the COVID-19 Pandemic in Low- and Middle-Income Countries. *Maternal and Child Health Journal,* 25**,** 15-21.

KOENKER, R. & BASSETT JR, G. 1978. Regression quantiles. *Econometrica: journal of the Econometric Society***,** 33-50.

KOMAREK, A. M., THURLOW, J., KOO, J. & DE PINTO, A. 2019. Economywide effects of climate-smart agriculture in Ethiopia. *Agricultural Economics,* 50**,** 765-778.

KOTHAVALE, A. & MEHER, T. 2021. Level of completion along continuum of care for maternal, newborn and child health services and factors associated with it among women in India: a population-based cross-sectional study. *BMC Pregnancy Childbirth,* 21**,** 731.

KOULIDIATI, J.-L., NESBITT, R. C., OUEDRAOGO, N., HIEN, H., ROBYN, P. J., COMPAORÉ, P., SOUARES, A. & BRENNER, S. 2018. Measuring effective coverage of curative child health services in rural Burkina Faso: a cross-sectional study. *BMJ open,* 8**,** e020423.

KRUK, M. E., GAGE, A. D., ARSENAULT, C., JORDAN, K., LESLIE, H. H., RODER-DEWAN, S., ADEYI, O., BARKER, P., DAELMANS, B. & DOUBOVA, S. V. 2018. High-quality health systems in the Sustainable Development Goals era: time for a revolution. *The Lancet global health,* 6**,** e1196-e1252.

KRUK, M. E., KELLEY, E., SYED, S. B., TARP, F., ADDISON, T. & AKACHI, Y. 2017. Measuring quality of health-care services: what is known and where are the gaps? *Bulletin of the World Health Organization,* 95**,** 389-389A.

KURLIKAR, P., RASTE, S. & CHAURASE, M. 2020. Utilization of maternal health care services in urban and rural areas of Maharashtra in India: a study based on district level household survey. *International Journal of Biomedicine Public Health,* 3**,** 70-76.

KYEI, N. N., CHANSA, C. & GABRYSCH, S. 2012. Quality of antenatal care in Zambia: a national assessment. *BMC pregnancy and childbirth,* 12**,** 1-11.

LANGLOIS, É. V., MISZKURKA, M., ZUNZUNEGUI, M. V., GHAFFAR, A., ZIEGLER, D. & KARP, I. 2015. Inequities in postnatal care in low- and middle-income countries: a systematic review and meta-analysis. *Bulletin of the World Health Organization,* 93**,** 259-270G.

LARSON, E., VAIL, D., MBARUKU, G. M., MBATIA, R. & KRUK, M. E. 2017. Beyond utilization: measuring effective coverage of obstetric care along the quality cascade. *International Journal for Quality in Health Care,* 29**,** 104-110.

LASSI, Z. S., MUSAVI, N. B., MALIQI, B., MANSOOR, N., DE FRANCISCO, A., TOURE, K. & BHUTTA, Z. A. 2016. Systematic review on human resources for health interventions to improve

maternal health outcomes: evidence from low- and middle-income countries. *Hum Resour Health,* 14**,** 10.

LASSI, Z. S., SALAM, R. A., DAS, J. K. & BHUTTA, Z. A. 2014. Essential interventions for maternal, newborn and child health: background and methodology. *Reprod Health,* 11 Suppl 1**,** S1.

LAURELL, A. C. 2007. Health system reform in Mexico: a critical review. *International Journal of Health Services,* 37**,** 515-535.

LAWN, J. & KERBER, K. 2006. Opportunities for Africa's Newborns: Practical data, policy and programmatic support for newborn care in Africa. Cape Town: Partnership for Maternal, Newborn Child Health.

LEEGWATER, A., WONG, W. & AVILA, C. 2015. A concise, health service coverage index for monitoring progress towards universal health coverage. *BMC health services research,* 15**,** 1-8.

LESLIE, H. H., DOUBOVA, S. V. & PÉREZ-CUEVAS, R. 2019. Assessing health system performance: effective coverage at the Mexican Institute of Social Security. *Health Policy Plan,* 34**,** ii67-ii76.

LESLIE, H. H., MALATA, A., NDIAYE, Y. & KRUK, M. E. 2017. Effective coverage of primary care services in eight high-mortality countries. *BMJ Glob Health,* 2.

LEVESQUE, J.-F., HARRIS, M. F. & RUSSELL, G. 2013. Patient-centred access to health care: conceptualising access at the interface of health systems and populations. *International Journal for Equity in Health,* 12**,** 18.

LILFORD, R. J., BROWN, C. A. & NICHOLL, J. 2007. Use of process measures to monitor the quality of clinical practice. *Bmj,* 335**,** 648-650.

LORI, J. R., PEROSKY, J., MUNRO-KRAMER, M. L., VELIZ, P., MUSONDA, G., KAUNDA, J., BOYD, C. J., BONAWITZ, R., BIEMBA, G., NGOMA, T. & SCOTT, N. 2019. Maternity waiting homes as part of a comprehensive approach to maternal and newborn care: a cross-sectional survey. *BMC Pregnancy Childbirth,* 19**,** 228.

LOZANO, R., SOLIZ, P., GAKIDOU, E., ABBOTT-KLAFTER, J., FEEHAN, D. M., VIDAL, C., ORTIZ, J. P. & MURRAY, C. J. 2006. Benchmarking of performance of Mexican states with effective coverage. *The Lancet,* 368**,** 1729-1741.

MAES, K., CLOSSER, S., TESFAYE, Y., GILBERT, Y. & ABESHA, R. 2018. Volunteers in Ethiopia's women's development army are more deprived and distressed than their neighbors: cross-sectional survey data from rural Ethiopia. *BMC Public Health,* 18**,** 258.

MAHASE, E. 2020. Covid-19: WHO declares pandemic because of "alarming levels" of spread, severity, and inaction. *BMJ* 368**,** m1036.

MAKATE, M. & MAKATE, C. 2017. The evolution of socioeconomic status-related inequalities in maternal health care utilization: evidence from Zimbabwe, 1994-2011. *Glob Health Res Policy,* 2**,** 1.

MÅLQVIST, M., YUAN, B., TRYGG, N., SELLING, K. & THOMSEN, S. 2013. Targeted interventions for improved equity in maternal and child health in low- and middle-income settings: a systematic review and meta-analysis. *PLoS One,* 8**,** e66453.

MARCHANT, T., BRYCE, J., VICTORA, C., MORAN, A. C., CLAESON, M., REQUEJO, J., AMOUZOU, A., WALKER, N., BOERMA, T. & GROVE, J. 2016. Improved measurement for mothers, newborns and children in the era of the Sustainable Development Goals. *Journal of global health,* 6.

MARCHANT, T., TILLEY-GYADO, R. D., TESSEMA, T., SINGH, K., GAUTHAM, M., UMAR, N., BERHANU, D., COUSENS, S. & ARMSTRONG SCHELLENBERG, J. R. 2015. Adding content to contacts: measurement of high quality contacts for maternal and newborn health in Ethiopia, north east Nigeria, and Uttar Pradesh, India. *PLoS One,* 10**,** e0126840.

MARMOT, M., FRIEL, S., BELL, R., HOUWELING, T. A. & TAYLOR, S. 2008. Closing the gap in a generation: health equity through action on the social determinants of health. *Lancet,* 372**,** 1661-9.

MARTÍNEZ, S., CARRASQUILLA, G., GUERRERO, R., GÓMEZ-DANTÉS, H., CASTRO, V., ARREOLA-ORNELAS, H. & BEDREGAL, P. 2011. Effective coverage of health interventions in Latin America and the Caribbean: metrics for the assessment of health systems performance. *Salud publica de Mexico,* 53**,** s78-84.

MCARTHUR, J. W., RASMUSSEN, K. & YAMEY, G. 2018. How many lives are at stake? Assessing 2030 sustainable development goal trajectories for maternal and child health. *Bmj,* 360**,** k373.

MCMAHON, S. A., GEORGE, A. S., CHEBET, J. J., MOSHA, I. H., MPEMBENI, R. N. & WINCH, P. J. 2014. Experiences of and responses to disrespectful maternity care and abuse during childbirth; a qualitative study with women and men in Morogoro Region, Tanzania. *BMC pregnancy and childbirth,* 14**,** 1-13.

MCNAMEE, P., TERNENT, L. & HUSSEIN, J. 2009. Barriers in accessing maternal healthcare: evidence from low-and middle-income countries. *Expert review of pharmacoeconomics outcomes research,* 9**,** 41-48.

MEKONNEN, Y. & MEKONNEN, A. 2003. Factors influencing the use of maternal healthcare services in Ethiopia. *Journal of health, population nutrition***,** 374-382.

MEMIRIE, S. T., VERGUET, S., NORHEIM, O. F., LEVIN, C. & JOHANSSON, K. A. 2016. Inequalities in utilization of maternal and child health services in Ethiopia: the role of primary health care. *BMC health services research,* 16**,** 1-8.

MIAN, N. U., ALVI, M. A., MALIK, M. Z., IQBAL, S., ZAKAR, R., ZAKAR, M. Z., AWAN, S. H., SHAHID, F., CHAUDHRY, M. A. & FISCHER, F. 2018. Approaches towards improving the quality of maternal and newborn health services in South Asia: challenges and opportunities for healthcare systems. *Global Health,* 14**,** 17.

MILLER, S. & BELIZÁN, J. M. 2015. The true cost of maternal death: individual tragedy impacts family, community and nations. *Reproductive Health,* 12**,** 1-4.

MINISTRY OF HEALTH 2021. Health Sector Transformation Plan II (HSTP II): 2020/21-2024/25. Addis Ababa, Ethiopia: Ministry of Health.

MOHAN, D., LEFEVRE, A. E., GEORGE, A., MPEMBENI, R., BAZANT, E., RUSIBAMAYILA, N., KILLEWO, J., WINCH, P. J. & BAQUI, A. H. 2017. Analysis of dropout across the continuum of maternal health care in Tanzania: findings from a cross-sectional household survey. *Health Policy Plan,* 32**,** 791-799.

MOHER, D., LIBERATI, A., TETZLAFF, J., ALTMAN, D. G. & GROUP, P. 2009. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *PLoS medicine,* 6**,** e1000097.

MOLLER, A. B., PATTEN, J. H., HANSON, C., MORGAN, A., SAY, L., DIAZ, T. & MORAN, A. C. 2019. Monitoring maternal and newborn health outcomes globally: a brief history of key events and initiatives. *Trop Med Int Health,* 24**,** 1342-1368.

MORAN, A. C., KERBER, K., SITRIN, D., GUENTHER, T., MORRISSEY, C. S., NEWBY, H., FISHEL, J., YODER, P. S., HILL, Z. & LAWN, J. E. 2013. Measuring coverage in MNCH: indicators for global tracking of newborn care. *PLoS Med,* 10**,** e1001415.

MORDAL, E., HANSSEN, I., KASSA, A. & VATNE, S. 2021. Mothers' Experiences and Perceptions of Facility-based Delivery Care in Rural Ethiopia. *Health Serv Insights,* 14**,** 11786329211017684.

MOTHUPI, M. C., KNIGHT, L. & TABANA, H. 2018. Measurement approaches in continuum of care for maternal health: a critical interpretive synthesis of evidence from LMICs and its implications for the South African context. *BMC Health Serv Res,* 18**,** 539.

MOYER, C. A. & MUSTAFA, A. 2013. Drivers and deterrents of facility delivery in sub-Saharan Africa: a systematic review. *Reproductive health,* 10**,** 1-14.

MUNN, Z., PETERS, M. D., STERN, C., TUFANARU, C., MCARTHUR, A. & AROMATARIS, E. 2018. Systematic review or scoping review? Guidance for authors when choosing between a systematic or scoping review approach. *BMC medical research methodology,* 18**,** 1-7.

MUNOS, M. K., MAIGA, A., DO, M., SIKA, G. L., CARTER, E. D., MOSSO, R., DOSSO, A., LEYTON, A. & KHAN, S. M. 2018. Linking household survey and health facility data for effective coverage measures: a comparison of ecological and individual linking methods using the Multiple Indicator Cluster Survey in Côte d'Ivoire. *J Glob Health,* 8.

MURPHY, G. A., GATHARA, D., MWACHIRO, J., ABUYA, N., ALUVAALA, J. & ENGLISH, M. 2018. Effective coverage of essential inpatient care for small and sick newborns in a high mortality urban setting: a cross-sectional study in Nairobi City County, Kenya. *BMC medicine,* 16**,** 1-11.

MURRAY, C. J., EVANS, D. B. & EVANS, D. 2003. *Health systems performance assessment: debates, methods and empiricism*, World Health Organization.

MUTUA, M. K., KIMANI-MURAGE, E. & ETTARH, R. R. 2011. Childhood vaccination in informal urban settlements in Nairobi, Kenya: who gets vaccinated? *BMC public health,* 11**,** 1-11.

MWASE, T., BRENNER, S., MAZALALE, J., LOHMANN, J., HAMADOU, S., SOMDA, S. M. A., RIDDE, V. & DE ALLEGRI, M. 2018. Inequities and their determinants in coverage of maternal health services in Burkina Faso. *International Journal for Equity in Health,* 17**,** 58.

NARAYANAN, I. 2006. Continuum of Care. *In:* KERBER, J. L. A. K. (ed.) *Opportunities for Africa's Newborns: Practical Data and Programmatic Support for Newborn Care in Africa.* 1st ed.: The Partnership for Maternal, Newborn and Child Health, USAID, UNCEF, Save the Children, AED and Population Council.

NEAL, S., CHANNON, A. A., CARTER, S. & FALKINGHAM, J. 2015. Universal health care and equity: evidence of maternal health based on an analysis of demographic and household survey data. *International journal for equity in health,* 14**,** 1-12.

NESBITT, R. C., LOHELA, T. J., MANU, A., VESEL, L., OKYERE, E., EDMOND, K., OWUSU-AGYEI, S., KIRKWOOD, B. R. & GABRYSCH, S. 2013. Quality along the continuum: a health facility assessment of intrapartum and postnatal care in Ghana. *PloS one,* 8**,** e81089.

NG, M., FULLMAN, N., DIELEMAN, J. L., FLAXMAN, A. D., MURRAY, C. J. & LIM, S. S. 2014. Effective coverage: a metric for monitoring universal health coverage. *PLoS Med,* 11**,** e1001730.

NGUHIU, P. K., BARASA, E. W. & CHUMA, J. 2017. Determining the effective coverage of maternal and child health services in Kenya, using demographic and health survey data sets: tracking progress towards universal health coverage. *Tropical Medicine & International Health,* 22**,** 442-453.

NGUYEN, P. H., KHƯƠNG, L. Q., PRAMANIK, P., BILLAH, S. M., MENON, P., PIWOZ, E. & LESLIE, H. H. 2021. Effective coverage of nutrition interventions across the continuum of care in Bangladesh: insights from nationwide cross-sectional household and health facility surveys. *BMJ open,* 11**,** e040109.

NIGUSSIE, Z. Y., ZEMICHEAL, N. F., TIRUNEH, G. T., BAYOU, Y. T., TEKLU, G. A., KIBRET, E. S., EIFLER, K., HODSDON, S. E., ALTAYE, D. E., ROSENBLUM, L., GETU, Y. A., NEBI, Z., LEMANGO, E. T., KEBEDE, E. & BETEMARIAM, W. A. 2021. Using mHealth to Improve Timeliness and Quality of Maternal and Newborn Health in the Primary Health Care System in Ethiopia. *Glob Health Sci Pract,* 9**,** 668-681.

NOOR, A. M., AMIN, A. A., AKHWALE, W. S. & SNOW, R. W. 2007. Increasing coverage and decreasing inequity in insecticide-treated bed net use among rural Kenyan children. *PLoS medicine,* 4**,** e255.

OH, J., MOON, J., CHOI, J. W. & KIM, K. 2020. Factors associated with the continuum of care for maternal, newborn and child health in The Gambia: a cross-sectional study using Demographic and Health Survey 2013. *BMJ Open,* 10**,** e036516.

OKAWA, S., WIN, H. H., LESLIE, H. H., NANISHI, K., SHIBANUMA, A., AYE, P. P. & JIMBA, M. 2019. Quality gap in maternal and newborn healthcare: a cross-sectional study in Myanmar. *BMJ global health,* 4**,** e001078.

OKEKE, E. N. & CHARI, A. V. 2015. Can institutional deliveries reduce newborn mortality? Evidence from Rwanda. Citeseer.

OKEREKE, M., UKOR, N. A., ADEBISI, Y. A., OGUNKOLA, I. O., FAVOUR IYAGBAYE, E., ADIELA OWHOR, G. & LUCERO-PRISNO, D. E., 3RD 2021. Impact of COVID-19 on access to healthcare in low- and middle-income countries: Current evidence and future recommendations. *Int J Health Plann Manage,* 36**,** 13-17.

OSAMOR, P. E. & GRADY, C. 2016. Women's autonomy in health care decision-making in developing countries: a synthesis of the literature. *Int J Womens Health,* 8**,** 191-202.

OWILI, P. O., MUGA, M. A., CHOU, Y. J., HSU, Y. H., HUANG, N. & CHIEN, L. Y. 2016. Associations in the continuum of care for maternal, newborn and child health: a population-based study of 12 sub-Saharan Africa countries. *BMC Public Health,* 16**,** 414.

PALO, S. K., DUBEY, S., NEGI, S., SAHAY, M. R., PATEL, K., SWAIN, S., MISHRA, B. K., BHUYAN, D., KANUNGO, S., SOM, M., MERTA, B. R., BHATTACHARYA, D., KSHATRI, J. S. & PATI, S. 2022. Effective interventions to ensure MCH (Maternal and Child Health) services during pandemic related health emergencies (Zika, Ebola, and COVID-19): A systematic review. *PLoS One,* 17**,** e0268106.

PANDA, B. K., KUMAR, G. & AWASTHI, A. 2020. District level inequality in reproductive, maternal, neonatal and child health coverage in India. *BMC Public Health,* 20**,** 58.

PANDEY, A. R., OJHA, B., SHRESTHA, N., MASKEY, J., SHARMA, D., GODWIN, P., CHALISE, B. & ARYAL, K. K. J. J. O. N. H. R. C. 2021. Progress in Reducing Inequalities in Reproductive, Maternal, Newborn and Child Health Services in Nepal. 19**,** 140-147.

PAPANICOLAS, I., RAJAN, D., KARANIKOLOS, M., SOUCAT, A., FIGUERAS, J. & ORGANIZATION, W. H. 2022. Health system performance assessment: a framework for policy analysis.

PARMAR, D. & BANERJEE, A. 2019. How do supply- and demand-side interventions influence equity in healthcare utilisation? Evidence from maternal healthcare in Senegal. *Soc Sci Med,* 241**,** 112582.

PARVIN, N., RAHMAN, M., ISLAM, M. J., HAQUE, S. E., SARKAR, P. & MONDAL, M. N. I. 2022. Socioeconomic inequalities in the continuum of care across women's reproductive life cycle in Bangladesh. *Scientific Reports,* 12**,** 15618.

PENN-KEKANA, L., PEREIRA, S., HUSSEIN, J., BONTOGON, H., CHERSICH, M., MUNJANJA, S. & PORTELA, A. 2017. Understanding the implementation of maternity waiting homes in low- and middle-income countries: a qualitative thematic synthesis. *BMC Pregnancy Childbirth,* 17**,** 269.

PETERS, D. H., GARG, A., BLOOM, G., WALKER, D. G., BRIEGER, W. R. & RAHMAN, M. H. 2008. Poverty and access to health care in developing countries. *Ann N Y Acad Sci,* 1136**,** 161-71.

PEVEN, K., DAY, L. T., BICK, D., PURSSELL, E., TAYLOR, C., AKUZE, J. & MALLICK, L. 2021. Household Survey Measurement of Newborn Postnatal Care: Coverage, Quality Gaps, and Internal Inconsistencies in Responses. *Glob Health Sci Pract,* 9**,** 737-751.

PIETERSE, P. & LODGE, T. 2015. When free healthcare is not free. Corruption and mistrust in Sierra Leone's primary healthcare system immediately prior to the Ebola outbreak. *Int Health,* 7**,** 400-4.

PINHEIRO, A., PRIYADARSHANI, P. & BURKE, T. 2021. Acess and Quality of Postnatal Care in Low- and Middle - Income Countries: A Pragmatic Review. *Glob J Reprod Med,* 8.

POWELL-JACKSON, T., MAZUMDAR, S. & MILLS, A. 2015. Financial incentives in health: New evidence from India's Janani Suraksha Yojana. *Journal of health economics,* 43**,** 154-169.

PUCHALSKI RITCHIE, L. M., KHAN, S., MOORE, J. E., TIMMINGS, C., VAN LETTOW, M., VOGEL, J. P., KHAN, D. N., MBARUKU, G., MRISHO, M., MUGERWA, K., UKA, S., GÜLMEZOGLU, A. M. & STRAUS, S. E. 2016. Low- and middle-income countries face many common barriers to implementation of maternal health evidence products. *J Clin Epidemiol,* 76**,** 229-37.

QUAIFE, M., ESTAFINOS, A. S., KERAGA, D. W., LOHMANN, J., HILL, Z., KIFLIE, A., MARCHANT, T., BORGHI, J. & SCHELLENBERG, J. 2021. Changes in health worker knowledge and

motivation in the context of a quality improvement programme in Ethiopia. *Health Policy Plan,* 36**,** 1508-1520.

QUENTIN, W., PARTANEN, V.-M., BROWNWOOD, I. & KLAZINGA, N. 2019. 3 Measuring healthcare quality. *Improving healthcare quality in Europe***,** 31.

RADEMAKERS, J., DELNOIJ, D. & DE BOER, D. 2011. Structure, process or outcome: which contributes most to patients' overall assessment of healthcare quality? *BMJ quality & safety,* 20**,** 326-331.

RAHMAN, S., CHOUDHURY, A. A., KHANAM, R., MOIN, S. M. I., AHMED, S., BEGUM, N., SHOMA, N. N., QUAIYUM, M. A. & BAQUI, A. H. 2017. Effect of a package of integrated demand- and supply-side interventions on facility delivery rates in rural Bangladesh: Implications for large-scale programs. *PLoS One,* 12**,** e0186182.

RANI, M., BONU, S. & HARVEY, S. J. I. J. F. Q. I. H. C. 2008. Differentials in the quality of antenatal care in India. 20**,** 62-71.

RASANATHAN, K. & DIAZ, T. 2016. Research on health equity in the SDG era: the urgent need for greater focus on implementation. *Int J Equity Health,* 15**,** 202.

REQUEJO, J., DIAZ, T., PARK, L., CHOU, D., CHOUDHURY, A., GUTHOLD, R., JACKSON, D., MOLLER, A. B., MONET, J. P., MORAN, A. C., SAY, L., STRONG, K. L. & BANERJEE, A. 2020. Assessing coverage of interventions for reproductive, maternal, newborn, child, and adolescent health and nutrition. *Bmj,* 368**,** l6915.

REQUEJO, J. H., NEWBY, H. & BRYCE, J. 2013. Measuring coverage in MNCH: challenges and opportunities in the selection of coverage indicators for global monitoring. *PLoS Med,* 10**,** e1001416.

RIAZ, A., ZAIDI, S. & KHOWAJA, A. R. 2015. Perceived barriers to utilizing maternal and neonatal health services in contracted-out versus government-managed health facilities in the rural districts of Pakistan. *Int J Health Policy Manag,* 4**,** 279-84.

RIDDE, V., HADDAD, S. & HEINMÜLLER, R. 2013. Improving equity by removing healthcare fees for children in Burkina Faso. *J Epidemiol Community Health,* 67**,** 751-7.

RODER-DEWAN, S., GAGE, A. D., HIRSCHHORN, L. R., TWUM-DANSO, N. A. Y., LILJESTRAND, J., ASANTE-SHONGWE, K., RODRÍGUEZ, V., YAHYA, T. & KRUK, M. E. 2019. Expectations of healthcare quality: A cross-sectional study of internet users in 12 low- and middle-income countries. *PLoS Med,* 16**,** e1002879.

RONO, J., KAMAU, L., MANGWANA, J., WARUGURU, J., ALUOCH, P. & NJOROGE, M. 2022. A policy analysis of policies and strategic plans on Maternal, Newborn and Child Health in Ethiopia. *International Journal for Equity in Health,* 21**,** 73.

SAHOO, K. C., NEGI, S., PATEL, K., MISHRA, B. K., PALO, S. K. & PATI, S. 2021. Challenges in Maternal and Child Health Services Delivery and Access during Pandemics or Public Health Disasters in Low-and Middle-Income Countries: A Systematic Review. *Healthcare (Basel),* 9.

SAKUMA, S., YASUOKA, J., PHONGLUXA, K. & JIMBA, M. 2019. Determinants of continuum of care for maternal, newborn, and child health services in rural Khammouane, Lao PDR. *PLoS One,* 14**,** e0215635.

SAMBO, L. G. & KIRIGIA, J. M. 2014. Investing in health systems for universal health coverage in Africa. *BMC Int Health Hum Rights,* 14**,** 28.

SAMUEL, O., ZEWOTIR, T. & NORTH, D. 2021. Decomposing the urban-rural inequalities in the utilisation of maternal health care services: evidence from 27 selected countries in Sub-Saharan Africa. *Reprod Health,* 18**,** 216.

SEID, A. & AHMED, M. 2021. Association between health insurance enrolment and maternal health care service utilization among women in Ethiopia. *BMC Public Health,* 21**,** 2329.

SERTSEWOLD, S. G., DEBIE, A. & GEBERU, D. M. 2021. Continuum of maternal healthcare services utilisation and associated factors among women who gave birth in Siyadebirena Wayu

district, Ethiopia: community-based cross-sectional study. *BMJ open,* 11**,** e051148-e051148.

SERVÁN-MORI, E., CERECERO-GARCÍA, D., HEREDIA-PI, I. B., PINEDA-ANTÚNEZ, C., SOSA-RUBÍ, S. G. & NIGENDA, G. 2019. Improving the effective maternal-child health care coverage through synergies between supply and demand-side interventions: evidence from Mexico. *Journal of global health,* 9.

SHARMA, J., LESLIE, H. H., KUNDU, F. & KRUK, M. E. 2017. Poor Quality for Poor Women? Inequities in the Quality of Antenatal and Delivery Care in Kenya. *PLOS ONE,* 12**,** e0171236.

SHENGELIA, B., TANDON, A., ADAMS, O. B. & MURRAY, C. J. 2005. Access, utilization, quality, and effective coverage: an integrated conceptual framework and measurement strategy. *Social science & medicine,* 61**,** 97-109.

SHIBANUMA, A., YEJI, F., OKAWA, S., MAHAMA, E., KIKUCHI, K., NARH, C., ENUAMEH, Y., NANISHI, K., ODURO, A., OWUSU-AGYEI, S., GYAPONG, M., ASARE, G. Q., YASUOKA, J., ANSAH, E. K., HODGSON, A. & JIMBA, M. 2018. The coverage of continuum of care in maternal, newborn and child health: a cross-sectional study of woman-child pairs in Ghana. *BMJ Glob Health,* 3**,** e000786.

SHIFERAW, S., SPIGT, M., GODEFROOIJ, M., MELKAMU, Y., TEKIE, M. J. B. P. & CHILDBIRTH 2013. Why do women prefer home births in Ethiopia? 13**,** 1-10.

SHITIE, A., ASSEFA, N., DHRESSA, M. & DILNESSA, T. 2020. Completion and Factors Associated with Maternity Continuum of Care among Mothers Who Gave Birth in the Last One Year in Enemay District, Northwest Ethiopia. *J Pregnancy,* 2020**,** 7019676.

SINGH, A. 2016. Supply-side barriers to maternal health care utilization at health sub-centers in India. *PeerJ,* 4**,** e2675.

SINGH, K., STORY, W. T. & MORAN, A. C. 2016. Assessing the Continuum of Care Pathway for Maternal Health in South Asia and Sub-Saharan Africa. *Matern Child Health J,* 20**,** 281-9.

SISAY, M. M., GEREMEW, T. T., DEMLIE, Y. W., ALEM, A. T., BEYENE, D. K., MELAK, M. F., GELAYE, K. A., AYELE, T. A. & ANDARGIE, A. A. 2019. Spatial patterns and determinants of postnatal care use in Ethiopia: findings from the 2016 demographic and health survey. *BMJ Open,* 9**,** e025066.

SIXMA, H. J., KERSSENS, J. J., CAMPEN, C. V. & PETERS, L. 1998. Quality of care from the patients' perspective: from theoretical concept to a new measuring instrument. *Health expectations,* 1**,** 82-95.

SMITH, P. C., MOSSIALOS, E., PAPANICOLAS, I. & LEATHERMAN, S. 2009. *Performance measurement for health system improvement: experiences, challenges and prospects*, Cambridge University Press.

SOUZA, J. P., GÜLMEZOGLU, A. M., VOGEL, J., CARROLI, G., LUMBIGANON, P., QURESHI, Z., COSTA, M. J., FAWOLE, B., MUGERWA, Y. & NAFIOU, I. 2013. Moving beyond essential interventions for reduction of maternal mortality (the WHO Multicountry Survey on Maternal and Newborn Health): a cross-sectional study. *The Lancet,* 381**,** 1747-1755.

SPAAN, E., MATHIJSSEN, J., TROMP, N., MCBAIN, F., TEN HAVE, A. & BALTUSSEN, R. 2012. The impact of health insurance in Africa and Asia: a systematic review. *Bull World Health Organ,* 90**,** 685-92.

SSERWANJA, Q., MUKUNYA, D., NABACHENJE, P., KEMIGISA, A., KIONDO, P., WANDABWA, J. N. & MUSABA, M. W. 2022a. Continuum of care for maternal health in Uganda: A national cross-sectional study. *PLoS One,* 17**,** e0264190.

SSERWANJA, Q., MUSABA, M. W., MUTISYA, L. M., OLAL, E. & MUKUNYA, D. 2021. Continuum of maternity care in Zambia: a national representative survey. *BMC Pregnancy Childbirth,* 21**,** 604.

SSERWANJA, Q., MUTISYA, L. M., NUWABAINE, L., KAMARA, K., MUTEBI, R. K. & MUSABA, M. W. 2022b. Continuum of maternal and newborn health in Sierra Leone: a 2019 national survey. *Arch Public Health,* 80**,** 186.

STRASSER, R., KAM, S. M. & REGALADO, S. M. 2016. Rural Health Care Access and Policy in Developing Countries. *Annual review of public health,* 37**,** 395-412.

SULLY, E. A., BIDDLECOM, A., DARROCH, J. E., RILEY, T., ASHFORD, L. S., LINCE-DEROCHE, N., FIRESTEIN, L. & MURRO, R. 2020. Adding it up: investing in sexual and reproductive health 2019. New York: Guttmacher Institute.

TAFERE, Y., YORKE, L., ROSE, P. & PANKHURST, A. 2022. Understanding the Influences on Girls' Primary Education in Ethiopia from the Perspectives of Girls and Their Caregivers. RISE Working

Paper Series. 22/097. https://doi.org/10.35489/BSG-RISE-WP_2022/097

TALUKDER, M. D. & ROB, U. 2010. Equity in access to maternal and child health services in five developing countries: what works. *Int Q Community Health Educ,* 31**,** 119-31.

TAMIRAT, K. S., TESSEMA, Z. T. & KEBEDE, F. B. 2020. Factors associated with the perceived barriers of health care access among reproductive-age women in Ethiopia: a secondary data analysis of 2016 Ethiopian demographic and health survey. *BMC Health Serv Res,* 20**,** 691.

TANAHASHI, T. 1978. Health service coverage and its evaluation. *Bulletin of the World Health organization,* 56**,** 295.

TANGCHAROENSATHIEN, V., MILLS, A. & PALU, T. 2015. Accelerating health equity: the key role of universal health coverage in the Sustainable Development Goals. *BMC Med,* 13**,** 101.

TAREKEGN, S. M., LIEBERMAN, L. S. & GIEDRAITIS, V. 2014. Determinants of maternal health service utilization in Ethiopia: analysis of the 2011 Ethiopian Demographic and Health Survey. *BMC Pregnancy and Childbirth,* 14**,** 161.

TAWFIQ, E., DESAI, J., HYSLOP, D. J. J. O. H. S. R. & POLICY 2019. Effects of results-based financing of maternal and child health services on patient satisfaction in Afghanistan. 24**,** 4-10.

THADDEUS, S. & MAINE, D. 1994. Too far to walk: maternal mortality in context. *Soc Sci Med,* 38**,** 1091-110.

THOMAS, K. J. A. 2020. Child deaths in the past, their consequences in the present, and mortality conditions in sub-Saharan Africa. *Proc Natl Acad Sci U S A,* 117**,** 4453-4455.

THOMSEN, S., HOA, D. T., MÅLQVIST, M., SANNEVING, L., SAXENA, D., TANA, S., YUAN, B. & BYASS, P. 2011. Promoting equity to achieve maternal and child health. *Reprod Health Matters,* 19**,** 176-82.

TIBEBE, A., AMARECH, G., MELESSE, T. & MARIAM., D. H. 2012. Examining out of pocket payments for maternal health in rural Ethiopia: Paradox of free health care un-affordability. *Ethiopian Journal of Health Development,* 26**,** 251-257.

TINKER, A., TEN HOOPE-BENDER, P., AZFAR, S., BUSTREO, F. & BELL, R. 2005. A continuum of care to save newborn lives. *Lancet,* 365**,** 822-5.

TIRUNEH, G. T., DEMISSIE, M., WORKU, A. & BERHANE, Y. 2022. Predictors of maternal and newborn health service utilization across the continuum of care in Ethiopia: A multilevel analysis. *PLOS ONE,* 17**,** e0264612.

TIRUNEH, G. T., WORKU, A., BERHANE, Y., BETEMARIAM, W. & DEMISSIE, M. 2020. Determinants of postnatal care utilization in Ethiopia: a multilevel analysis. *BMC Pregnancy and Childbirth,* 20**,** 549.

TITALEY, C. R., HUNTER, C. L., HEYWOOD, P. & DIBLEY, M. J. 2010. Why don't some women attend antenatal and postnatal care services?: a qualitative study of community members' perspectives in Garut, Sukabumi and Ciamis districts of West Java Province, Indonesia. *BMC Pregnancy Childbirth,* 10**,** 61.

TIZAZU, M. A., SHAREW, N. T., MAMO, T., ZERU, A. B., ASEFA, E. Y. & AMARE, N. S. 2021. Completing the Continuum of Maternity Care and Associated Factors in Debre Berhan Town, Amhara, Ethiopia, 2020. *J Multidiscip Healthc,* 14**,** 21-32.

TRAVASSOS, M. A., BEYENE, B., ADAM, Z., CAMPBELL, J. D., MULHOLLAND, N., DIARRA, S. S., KASSA, T., OOT, L., SEQUEIRA, J. & REYMANN, M. 2016. Immunization coverage surveys and linked biomarker serosurveys in three regions in Ethiopia. *PLoS One,* 11**,** e0149970.

TSEGA, D., ADMAS, M., TALIE, A., TSEGA, T. B., BIRHANU, M. Y., ALEMU, S. & MENGIST, B. 2022. Maternity Continuum Care Completion and Its Associated Factors in Northwest Ethiopia. *J Pregnancy,* 2022**,** 1309881.

TUNÇALP, Ö., WERE, W., MACLENNAN, C., OLADAPO, O., GÜLMEZOGLU, A. & BAHL, R. J. B. 2015. Improving quality of care for mothers and newborns—the WHO Vision. 1471-0528.

UNITED NATIONS. 2016. *Take Action for the Sustainable Development Goals* [Online]. Available: https://www.un.org/sustainabledevelopment/sustainable-development-goals/ [Accessed September 15, 2022].

UNITED NATIONS INTER-AGENCY GROUP FOR CHILD MORTALITY ESTIMATION (UNIGME) 2019. Levels & Trends in Child Mortality: Report 2019, Estimates developed by the United Nations Inter-agency Group for Child Mortality Estimation. New York: United Nations Children's Fund.

UNITED NATIONS POPULATION FUND 2022. Ethiopia: From conflict to climate shocks, women and girls are disproportionately affected.

USMAN, A. K., WOLKA, E., TADESSE, Y., TARIKU, A., YESHIDINBER, A., TEKLU, A. M., SENTURIA, K., GEZAHEGN, W. & LITCH, J. A. 2019. Health system readiness to support facilities for care of preterm, low birth weight, and sick newborns in Ethiopia: a qualitative assessment. *BMC Health Serv Res,* 19**,** 860.

VAN LERBERGHE, W. 2005. *The World Health Report 2005: Make every mother and child count*, World Health Organization.

VAZ, L. M., FRANCO, L., GUENTHER, T., SIMMONS, K., HERRERA, S. & WALL, S. N. 2020. Operationalising health systems thinking: a pathway to high effective coverage. *Health Research Policy and Systems,* 18**,** 1-17.

VENKATESWARAN, M., BOGALE, B., ABU KHADER, K., AWWAD, T., FRIBERG, I. K., GHANEM, B., HIJAZ, T., MØRKRID, K. & FRØEN, J. F. 2019. Effective coverage of essential antenatal care interventions: a cross-sectional study of public primary healthcare clinics in the West Bank. *PloS one,* 14**,** e0212635.

VICTORA, C. G., BARROS, A. J., AXELSON, H., BHUTTA, Z. A., CHOPRA, M., FRANÇA, G. V., KERBER, K., KIRKWOOD, B. R., NEWBY, H., RONSMANS, C. & BOERMA, J. T. 2012. How changes in coverage affect equity in maternal and child health interventions in 35 Countdown to 2015 countries: an analysis of national surveys. *Lancet,* 380**,** 1149-1156.

VICTORA, C. G., FENN, B., BRYCE, J. & KIRKWOOD, B. R. 2005. Co-coverage of preventive interventions and implications for child-survival strategies: evidence from national surveys. *Lancet,* 366**,** 1460-1466.

VICTORA, C. G., JOSEPH, G., SILVA, I. C., MAIA, F. S., VAUGHAN, J. P., BARROS, F. C. & BARROS, A. J. 2018. The inverse equity hypothesis: analyses of institutional deliveries in 286 national surveys. *American journal of public health,* 108**,** 464-471.

VICTORA, C. G., REQUEJO, J. H., BARROS, A. J., BERMAN, P., BHUTTA, Z., BOERMA, T., CHOPRA, M., DE FRANCISCO, A., DAELMANS, B. & HAZEL, E. 2016. Countdown to 2015: a decade of tracking progress for maternal, newborn, and child survival. *The Lancet,* 387**,** 2049-2059.

VICTORA, C. G., VAUGHAN, J. P., BARROS, F. C., SILVA, A. C. & TOMASI, E. J. T. L. 2000. Explaining trends in inequities: evidence from Brazilian child health studies. 356**,** 1093-1098.

WAGSTAFF, A. & NEELSEN, S. 2020. A comprehensive assessment of universal health coverage in 111 countries: a retrospective observational study. *The Lancet Global Health,* 8**,** e39-e49.

WAGSTAFF, A., O'DONNELL, O., VAN DOORSLAER, E. & LINDELOW, M. 2007. *Analyzing health equity using household survey data: a guide to techniques and their implementation*, World Bank Publications.

WANG, W. & HONG, R. 2015. Levels and determinants of continuum of care for maternal and newborn health in Cambodia-evidence from a population-based survey. *BMC pregnancy and childbirth,* 15**,** 62-62.

WANG, W., MALLICK, L., ALLEN, C. & PULLUM, T. 2019. Effective coverage of facility delivery in Bangladesh, Haiti, Malawi, Nepal, Senegal, and Tanzania. *PloS one,* 14**,** e0217853.

WARREN, C., DALY, P., TOURE, L. & MONGI, P. 2006. Postnatal care. *Opportunities for Africa's Newborns*.

WEHRMEISTER, F. C., BARROS, A. J., HOSSEINPOOR, A. R., BOERMA, T. & VICTORA, C. G. 2020a. Measuring universal health coverage in reproductive, maternal, newborn and child health: An update of the composite coverage index. *PLOS ONE,* 15**,** e0232350.

WEHRMEISTER, F. C., FAYÉ, C. M., DA SILVA, I. C. M., AMOUZOU, A., FERREIRA, L. Z., JIWANI, S. S., MELESSE, D. Y., MUTUA, M., MAÏGA, A., CA, T., SIDZE, E., TAYLOR, C., STRONG, K., CARVAJAL-AGUIRRE, L., PORTH, T., HOSSEINPOOR, A. R., BARROS, A. J. D. & BOERMA, T. 2020b. Wealth-related inequalities in the coverage of reproductive, maternal, newborn and child health interventions in 36 countries in the African Region. *Bull World Health Organ,* 98**,** 394-405.

WEHRMEISTER, F. C., RESTREPO-MENDEZ, M.-C., FRANCA, G. V., VICTORA, C. G. & BARROS, A. J. 2016. Summary indices for monitoring universal coverage in maternal and child health care. *Bull World Health Organ,* 94**,** 903-912.

WEITZMAN, A. 2017. The effects of women's education on maternal health: Evidence from Peru. *Social science & medicine (1982),* 180**,** 1-9.

WEKESAH, F. M., MBADA, C. E., MUULA, A. S., KABIRU, C. W., MUTHURI, S. K. & IZUGBARA, C. O. 2016. Effective non-drug interventions for improving outcomes and quality of maternal health care in sub-Saharan Africa: a systematic review. *Syst Rev,* 5**,** 137.

WELLS, S., TAMIR, O., GRAY, J., NAIDOO, D., BEKHIT, M. & GOLDMANN, D. 2018. Are quality improvement collaboratives effective? A systematic review. *BMJ Quality & Safety,* 27**,** 226-240.

WHO 2004. *Making pregnancy safer: the critical role of the skilled attendant: a joint statement by WHO, ICM and FIGO*, World health organization.

WHO 2007. Everybody's business - strengthening health systems to improve health outcomes: WHO's framework for action. Geneva: WHO.

WHO 2010a. Packages of interventions for family planning, safe abortion care, maternal, newborn and child health. Geneva: WHO; Available from: http://www.who.int/maternal_child_adolescent/documents/fch_10_06/en/.

WHO 2010b. The world health report: health systems financing: the path to universal coverage. Geneva (Switzerland): WHO.

WHO 2011. Keeping promises, measuring results: commission on information and accountability for Women's and Children's health. Geneva: World Health Organization.

WHO 2013. *Handbook on health inequality monitoring: with a special focus on low-and middle-income countries*, World Health Organization.

WHO 2014. Every newborn: an action plan to end preventable deaths. Geneva: World Health Organization.

WHO 2015. *State of inequality: reproductive maternal newborn and child health: interactive visualization of health data,* Geneva, Switzerland, World Health Organization.

WHO. 2016a. *Standards for improving quality of maternal and newborn care in health facilities* [Online]. Available: http://www.who.int/reproductivehealth/publications/maternal_perinatal_health/improving-mnh-health-facilities/en/ [Accessed 08 Aug 2021].
WHO. 2016b. *WHO recommendations on antenatal care for a positive pregnancy experience* [Online]. Available: http://apps.who.int/iris/bitstream/10665/250796/1/9789241549912-eng.pdf [Accessed 15 August 2022].
WHO. 2017a. *1 in 10 infants worldwide did not receive any vaccinations in 2016* [Online]. WHO. Available: https://www.who.int/mediacentre/news/releases/2017/infants-worldwide-vaccinations/en/. [Accessed 18 August 2022].
WHO 2017b. Sexual and reproductive health: fact sheet on Sustainable Development Goals (SDGs): health targets. *In:* EUROPE, W. H. O. R. O. F. (ed.).
WHO 2018. Background paper for the technical consultation on effective coverage of health systems, 27–29 August 2001, Rio de Janeiro, Brazil. Geneva: World Health Organization. 2001.
WHO. 2019a. *Maternal mortality: Key facts.* [Online]. World Health Organization. Available: https://www.who.int/news-room/fact-sheets/detail/maternal-mortality [Accessed 10 April 2022].
WHO 2019b. Trends in maternal mortality 2000 to 2017: estimates by WHO, UNICEF, UNFPA, World Bank Group and the United Nations Population Division. World Health Organization.
WHO. 2020a. *Children: improving survival and well-being* [Online]. World Health Organization. Available: https://www.who.int/news-room/fact-sheets/detail/children-reducing-mortality [Accessed 10 April 2022].
WHO 2020b. Maintaining essential health services: operational guidance for the COVID-19 context: interim guidance, 1 June 2020. World Health Organization.
WHO 2020c. Newborns: improving survival and well-being. Geneva: World Health Organization.
WHO. 2021. *Infant and young child feeding* [Online]. Available: https://www.who.int/news-room/fact-sheets/detail/infant-and-young-child-feeding [Accessed 18 August 2022].
WHO. 2022a. *Child mortality (under 5 years)* [Online]. Available: https://www.who.int/news-room/fact-sheets/detail/levels-and-trends-in-child-under-5-mortality-in-2020 [Accessed 15 May 2022].
WHO. 2022b. *Newborn Mortality* [Online]. Available: https://www.who.int/news-room/fact-sheets/detail/levels-and-trends-in-child-mortality-report-2021#:~:text=Globally%202.4%20million%20children%20died,up%20from%2040%25%20in%201990. [Accessed 1 June 2022].
WHO 2022c. WHO recommendations on maternal and newborn care for a positive postnatal experience. Geneva: World Health Organization.
WILLEY, B., WAISWA, P., KAJJO, D., MUNOS, M., AKUZE, J., ALLEN, E. & MARCHANT, T. 2018. Linking data sources for measurement of effective coverage in maternal and newborn health: what do we learn from individual-vs ecological-linking methods? *Journal of global health,* 8.
WILSON, A., SPOTSWOOD, N., HAYMAN, G., VOGEL, J., NARASIA, J., ELIJAH, A., MORGAN, C., MORGAN, A., BEESON, J. & HOMER, C. J. T. L. R. H.-W. P. 2020. Improving the quality of maternal and newborn care in the Pacific region: a scoping review. 3**,** 100028.
WINTER, R., PULLUM, T., FLOREY, L. & HODGINS, S. 2017. Impact of scale-up of maternal and delivery care on reductions in neonatal mortality in USAID MCH Priority Countries, 2000–2010. *Applied Demography and Public Health in the 21st Century*. Springer.
WOLDEGIORGIS, M. A., BHOWMIK, J. & MEKONNEN, W. 2017. Trends in reproductive health indicators in Ethiopia: 2000–2014. *Int J Healthcare,* 3**,** 10.5430.

WOLDIE, M., FEYISSA, G. T., ADMASU, B., HASSEN, K., MITCHELL, K., MAYHEW, S., MCKEE, M. & BALABANOVA, D. 2018. Community health volunteers could help improve access to and use of essential health services by communities in LMICs: an umbrella review. *Health Policy Plan,* 33**,** 1128-1143.

WORKIE, N. W. & RAMANA, G. N. 2013. The health extension program in Ethiopia. UNICO Studies Series. Washington, DC: World Bank.

WORKU, A. G., YALEW, A. W. & AFEWORK, M. F. 2013. Factors affecting utilization of skilled maternal care in Northwest Ethiopia: a multilevel analysis. *BMC Int Health Hum Rights,* 13**,** 20.

WORLD BANK. 2017. *Literacy rate- Ethiopia* [Online]. Available: https://data.worldbank.org/indicator/SE.ADT.LITR.ZS?locations=ET [Accessed 19 August 2022].

WORLD BANK. 2020. *Ethiopia* [Online]. Available: https://data.worldbank.org/country/ET [Accessed 16 August 2022].

WORLD BANK. 2021. *Population, total- Ethiopia* [Online]. Available: https://data.worldbank.org/indicator/SP.POP.TOTL?locations=ET [Accessed 18 August 2022].

WORLD BANK. 2022. *World Bank Country and Lending Groups* [Online]. Available: https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups [Accessed 20 August 2022].

WORLD MAP. 2016. *Ethiopia political map showing the international boundary, ethnically based states and self-governing administrations boundaries with their capitals and national capital* [Online]. Available: http://wwwmapsofworldcom/ethiopia/ [Accessed 15 September 2022].

WUNEH, A. D., MEDHANYIE, A. A., BEZABIH, A. M., PERSSON, L., SCHELLENBERG, J. & OKWARAJI, Y. B. 2019. Wealth-based equity in maternal, neonatal, and child health services utilization: a cross-sectional study from Ethiopia. *Int J Equity Health,* 18**,** 201.

YAKOB, B., GAGE, A., NIGATU, T. G., HURLBURT, S., HAGOS, S., DINSA, G., BOWSER, D., BERMAN, P., KRUK, M. E. & TEKLE, E. 2019. Low effective coverage of family planning and antenatal care services in Ethiopia. *International Journal for Quality in Health Care,* 31**,** 725-732.

YAYA, S., BISHWAJIT, G., UTHMAN, O. A. & AMOUZOU, A. 2018. Why some women fail to give birth at health facilities: A comparative study between Ethiopia and Nigeria. *PLOS ONE,* 13**,** e0196896.

YAYA, S. & GHOSE, B. 2019. Global Inequality in Maternal Health Care Service Utilization: Implications for Sustainable Development Goals. *Health Equity,* 3**,** 145-154.

YEJI, F., SHIBANUMA, A., ODURO, A., DEBPUUR, C., KIKUCHI, K., OWUSU-AGEI, S., GYAPONG, M., OKAWA, S., ANSAH, E., ASARE, G. Q., NANISHI, K., WILLIAMS, J., ADDEI, S., TAWIAH, C., YASUOKA, J., ENUAMEH, Y., SAKEAH, E., WONTUO, P., JIMBA, M., HODGSON, A. & GHANA, E. I. R. P. T. 2015. Continuum of Care in a Maternal, Newborn and Child Health Program in Ghana: Low Completion Rate and Multiple Obstacle Factors. *PLOS ONE,* 10**,** e0142849.

YITBAREK, K., ABRAHAM, G. & MORANKAR, S. 2019. Contribution of women's development army to maternal and child health in Ethiopia: a systematic review of evidence. *BMJ Open,* 9**,** e025937.

YUAN, B., MÅLQVIST, M., TRYGG, N., QIAN, X., NG, N. & THOMSEN, S. 2014. What interventions are effective on reducing inequalities in maternal and child health in low- and middle-income settings? A systematic review. *BMC Public Health,* 14**,** 634.

ZEID, S., GILMORE, K., KHOSLA, R., PAPOWITZ, H., ENGEL, D., DAKKAK, H., RAHAB, N., SHARMA, A. & FAIR, M. 2015. Women's, children's, and adolescents' health in humanitarian and other crises. *BMJ* 351**,** h4346.

ZENG, W., SHEPARD, D. S., NGUYEN, H., CHANSA, C., DAS, A. K., QAMRUDDIN, J. & FRIEDMAN, J. 2018a. Cost-effectiveness of results-based financing, Zambia: a cluster randomized trial. *Bulletin of the World Health Organization,* 96**,** 760-771.

ZENG, W., SHEPARD, D. S., RUSATIRA, J. D. D., BLAAKMAN, A. P. & NSITOU, B. M. 2018b. Evaluation of results-based financing in the Republic of the Congo: a comparison group pre–post study. *Health policy planning,* 33**,** 392-400.

Appendices

Appendix 1. EC and crude coverage estimates of maternal and child health services, the gaps and the distribution across wealth quintiles a

No.	Author and country	Intervention (s)	Effective coverage (EC) (%)	Quality measurement domain	Crude coverage (CC) (%) and percentage gap between effective coverage and crude coverage	EC across wealth quintiles	Quality rating
1	(Hategeka et al., 2020), Rwanda	. Antenatal care (ANC) . Delivery care . Care for child diarrhoea . Care for child pneumonia .Care for chid fever	. Average EC has increased from 21% in 2010 to 33% in 2015 across all five services. . EC was 20% for ANC, 40% for facility delivery, 44% for child pneumonia, 34% for child fever and 27% for child diarrhoea.	Processes of care (care competence, system competence and positive user experience)	. Average CC has increased from 48% (27% gap) in 2010 to 57% (24% gap) in 2015. . CC was 44% (24% gap) for ANC, 91% (51% gap) for facility delivery, 54% (10% gap) for child pneumonia, 50% (16% gap) for child fever and 44% (17% gap) for child diarrhoea.	EC remained largely inequitable across wealth quintiles.	8

2	(Nguhiu et al., 2017), Kenya	. Family planning (FP) . ANC . Skilled delivery & perinatal care . Exclusive breast feeding (EBF) . Immunization . Management of Diarrhoea . Care seeking for acute respiratory illness (ARI) .Use of insecticide treated nets (ITN)	. Aggregate EC has increased from 27% in 2003 to 51% in 2014. . In 2014, EC was 41% for FP, 45% for ANC, 51% for skilled delivery & perinatal care, 72% for EBF, 56% for immunization, 54% for management of Diarrhoea, 41% for care seeking for ARI, and 59% for use of ITN.	Processes of care	. Aggregate CC has increased from 45% (18% gap) in 2003 to 68% (17% gap) in 2014. .In 2014, CC was 68% (27% gap) for FP, 58% (13% gap) for ANC, 61% (10% gap) for skilled delivery & perinatal care, 99.6% (28% gap) for EBF, 80% (24% gap) for immunization, 82% (28% gap) for management of diarrhoea, 59% (18% gap) for care seeking for ARI, and 75% (16% gap) for use of ITN.	. The wealthiest quintile had higher EC of services than the poorest quintile. .With the increase in aggregate EC, there has been a general reduction in the economic inequalities in EC for maternal and child health (MCH) services.	9

3	(Joseph et al., 2020), Malawi	.Nutrition interventions during ANC & delivery	. Women attended a median of three ANC visits but received a median of 1.6 interventions on iron folic acid, 1 instance of counselling on diet during pregnancy, and 0.06 instances of counselling on optimal breastfeeding. Women thus received a median of 1.35 maternal nutrition interventions and 0.57 interventions that might increase uptake of breastfeeding.	Processes of care	Utilization of ANC and facility-delivery was high. After adjustment for nutrition-related quality, women received nutrition-related interventions considerably less often than they sought care.	-	9

4	(Lozano et al., 2006), Mexico	. ANC . Skilled birth attendance (SBA) . Services delivered to premature babies .Treatment of ARI in children	ANC- 67 % SBA- 93 % Services delivered to premature babies- 81 % ARI- 58.1 %	Process of care & outcome	EC measures were lower than CC estimates.	. Inequalities exist in EC between income quintiles. .The absolute gap in EC between quintiles is 9% for the MCH interventions.	6
5	(Yakob et al., 2019), Ethiopia	. ANC .FP	ANC- 21.5% FP- 21.7%	Processes of care	CC was 62.4% (41% gap) for ANC, and 60.6% (39% gap) for FP.	-	9
6	(Gutiérrez, 2013), Mexico	. ARI treatment . Delivery care .Prenatal care	EC ranged from 59% for ARI treatment to 94% for delivery care.	Processes of care	-	Care of ARI is significantly greater among non-poor in relation to the	6

						multidimensional poor and those who are vulnerable due to deficiencies, as well as the socioeconomic quintile. The estimated gap between quintile I and V is 29.8%, which translates into coverage of more than 17 percentage points higher in quintile V. .In the case of hospital care during	

						childbirth, the differences are not significant, although a tendency to give greater coverage among those in better socioeconomic conditions is also identified. The gap for adequate prenatal care is 27.1%, between a coverage of 72.4% in the first	

						quintile, and 92.0% in the fifth.	
7	(Martínez et al., 2011), Latin American & the Caribbean	.Breast feeding	EC ranged from 52% to 95%.	Development of acute diarrheal disease and ARI	CC results were given for the MCH interventions, but quality was not measured except for breast feeding.	-	5
8	(Wang et al., 2019), Bangladesh, Haiti, Malawi, Nepal, Senegal,	Facility delivery	EC was 26.8 % in Bangladesh, 24.4 % in Haiti, 66.4% in Malawi, 41.9% in Nepal, 51.3% in Senegal and 44.2% in Tanzania.	Structure	CC was 39.7% (13% gap) in Bangladesh, 40% (16% gap) in Haiti, 92.9% (27% gap) in Malawi, 52.7% (11% gap) in Nepal, 77% (26% gap) in Senegal, and 65% (21% gap) in Tanzania.	-	9

	Tanzania						
9	(Nesbitt et al., 2013), Ghana	SBA	EC was 18%.	Processes of care & structure	.CC was 68% (50% gap)	- EC varied with wealth quintile; 4% of live-births in the lowest wealth quintile were in high quality facilities compared to 37% of live-births in the highest quintile.	9

10	(Koulidiati et al., 2018), Burkina Faso	Care seeking for childhood illnesses	EC was 5.3% considering high quality, and 44.6% (Considering both high and intermediate quality facilities).	Processes of care & structure	CC was 69.5% (64% gap considering high-quality facilities).	-	6
11	(Leslie et al., 2017), Haiti, Kenya, Malawi, Namibia, Senegal, Rwanda, Tanzania, Uganda	ANC FP Care for seek children < 5	. Average EC of the three services was 25.4% across all countries. . Individually, the average EC across these services was: 19.2% in Haiti, 26.3% in Kenya, 24.7% in Malawi, 40.7% in Namibia, 19% in	Processes of care	. Average CC of the three services was 69.2% (44% gap) across all countries. . Individually, the average CC across these services was: 58.9% in Haiti, 67.1% in Kenya, 81.2% in Malawi, 80.3% in Namibia, 58.8% in Senegal, 67.5% in Rwanda, 67.5% in Tanzania, and 68.2% in Uganda.	EC was highest on average in Namibia (by far the wealthiest country in the sample).	9

			Senegal, 24.5% in Rwanda, 22.5% in Tanzania, and 26.3% in Uganda.				
12	(Carter et al., 2018), Zambia	Care for sick children <5	Using exact-match linking: EC of was estimated at 60% in the rural area and 49% in the urban area.	Structure	From the exact-match linking result: There was a16-point rural gap and 13-point urban gap in coverage between seeking skilled care and EC. (i.e.CC was 76% in the rural area and 62% in the urban area).	-	9
13	(Leslie et al., 2019), Mexico	ANC Delivery care Newborn care Under 5 diarrhoea	EC was 63.3% for ANC, 31.1% for delivery care, 74.3% for newborn care and	Outcome	-	Substantial inequality in EC existed between states, but wealth status was not considered.	8

			26.8% for under-5 diarrhoea				
14	(Marchant et al., 2015), Nigeria, Ethiopia, and India	ANC SBA Post-partum checks (PPC) Post-natal care (PNC)	In Gombe, EC was 11% for ANC, 8% for SBA, 0% for PPC, and 0% for PNC. In Ethiopia, EC was 4% for ANC, 4% for SBA, 0% for PPC, and 0% for PNC. In India, EC was 6% for ANC, 4% for SBA, 0% for PPC, and 0% for PNC.	Processes of care	In Gombe, CC was 61% for ANC, 22% for SBA, 7% for PPC, and 4% for PNC. In Ethiopia, CC was 56% for ANC, 15% for SBA, 3% for PPC, and 4% for PNC. In India CC was 74% for ANC, 76% for SBA, 54% for PPC, and 19% for PNC. .The gap ranges from 3% for post-partum check (Ethiopia) to 72% for SBA (India).	-	9

15	(Okawa et al., 2019), Myanmar	ANC Peripartum care and PNC	The EC was 14.6% for ANC, 15.2% for peripartum care and 3.6% for PNC.	Processes of care	The CC was 60.9% (46% gap) for ANC, 61.3% (46% gap) for peripartum care and 11.5% (8% gap) for PNC.	Household wealth was not associated with receiving high-quality care.	7
16	(Murphy et al., 2018), Kenya	Inpatient neonatal care	EC was 25%.	Structure & processes of care	-	-	9
17	(Willey et al., 2018), Uganda	SBA	. Using the individual-linking method, EC of SBA was 10%. . Using ecological linking method EC ranged from 4.68 % to 11 %.	Structure	CC was 55% (45% gap when using the individual linking method & 44% to 50% when using ecological linking method).	-	9

18	(Larson et al., 2017), Tanzania	Delivery care	.EC was 25%. However, applying a conservative standard (90% completion of required elements), the EC was zero.	Structure & processes of care	CC was 82% (57% gap).	The wealthiest 20% of women were 4.1 times as likely to deliver in facilities offering at least the minimum threshold of quality care through the cascade compared to the poorest 80% of women. EC of delivery care was very low, particularly among poorer women.	8

19	(Munos et al., 2018), Côte d'Ivoire	ANC Delivery and immediate newborn care PNC Care seeking for sick child	EC estimates generated using ecological and exact-match linking methods varied across the interventions.	Structure & processes of care	.CC was 82% for ANC, 65% for delivery care, 65% for newborn care, 5% for PNC, and 43% for sick childcare. .EC estimates computed using exact-match methods were 13%-63% lower than the care seeking estimates from the CC.	-	9
20	(Hodgins and D'Agostino, 2014), 41 countries	ANC	EC ranged from 14% in Niger to 84% In Dominican republic.	Processes of care	Coverage for specific interventions was generally much lower among all pregnant women (reflecting population effective coverage) than among only those who had received ANC 4+ visits.	-	9
21	(Idzerda et al., 2011), Roma, Serbia	ARI in children	EC was 36.8% in the general population,	Processes of care	CC was 63.2% (26% gap) in the general population, 67.4% (37% gap) in Roma, and	-	5

			30.8% in Roma and 66.7% in the poorest 20% of the Roma population.		88.9% (22% gap) in the poorest 20%.		
22	(Engle-Stone et al., 2015), Cameroon	Nutrition interventions	EC estimates varied across the nutrition interventions and they were lower.	Biomarkers	Estimates of coverage were greater than the EC estimates.	-	9
23	(Colston, 2011), Mexico & Nicaragua	Immunization	EC was 68% in Mexico and 50% in Nicaragua.	Biomarkers	CC was 83% (15% gap) in Mexico and 85% (35% gap) in Nicaragua.	-	9
24	(Venkateswaran et al., 2019), West Bank, Palestine	ANC	EC of the specific ANC interventions varied from 7% to 59%.	Processes of care	Coverage of one screening (conceptually equivalent to CC) and EC of ANC interventions were notably different	-	7

					for screening for: hypertension (98% vs. 10%); fetal growth abnormalities (66% vs. 6%); anemia (93% vs. 14%); gestational diabetes (93% vs. 34%), and antenatal ultrasound (74% vs. 24%).		
25	(Kyei et al., 2012), Zambia	ANC	Only 29% of mothers received good quality ANC and only 8% received good quality ANC and attended in the first trimester (as a proxy for EC).	Processes of care	94% (86% gap) of mothers had at least one ANC visit with a skilled health worker and 60% (52% gap) had at least four visits.	-	9
26	(Travassos et al., 2016), Ethiopia	Immunization	Estimates of immunization coverage by immunization card,	Biomarkers	- Among toddlers, the estimation of coverage based on documented	-	7

			maternal recall and protective serologic biomarkers varied across the study regions.		vaccination (vaccination card or EPI registry record) was only slightly lower (4–11%) than the prevalence of protective tetanus antitoxin biomarkers. Moreover, among the toddlers whose evidence of vaccination derived from maternal recall, the prevalence of protective serologic biomarkers was higher than maternal recall estimates of coverage. - Estimates of pentavalent coverage by immunization card were lower than the prevalence of protective serologic biomarkers. In contrast, EPI register record estimates were similar to biomarker findings.		

27	(Nguyen et al., 2021), Bangladesh	Nutrition interventions across the continuum of maternal and early childhood care (specifically ANC and delivery for women and growth monitoring and curative care for young children.	18% for ANC, 23% for institutional delivery, 20% for child growth monitoring and 52% for sick child Care.	Structure	Contact coverage varied from 28% for attending at least four ANC visits to 38% for institutional delivery, 35% for child growth monitoring and 81% for sick child care. - The gaps between contact and Input-adjusted coverage ranged between 10 and 30 percentage points.	Inequalities in input-adjusted coverage were large during ANC and institutional delivery (14–17 percentage points (pp) between urban and rural areas, 15 pp between low and high education, and 28-34 pp between highest and	7

						lowest wealth quintiles), but narrower for child growth monitoring and sick child care (<2 pp).	

Appendix 2. Quality assessment results of the included studies using Joanna Briggs Institute's standardized critical appraisal instrument for prevalence studies for chapter six

Citation	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Total score
Hategeka C, *et al*., 2020 (Hategeka et al., 2020)	Y	Y	Y	Y	Y	N	Y	Y	Y	8
Nguhiu et al., 2017 (Nguhiu et al., 2017)	Y	Y	Y	Y	Y	Y	Y	Y	Y	9
Joseph et al., 2020 (Joseph et al., 2020)	Y	Y	Y	Y	Y	Y	Y	Y	Y	9
Lozano et al., 2006 (Lozano et al., 2006)	Y	Y	Y	Y	N	N	Y	N	Y	6
Yakob et al., 2019 (Yakob et al., 2019)	Y	Y	Y	Y	Y	Y	Y	Y	Y	9
Gutiérrez, J. P. et al., 2013. (Gutiérrez, 2013)	Y	Y	Y	Y	U	N	Y	N	Y	6
Martínez S. et al., 2011 (Martínez et al., 2011)	Y	Y	Y	Y	U	N	U	N	Y	5
Wang et al., 2019 (Wang et al., 2019)	Y	Y	Y	Y	Y	Y	Y	Y	Y	9
Nesbitt et al., 2013 (Nesbitt et al., 2013)	Y	Y	Y	Y	Y	Y	Y	Y	Y	9
Koulidiati J-l, et al. , 2018 (Koulidiati et al., 2018)	N	N	Y	Y	N	Y	Y	Y	Y	6

Leslie HH, et al., 2017 (Leslie et al., 2017)	Y	Y	Y	Y	Y	Y	Y	Y	Y	9
Carter et al., 2018 (Carter et al., 2018)	Y	Y	Y	Y	Y	Y	Y	Y	Y	9
Leslie et al., 2019 (Leslie et al., 2019)	Y	Y	N	Y	Y	Y	Y	Y	Y	8
Marchant et al., 2015 (Marchant et al., 2015)	Y	Y	Y	Y	Y	Y	Y	Y	Y	9
Okawa S. et al., 2019 (Okawa et al., 2019)	N	N	Y	Y	Y	Y	Y	Y	Y	7
Murphy et al., 2018 (Murphy et al., 2018)	Y	Y	Y	Y	Y	Y	Y	Y	Y	9
Willey et al., 2018 (Willey et al., 2018)	Y	Y	Y	Y	Y	Y	Y	Y	Y	9
Larson et al., 2016 (Larson et al., 2017)	Y	N	Y	Y	Y	Y	Y	Y	Y	8
Munos et al., 2018 (Munos et al., 2018)	Y	Y	Y	Y	Y	Y	Y	Y	Y	9
Hodgins et al., 2014 (Hodgins and D'Agostino, 2014)	Y	Y	Y	Y	Y	Y	Y	Y	Y	9
Idzerda et al, 2011 (Idzerda et al., 2011)	Y	Y	Y	Y	U	N	U	U	Y	5

Engle-Stone et al., 2015 (Engle-Stone et al., 2015)	Y	Y	Y	Y	Y	Y	Y	Y	Y	9
Colson et al., 2015 (Colson et al., 2015)	Y	Y	Y	Y	Y	Y	Y	Y	Y	9
Venkateswaran et al., 2019 (Venkateswaran et al., 2019)	Y	Y	Y	Y	N	N	Y	Y	Y	7
Kyei et al., 2012 (Kyei et al., 2012)	Y	Y	Y	Y	Y	Y	Y	Y	Y	9
Travassos et al., 2016 (Travassos et al., 2016)	N	Y	Y	Y	N	Y	Y	Y	Y	7
Nguyen PH, et al., 2021 (Nguyen et al., 2021)	Y	Y	Y	Y	N	N	Y	Y	Y	7
Legend Y=Yes, N=No, U=Unclear										

Q1: Was the sample frame appropriate to address the target population?

Q2: Were study participants sampled in an appropriate way?

Q3: Was the sample size adequate?

Q4: Were the study subjects and the setting described in detail?

Q5: Was the data analysis conducted with sufficient coverage of the identified sample?

Q6: Were valid methods used for the identification of the condition?

Q7: Was the condition measured in a standard, reliable way for all participants?

Q8: Was there appropriate statistical analysis?

Q9: Was the response rate adequate, and if not, was the low response rate managed appropriately?

Appendix 3. Quality measurement strategies of studies assessing the effective coverage of maternal and child health services for chapter six

Author	Domain	Quality indices	
(Hategeka et al., 2020)	Process	Antenatal care (ANC)	Blood pressure, urine and blood samples taken during ANC with skilled provider, iron supplementation, told about danger signs or where to go in case of complications during ANC with skilled provider (counselling)
		Postpartum care	Postpartum check-up for mothers in a health facility after delivery and before discharge, women who were examined or asked questions about their health within one hour of delivery (Timely care), children who had all three doses of the DPT vaccine by one year of age
		Care for sick children	Received antibiotics when seeking care at a facility for symptoms of pneumonia Children who had blood taken from finger or heel for testing / tested for malaria (For fever) Children who received oral rehydration therapy (from oral rehydration salts (ORS), pre-packaged ORS liquid or other homemade fluids)/ ORT
(Nguhiu et al., 2017)	Process	Family planning	Facility level score based on the presence of client privacy during consultation, availability of reproductive health counselling visual aids and record tools, and reproductive health commodity management practices in a facility
		ANC	Blood pressure taken, urine sample taken, blood sample taken, respondent informed about pregnancy complications, iron tablets/syrup prescribed, and a drug for intestinal parasites prescribed, during any ANC visit
		Delivery care	Routine rooming in with the mother, routine weighing of new-borns, complete examination of new-borns before discharge, administration of BCG before discharge and other indicators.
		Exclusive breastfeeding	Breastfeeding only, with no other complementary feed offered reported
		Immunization	Observed or health worker reported availability of at least one working weighing scale and thermometer, and routinely performed processes including use of guidelines to assess and treat

			sick children, routine weighing, temperature taking and recording, assessment of immunization status and keeping of individual patient records.
		Management of diarrhoea	Children who had diarrhoea in the preceding 4 weeks, who were given the guideline recommended oral rehydration salt mixture
		Care seeking for acute respiratory infection (ARI)	Observed or health worker reported availability of at least one working weighing scale and thermometer, and routinely performed processes including use of guidelines to assess and treat sick children, routine weighing, temperature taking and recording, assessment of immunisation status and keeping of individual patient records
		Use of ITN	Proportion of children and pregnant women who actually slept under an insecticide treated net in the preceding night
(Nguyen et al., 2021)	Structure	ANC	Human resources► Staff with any training on ANC Guidelines, national guidelines for ANC, visual aids for client education. Basic equipment ► Adult weighing scale, tape measure for fundal height, Blood pressure apparatus, Stethoscope, Foetal stethoscope. Diagnostic capacity. ► Haemoglobin. ► Urine protein. Essential medicines. ► Iron tablets. ► IFA tablets.
		Delivery care	Human resources ► Staff with any training on IMPACT Guidelines ► Guidelines on basic birth care BEmONC ► Guidelines on comprehensive birth care: CEmONC Basic equipment ► Infant scale ► Manual or digital BP apparatus
		Child growth monitoring	Human resources ► Staff with any training on growth monitoring Guidelines ► Guidelines for growth monitoring

			Basic equipment: ► Scale ► Length or height board ► Tape for measuring head ► Growth chart
		Sick child care	Human resources ► Staff with any training on IMCI Guidelines ► IMCI guideline: national guidelines for IMCI, IMCI chart booklet, IMCI card, other visual aids Basic equipment ► Scale Diagnostic capacity ► Haemoglobin Essential medicines: ► ORS ► Albendazole/ mebendazole ► Iron tablet ► Vitamin A ► Zinc tablet/zinc sulphate syrup.
(Larson et al., 2017)	Process & structure	Obstetric care	Facility infrastructure(toilet, electricity, water) Availability of equipment, supplies and medicines (stainless steel bowls, stethoscope, uterotonic, magnesium sulphate, blood pressure cuff etc.) Health worker knowledge and competence; Provision of routine obstetric services; (baby breastfed within 1 hr, APGAR, HIV test, baby weighed, maternal blood pressure ,Partograph) Provision of emergency obstetric and newborn services(uterotonic, removal of conception retained products, newborn resuscitation, antibiotics, anticonvulsants, manual removal of placenta)
(Nesbitt et al., 2013)	Process & structure	Skilled birth attendance (SBA)	Routine delivery- Monitor labour with partograph, Use measures of infection prevention during delivery, measure blood pressure, controlled cord traction, oxytocin within 1 minute of delivery, uterine massage, place baby on mother's abdomen after delivery etc. Emergency obstetric care- Parenteral antibiotic, parenteral oxytocin, parenteral anticonvulsant, manual removal of placenta, instrumental delivery etc.

			Emergency newborn care- Injectable antibiotics for newborn sepsis, newborn resuscitation with bag and mask, skin-to-skin or Kangaroo Mother Care for low birth weight etc. Non-medical quality- Woman can choose to have delivery companion, patient toilet exists, toilet has water for hand washing, toilet is clean, toilet has soap for hand washing.
(Lozano et al., 2006)	Process & outcome	ANC	Received blood test and had BP measured
		SBA	Birth took place in hospital
		Services delivered to premature babies	Difference in mortality rate in premature babies compared with max and min risk-adjusted mortality
		ARI	Treatment from a health worker
(Okawa et al., 2019)	Process	ANC	Tetanus toxoid two doses injected, blood pressure measured, deworming, vitamin b1 tablets given, iron folate tablets prescribed, HIV tested, syphilis tested, urine protein checked, tuberculosis screening done, body weight measured, urine sugar checked, emotional status, haemoglobin, domestic violence checked
		Peripartum care	Newborn body dried, disposable delivery kit used, delivered on a clean floor/bed, first bathing of newborn after 6 hours, birth weight measured, breastfeeding initiated <30 min, skin-to-skin contact
		Postnatal care	Maternal- family planning counselling, blood pressure measured, temperature measured, anaemia checked, iron folate prescribed, Vitamin B1 tablets, Vitamin A tablets, breast and nipple checked, vaginal healing checked, uterus checked, lochia checked, emotional status checked. Neonatal- BCG immunisation given, Hepatitis B immunisation, temperature measured, physical examination, breast feeding checked,

(Yakob et al., 2019)	Process	Family planning	Discussed STI prevention and condom, partner status, asked STI symptoms, checked current breastfeeding, asked chronic illness, discussed HIV risks, assured confidentiality, used visual aids, asked desired timing of next chid, assed menstrual regularity, asked last deliver date, asked client age, asked reproductive intentions, Measured blood pressure etc.
		ANC	Checked blood pressure, measured weight, checked fetal heartbeat, checked uterine height, checked pallor, asked LMP, done HIV test, done urine test, done anaemia test, counselled nutrition, asked danger signs, provided TT vaccination, HIV counselling, syphilis test, provided iron etc.
(Wang et al., 2019)	Structure	Facility delivery	Domain A: Comprehensive emergency obstetric care Parenteral administration of antibiotics, parenteral administration of uterotonic drugs/oxytocin, Parenteral administration of anticonvulsants, manual removal of placenta, assisted vaginal delivery, removal of retained products, caesarean section, blood transfusion Domain B: Newborn signal functions and immediate care Neonatal resuscitation, skin to skin, breastfeeding in 1st hour, drying and wrapping newborns Domain C: General requirements Improved water source, electricity, improved sanitation, 24/7 SBA, emergency transport Domain D: Equipment Sterilization equipment, delivery bed, examination light, delivery pack, Suction apparatus, manual vacuum extractor, partograph, gloves, newborn bag and mask, infant scale, blood pressure apparatus, disinfectant etc. Domain E: Medicines and commodities Hydrocortisone, injectable antibiotic, injectable uterotonic, skin disinfectant, magnesium sulphate, chlorhexidine for cord cleaning , antibiotic eye ointment, IV solution with infusion set

			Domain F: Guidelines, staff training and supervision Integrated Management of Pregnancy and Childbirth guidelines, EmOC Guidelines, guidelines for management of preterm labor,Training in neonatal resuscitation, training in early and exclusive breastfeeding, training in newborn infection management, training in cord care, training in CEmOC , supervision etc.
(Leslie et al., 2017)	Process	ANC	History taking- Last menstrual period to calculate gestational age, prior pregnancy experience, danger signs in current pregnancy, previous complications on record Routine Examination – Provider assessed fundal height, weight, edema, vaginal exam, fetal heart rate, BP, ultrasound Screening- Provider screened HIV, anaemia, syphilis test, blood group test, urine test Preventive measures -Prescribed or gave iron or folic acid or both, provider prescribed or gave tetanus toxoid injection, prescribed or gave intermittent preventive treatment in pregnancy. Education – Provider counselled on: Nutrition Sleeping under an insecticide-treated net, delivery planning: preparation (money, transport) and location emergency planning: supplies for home delivery Breastfeeding, post-partum and PNC, Pregnancy spacing Record keeping- Provider completed ANC card
		Family planning	Reproductive history- Age, living children, last delivery date, pregnancy complications, last menstrual period, desire for child / more children, desired timing for birth of next child, breastfeeding, menses Health history/exam- Blood pressure, weight, smoking, STI symptoms, chronic illness, pelvic exam Counselling on methods - Any counselling on method

		Sick child care	History taking- Inability to drink anything, normal feeding pattern, sick feeding pattern, cough or difficult breathing, diarrhoea and blood in stool (dysentery), fever, vomiting , convulsions , maternal HIV status, ear problems Routine examination – Weight, plotted weight on chart, temperature, pallor, edema of feet, mouth Drug administration and immunization- Checked immunization card or immunized, Vitamin A dosage, deworming medication Client Education and Counselling - Explained how to administer prescribed medication, directions for feeding , described danger signs requiring return to facility , scheduled/discussed return visit, gave diagnosis
(Venkateswaran et al., 2019)	Process	ANC	Screening for hypertension, SFH measurement, screening for anaemia, antenatal ultrasound, screening for gestational diabetes mellitus, screening for asymptomatic bacteriuria, screening for Rh-type, screening for tetanus immunization status
(Murphy et al., 2018)	Process & structure	Inpatient neonatal care	(I) Documentation of newborn characteristics- Age, sex, mode of delivery, Apgar score etc. (II) Documentation of signs and symptoms- Temperature, bulging fontanelle, can suck or breastfed etc. (III) Evidence of monitoring – weight, vital signs etc. (IV) Correct antibiotic dose (V) Correct oxygen treatment and (VI) Correct fluids and feeds prescribed Structural domains: (i) Infrastructure (three items), (ii) laboratory services (10 items), (iii) hygiene equipment (14 items), (iv) safe delivery equipment and drugs for mothers (37 items), (v) resuscitation equipment for newborns on the delivery ward (20 items), (vi) essential equipment in the newborn unit (NBU) (18 items), (vii) intravenous fluids and feeds in the NBU (eight items) and (viii) NBU drugs (17 items)

(Marchant et al., 2015)	Process	ANC	Measured weight, measured height, measured blood pressure, urine test, HIV test, counselling on breast feeding, danger signs and birth preparedness.
		SBA	Received active management of third stage of labour components
		Postpartum check	Checked breasts, checked bleeding, counselling on danger signs, family planning and nutrition
		Postnatal check	Checked weight, checked cord, examined danger signs, caregiver counselling on thermal care, counselling on breastfeeding
(Koulidiati et al., 2018)	Process & structure	Care seeking for childhood illness	Provider asks- danger signs, fever, cough, ear problems Provider checks- child weight, temperature, anaemia, vaccination status Provider knowledge on appropriate first-line management processes of (1) severe dehydration in a 2-year-old (five process indicators), (2) breathing difficulties in a 1-year-old (three process indicators), and (3) lethargy in a newborn (three process indicators) assessed by the three vignettes. Availability of electricity, water, sanitation, transport, and waiting room
(Hodgins and D'Agostino, 2014)	Process	ANC	Blood pressure measurement, tetanus toxoid, ANC at < 4 months of gestation, urine testing, counselling on danger signs, HIV testing, iron supplement etc.
(Joseph et al., 2020)	Process	Nutrition interventions	Provision of iron-folic acid (IFA) supplements and counselling on their side effects, counselling on appropriate nutrition and diets during pregnancy, and counselling and support for early and exclusive breastfeeding Direct observation of breastfeeding initiation within 1 hour of delivery, the newborn being placed skin-to skin if breathing, and keeping the mother and newborn in the same room.
(Willey et al., 2018)	Structure	SBA	Infrastructure- electricity, water Infection prevention- disinfectants, glove, sterilizer

			Monitoring labour- BP cuff, timer, stethoscope etc. Essential drugs- Parenteral antibiotics, anticonvulsants etc. Neonatal resuscitation- bag and mask Clean cord care- sterile cord cutter, cord tie
(Carter et al., 2018)	Structure	Care seeking for childhood illness	Diagnostics- Malaria Diagnostic (RDTs or microscopy), malnutrition diagnostic (MUAC or scale + height board + growth chart), ARI diagnostic (stethoscope or respiratory timer), General microscopy Basic medicines- ORS, zinc, Artemisinin combination therapy (ACT), oral antibiotic Severe/complicated illness medicines- Intravenous fluids, injectable quinine or artesunate, injectable antibiotics Human Resources- Training, guidelines, supervision Available services- Diagnosis and treat malaria, diarrhoea, ARI, malnutrition, facilitated referral capacity Knowledge- Average performance on case scenarios
(Munos et al., 2018)	Process & structure	ANC, delivery car, care-seeking for chid illness, postnatal care	Identified items of structural quality in the domains of service availability; availability of drugs, diagnostics, and commodities; and training, supervision, and availability of guidelines,
(Martínez et al., 2011)		Breastfeeding	The presence of diarrheal disease or ARI
(Leslie et al., 2019)	Outcome	ANC	Proportion of births at full term
		Delivery care	Proportion of deliveries without complications or death.

		Newborn care	Proportion of live births reaching 28 days without death due to respiratory infection, nosocomial infection or sepsis.
		Diarrhoea management	Visits to IMSS family medicine clinics that did not result in hospitalization due to diarrhoea for children under age 5.
(Engle-Stone et al., 2015)	Biomarkers	Nutrition	Vitamin A intake
(Kyei et al., 2012)	Process	ANC	Weight measurement, height measurement, blood pressure measurement, urine sample taken for analysis, blood sample taken for analysis, offered voluntary counselling and testing, iron supplementation provided, antimalarial drug provided, birth preparedness plan discussed, treatment provided for intestinal parasites and tetanus toxoid vaccination.
(Travassos et al., 2016)	Biomarkers	Immunization	Serum IgG antibodies to vaccine antigens
(Colson et al., 2015)	Biomarkers	Immunization	Dried blood sample assay for measles-specific IgG
(Gutiérrez, 2013)	Process	ARI	Treatment from a health worker
		Delivery	Birth took place in hospital
		Prenatal care	Received blood test and has blood pressure measured
(Idzerda et al., 2011)	Process	ARI	The proportion of children with an ARI that received the correct treatment for this condition.

Appendix 4. Search strategy for chapter six

Databases	Search Terms
Web of Science	ts=(mother* OR female OR maternal OR women OR children OR child OR infant OR pediatric* OR paediatric* OR newborn OR neonate OR childhood) **AND** ts=("Maternal and child health services" OR “maternal & child health services” OR "Maternal and child health service" OR "Maternal-Child Health Services" OR "Maternal-Child Health Service" OR "Maternal Health Services" OR "Maternal Health Service" OR "Maternal Health" OR "Child Health Services" OR "Child Health Service" OR "Child health" OR “child health care” OR "Family Planning Services" OR "Family Planning Service" OR "Prenatal Care" OR pregnancy OR "perinatal care" OR "Obstetric Delivery" OR "Infant care" OR "Postnatal Care" OR "Health Services" OR “health service” OR "Maternal-Child Health" OR "obstetric care" OR "Delivery care" OR delivery OR "Newborn care" OR "Women's health" OR "Women's Health Service" OR "Women's Health Services" OR "Infant health" OR fever OR "Respiratory Tract Infections" OR diarrhoea OR diarrhea OR "Curative child health services" OR "Curative child health service" OR "Neonatal care " OR ” neonatal health” OR "Child treatment" OR "Family planning" OR "Antenatal care" OR "Facility delivery" OR "Skilled birth attendance" OR "skilled attendance at birth" OR "skilled attendance" OR "Institutional delivery" OR "Institutional deliveries" OR "Postpartum care" OR immunization OR vaccination OR "Newborn health" OR "Management of child illness" OR "Management of child illnesses" OR "childhood illness management" OR “childhood disease” OR “childhood illnesses” OR "Management of childhood illnesses" OR "maternal and neonatal health" OR "Delivery of Health Care" OR “health care” OR “health facility” OR "Maternal health care services" OR

	"Maternal and newborn health*" OR “maternal and child health*” OR “reproductive health service*” OR “reproductive health”) **AND** ts=("Effective coverage " OR "Crude coverage" OR "Quality-adjusted coverage" OR "Quality adjusted coverage" OR "Quality contacts" OR “high quality contacts” OR "quality-adjusted contacts")
Medline	exp Mothers/ OR Mother.mp. OR Female/ OR maternal.mp. OR exp Women/ OR Children.mp. OR exp Child/ OR exp Child, Preschool/ OR preschool child.mp. OR exp Adolescent/ OR exp Adult/ OR exp Young Adult/ OR exp Middle Aged/ OR exp Infant/ OR exp Infant, Newborn/ OR exp Pediatrics/ OR Newborn.mp. OR childhood.mp. OR exp Adult Children/ OR Neonate.mp. **AND** "Maternal and child health services".mp. OR "Maternal and child health service".mp. OR "Maternal & child health services".mp. OR "Maternal and child health".mp. OR exp Maternal-Child Health Services/ OR exp Maternal Welfare/ OR exp Maternal Health Services/ OR Maternal health service.mp. OR exp Maternal Health/ OR Maternal health services.mp. OR exp Child Health Services/ OR Child health service.mp. OR Child health services.mp. OR exp Child Health/ OR Child health care.mp. OR Maternal-Child Health.mp. OR Maternal care.mp. OR exp Prenatal Care/ OR exp Pregnancy/ OR exp Perinatal Care/ OR exp Delivery, Obstetric/ OR exp Infant Care/ OR exp Postnatal Care/ OR post-natal care.mp. OR exp Family Planning Services/ OR exp Pregnancy Complications/ OR Obstetric delivery.mp. OR obstetric care.mp. OR delivery care.mp. OR Newborn care.mp. OR exp Women's Health/ OR exp Women's Health Services/ OR exp Infant Health/ OR Neonatal care.mp. OR exp Fever/ OR exp Respiratory Tract Infections/ OR Respiratory tract infection.mp. OR exp Diarrhea/ OR Curative child health services.mp. OR child treatment.mp. OR Childhood disease.mp. OR Sick child visits.mp. OR Management of child illness.mp. OR Management of child illnesses.mp. OR childhood illness management.mp. OR Family planning.mp. OR Antenatal care.mp. OR Facility delivery.mp. OR Skilled birth

	attendance.mp. OR skilled attendance.mp. OR Institutional delivery.mp. OR institutional deliveries.mp. OR Postpartum care.mp. OR *Immunization/ OR *Vaccination/ OR Newborn health.mp. OR "Maternal and newborn health".mp. OR Maternal-Child Care.mp. OR "maternal and neonatal health ".mp. OR Neonatal health.mp. OR exp "Health Services Needs and Demand"/ OR exp Health Services Research/ OR exp Health Services Accessibility/ OR "Delivery of Health Care"/ OR Health care delivery.mp. OR health care access.mp. OR exp Health Services/ OR exp "Patient Acceptance of Health Care"/ OR exp Reproductive Health Services/ OR exp Reproductive Health/ OR Child health care.mp. OR child birth.mp. OR health care facility.mp. OR maternal health care services.mp. OR healthcare.mp. OR health interventions.mp. **AND** effective coverage.mp. OR Crude coverage.mp. OR quality-adjusted coverage.mp. OR Quality contacts.mp. OR quality-adjusted contacts.mp. OR High quality contacts.mp.
Embase	Mothers.mp. OR exp mother/ OR exp female/ OR maternal.mp. OR women.mp. OR Children.mp. OR exp child/ OR exp preschool child/ OR exp adolescent/ OR exp adult/ OR exp young adult/ OR exp middle aged/ OR exp infant/ OR exp pediatrics/ OR exp newborn/ OR exp childhood/ OR exp adult child/ OR Neonate.mp. **AND** "Maternal and child health services".mp. OR Maternal & child health services.mp. OR "Maternal and child health service".mp. OR exp maternal child health care/ OR "Maternal and child health".mp. OR "Maternal-Child Health Services".mp. OR exp maternal welfare/ OR Maternal Health Services.mp. OR exp maternal health service/ OR Maternal Health.mp. OR Child Health Services.mp. OR Child health service.mp. OR exp child health/ OR exp child health care/ OR Maternal-Child Health.mp. OR exp maternal care/ OR "Maternal and newborn health".mp OR Maternal-Child Care.mp. OR "maternal and neonatal health".mp. OR exp prenatal care/ OR exp pregnancy/ OR exp perinatal care/ OR exp infant care/ OR Infant health.mp. OR Neonatal care.mp. OR Neonatal health.mp. OR exp postnatal care/ OR post-natal

	care.mp. OR Family Planning Services.mp. OR exp pregnancy complication/ OR exp obstetric delivery/ OR obstetric care.mp. OR delivery care.mp. OR exp newborn care/ OR Newborn health.mp. OR exp women's health/ OR Women's Health Services.mp. OR exp fever/ OR exp respiratory tract infection/ OR exp diarrhea/ OR Curative child health services.mp. OR child treatment.mp. OR exp childhood disease/ OR Sick child visits.mp. OR Management of child illness.mp. OR Management of childhood illnesses.mp. OR Management of childhood illnesses.mp. OR exp family planning/ OR Antenatal care.mp. OR Facility delivery.mp. OR Skilled birth attendance.mp. OR skilled attendance.mp. OR Institutional delivery.mp. OR institutional deliveries.mp. OR Postpartum care.mp. OR exp immunization/ OR exp vaccination/ OR exp health services research/ OR exp health care need/ OR Health Services Accessibility.mp. OR exp health care delivery/ OR Delivery of Health Care.mp. OR exp health care access/ OR exp health service/ OR Health Services.mp OR Reproductive health services.mp. OR exp child health care/ OR child health care/ OR exp childbirth/ OR exp health care facility/ OR maternal health care services.mp OR exp health care/ OR health interventions.mp. **AND** "Effective coverage ".mp. OR Crude coverage.mp. OR Quality-adjusted coverage.mp. OR Quality adjusted coverage.mp. OR Quality contacts.mp. OR High quality contacts.mp.
Maternity & Infant Care	Mothers.de. OR Mother.mp. OR Female.de. OR Maternal.de. or maternal.mp. OR Women.de. or women.mp. OR Child.de. or Children.mp. OR Child - preschool.de. OR Adolescent.de. OR Adult.de. OR Middle aged.de. OR Infant.mp. or Infant.de. OR Infant - newborn.de. OR Paediatrics.de. OR newborn.de. or Newborn.mp. OR Childhood.de. or childhood.mp. OR Neonate.mp. or Neonate.de. **AND** “Maternal & child health services".mp. OR "Maternal & child health service".mp. OR "Maternal and child health services".mp. OR "maternal child health care".mp. OR "Maternal and child health".mp. OR "Maternal-Child Health Services".mp.

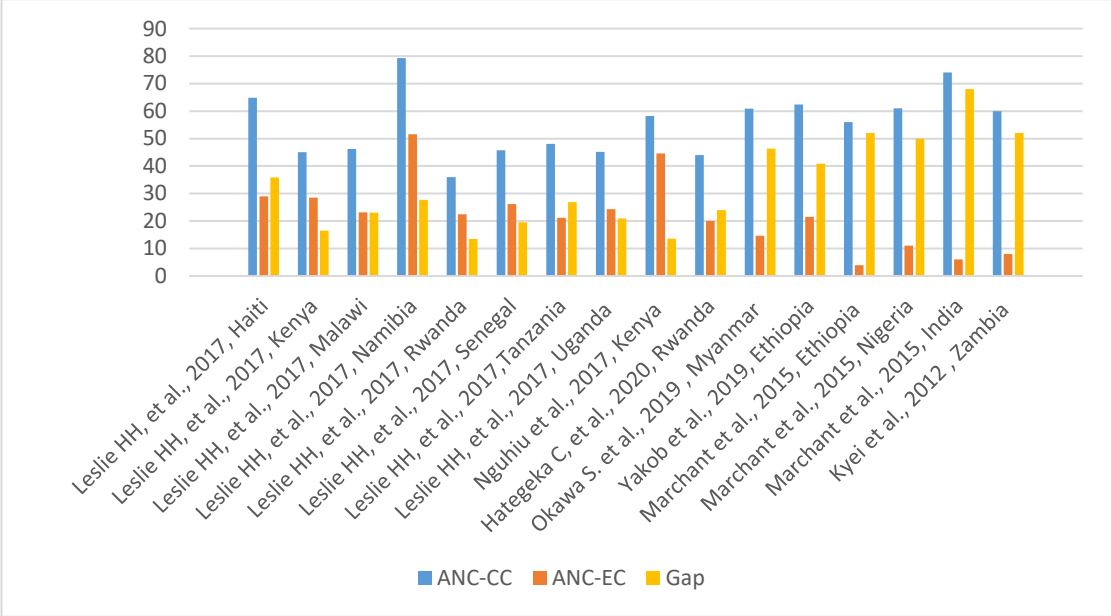
	OR Maternal health services.de. OR "Maternal health service".mp. OR "Maternal Health Services".mp. OR Maternal health.de. OR Child health services.de. OR "Child health service".mp. OR "Child health services".mp. OR Child health.de. OR "Child health care".mp. OR "Maternal-Child Health".mp. OR Maternal care.de. OR "Maternal-Child Care".mp. OR (maternal and neonatal health).mp. [mp=abstract, heading word, title] OR Prenatal care.de. OR Pregnancy.de. OR Perinatal care.de. OR Delivery.de. OR Infant care.de. OR Infant health.de. OR Neonatal care.de. OR "Neonatal health".mp. OR "Postnatal Care".mp. or Postnatal care.de. OR Family planning services.de. or "Family Planning Services".mp. OR Pregnancy complications.de. OR "Obstetric delivery".mp. OR "obstetric care".mp. OR "delivery care".mp. OR "Newborn care".mp. OR "Newborn health".mp. OR Women's health.de. OR Women's health services.de. OR Fever.de. OR Respiratory tract infections.de. OR Respiratory tract infection.mp. OR Diarrhoea.de. OR "child treatment".mp. OR "Childhood disease".mp. OR Family planning.de. or "Family planning".mp. OR Antenatal care.de. or "Antenatal care".mp. OR "Facility delivery".mp. OR Skilled birth attendance.mp. [mp=abstract, heading word, title] OR skilled attendance.mp. [mp=abstract, heading word, title] OR Institutional delivery.mp. [mp=abstract, heading word, title] OR Postpartum care.de. or Postpartum care.mp. OR Immunization.mp. or Immunization.de. OR Health services research.de. OR health care need.mp. OR "Health services needs and demands".de. OR Health services accessibility.de. OR "Delivery of health care".de. OR Health care delivery.mp. OR health care access.mp. or Access to health care.de. OR Health services.de. or health service.mp. OR health Services.mp. OR "Patient acceptance of health care".de. OR Reproductive health services.de. OR Reproductive health services.mp. OR Reproductive health.de. OR Reproductive health.mp. OR Child health care.mp. OR health care facility.mp. or Health facility environment.de. OR Health facilities.de. or Health facility.mp. OR maternal health care services.mp. OR

	healthcare.mp. OR health interventions.mp. **AND** Effective coverage.mp. [mp=abstract, heading word, title] OR Crude coverage.mp. [mp=abstract, heading word, title]
CINHAL	(MH "Mothers+") OR "Mother" OR (MH "Female") OR "maternal" OR (MH "Women+") OR "Children" OR (MH "Child+") OR (MH "Child, Preschool") OR (MH "Adult+") OR (MH "Young Adult") OR (MH "Middle Age") OR (MH "Infant+") OR (MH "Infant, Newborn+") OR (MH "Pediatrics+") OR "Newborn" OR "childhood" OR (MH "Adult Children") OR "Neonate" **AND** ""“Maternal & child health services”"" OR ""Maternal and child health services"" OR ""maternal child health care"" OR ""Maternal and child health"" OR ""Maternal-Child Health Services"" OR (MH "Maternal Welfare") OR (MH "Maternal Health Services+") OR ""Maternal health service"" OR ""Maternal Health"" OR (MH "Child Health Services+") OR ""Child health service"" OR (MH "Child Health") OR ""Child health care"" OR (MH "Maternal-Child Health") OR ""Maternal care"" OR ""Maternal and newborn health"" OR (MH "Maternal-Child Care") OR ""maternal and neonatal health"" OR (MH "Prenatal Care") OR (MH "Pregnancy+") OR (MH "Perinatal Care") OR (MH "Delivery, Obstetric+") OR (MH "Infant Care+") OR ""Infant health"" OR ""Neonatal care"" OR ""Neonatal health"" OR (MH "Postnatal Care+") OR ""post-natal care"" OR ""Family Planning Services"" OR (MH "Pregnancy Complications+") OR ""Obstetric delivery"" OR (MH "Obstetric Care+") OR ""delivery care"" OR ""Newborn care"" OR ""Newborn health"" OR (MH "Women's Health") OR (MH "Women's Health Services") OR (MH "Fever+") OR (MH "Respiratory Tract Infections") OR (MH "Diarrhea") OR "Diarrhoea" OR "Diarrhea" OR ""Curative child health services"" OR ""child treatment"" OR ""Childhood disease"" OR ""Childhood illnesses"" OR ""Sick child visits"" OR ""Management of child illness"" OR ""Management of childhood illnesses"" OR ""childhood illness management"" OR (MH

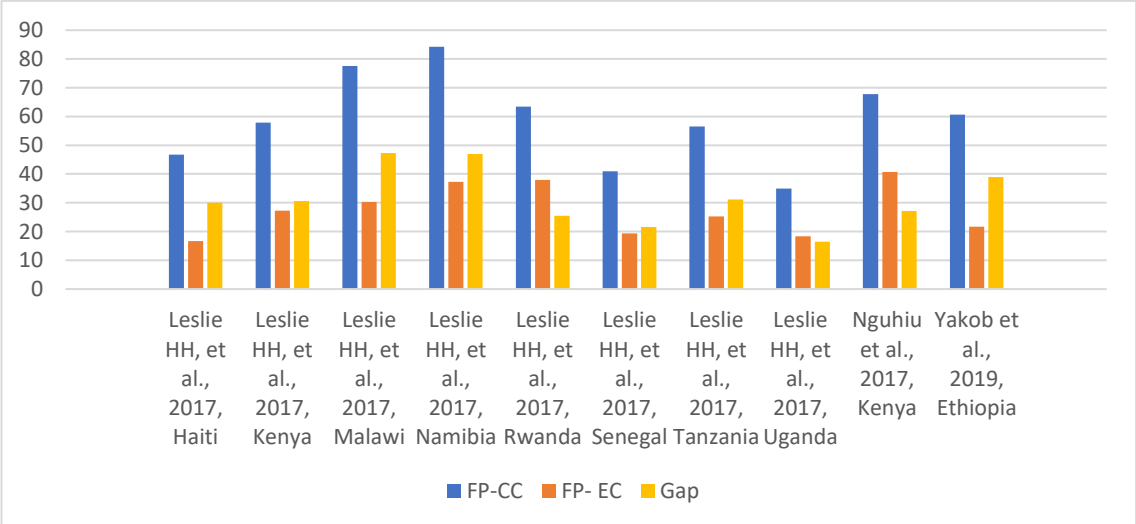
	"Family Planning+") OR ""Family planning"" OR ""Antenatal care"" OR ""Facility delivery"" OR ""Skilled birth attendance"" OR ""skilled attendance"" OR ""Institutional delivery"" OR ""institutional deliveries"" OR ""Postpartum care"" OR (MH "Immunization+") OR "Immunization" OR "vaccination" OR (MH "Health Services Needs and Demand+") OR (MH "Health Services Research+") OR ""health care need"" OR (MH "Health Services Accessibility+") OR (MH "Health Care Delivery+") OR ""health care access"" OR ""health service"" OR (MH "Health Services+") OR "services" OR ""Reproductive health services"" OR (MH "Reproductive Health") OR ""Child health care"" OR ""Reproductive health"" OR (MH "Childbirth+") OR ""health care facility"" OR "Childbirth" OR ""Health facility"" OR (MH "Health Facilities+") OR ""maternal health care services"" OR "healthcare" OR ""health interventions"" **AND** ""Effective coverage"" OR ""Crude coverage"" OR ""Quality-adjusted coverage"" OR ""Quality adjusted coverage"" OR ""quality-adjusted contacts"" OR ""High quality contacts""
Scopus	(TITLE-ABS-KEY (mother* OR female OR maternal OR wom?n OR children OR child OR infant OR pediatric* OR paediatric* OR newborn OR neonate OR childhood)) AND (TITLE-ABS-KEY ("Maternal and child health services" OR “maternal & child health services” OR "Maternal and child health service" OR "Maternal-Child Health Services" OR "Maternal-Child Health Service" OR "Maternal Health Services" OR "Maternal Health Service" OR "Maternal Health" OR "Child Health Services" OR "Child Health Service" OR "Child health" OR “child health care” OR "Family Planning Services" OR "Family Planning Service" OR "Prenatal Care" OR pregnancy OR "perinatal care" OR "Obstetric Delivery" OR "Infant care" OR "Postnatal Care" OR "Health Services" OR “health service” OR "Maternal-Child Health" OR "obstetric care" OR "Delivery care" OR delivery OR "Newborn care" OR "Wom?n's health" OR "Wom?n's Health Service" OR "Wom?n's Health Services"

	OR "Infant health" OR fever OR "Respiratory Tract Infections" OR diarrhoea OR diarrhea OR "Curative child health services" OR "Curative child health service" OR "Neonatal care " OR ” neonatal health” OR "Child treatment" OR "Family planning" OR "Antenatal care" OR "Facility delivery" OR "Skilled birth attendance" OR "skilled attendance at birth" OR "skilled attendance" OR "Institutional delivery" OR "Institutional deliveries" OR "Postpartum care" OR immunization OR vaccination OR "Newborn health" OR "Management of child illness" OR "Management of child illnesses" OR "childhood illness management" OR “childhood disease” OR “childhood illnesses” OR "Management of childhood illnesses" OR "maternal and neonatal health" OR "Delivery of Health Care" OR “health care” OR “health facility” OR "Maternal health care services" OR "Maternal and newborn health*" OR “maternal and child health*” OR “reproductive health service*” OR “reproductive health”)) **AND** (TITLE-ABS-KEY ("Effective coverage " OR "Crude coverage" OR "Quality-adjusted coverage" OR "Quality adjusted coverage" OR "Quality contacts" OR “high quality contacts” OR "quality-adjusted contacts"))
Hand search	Varieties of key terms from the above-mentioned were used.

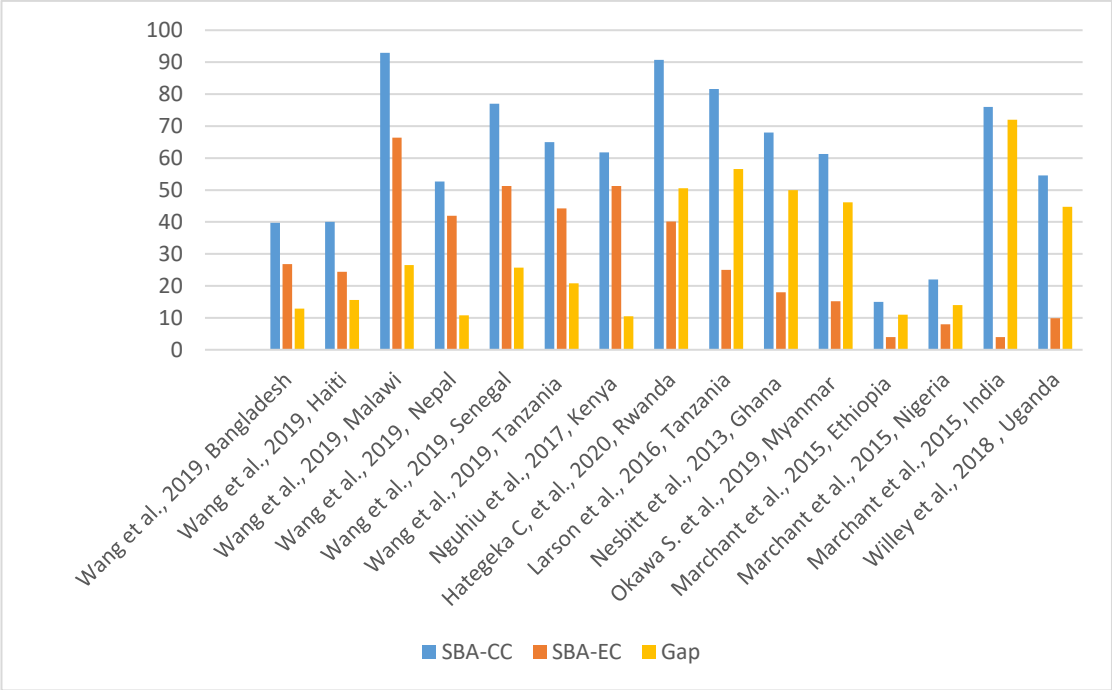
Supplementary materials for study III in chapter six (Appendices 5-9)



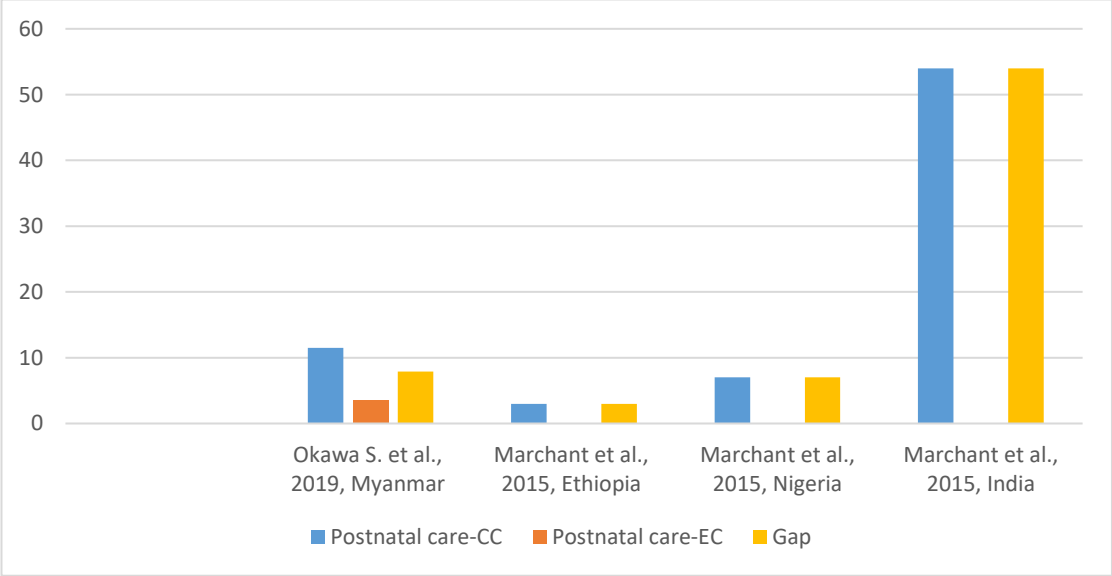
Appendix 5. The effective coverage (EC), crude coverage (CC), and the gap between EC & CC of antenatal care (ANC) across the studies



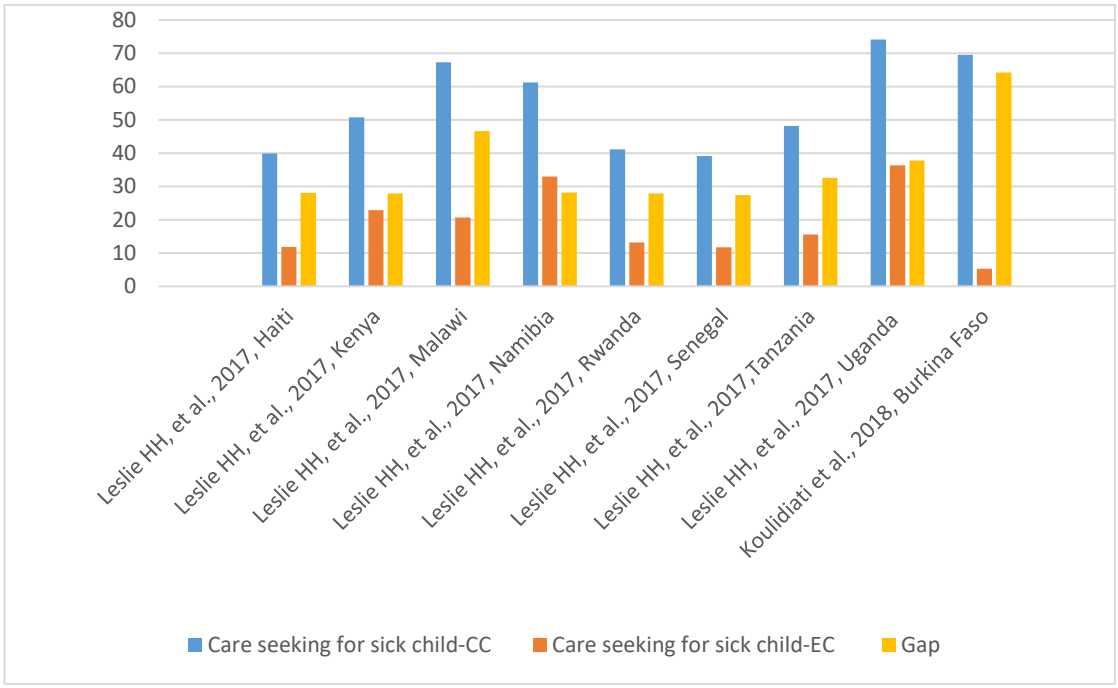
Appendix 6. The effective coverage (EC), crude coverage (CC), and the gap between EC & CC of family planning across the studies



Appendix 7. The effective coverage (EC), crude coverage (CC), and the gap between EC & CC of skilled birth attendance (SBA) across the studies



Appendix 8. The effective coverage (EC), crude coverage (CC), and the gap between EC & CC of postnatal care across the studies



Appendix 9. The effective coverage (EC), crude coverage (CC), and the gap between EC & CC of care seeking for sick child across the studies