UTS UNIVERSITY OF TECHNOLOGY SYDNEY

Women's Use of Quality Maternal Healthcare Services Across the Continuum in Low and lower-middle-income Countries, With a Focus on Ethiopia.

By Melese Girmaye Negero

Thesis submitted in fulfilment of the requirements for the degree of
Doctor of Philosophy in Public Health

Under the Supervision of Professor Angela Dawson and Professor David Sibbritt

University of Technology Sydney
Faculty of Health

April 2023

CERTIFICATE OF ORIGINAL AUTHORSHIP

I, *Melese Girmaye Negero*, declare that this thesis is submitted in fulfilment of the requirements for the award of *Doctor of Philosophy in Public Health*, in the *School of Public Health, 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.

Date: 24 April 2023.

Statement of Contributions of Jointly Authored Works

The research works presented in this thesis have been submitted for publication in peer-reviewed journals. They include five articles (one systematic review paper and four original articles), presented in Chapter 2 and Chapter 4 to Chapter 8. I have taken primary responsibility for determining the research question, undertaking the analyses and drafting the manuscript for each of these papers.

I have received support in these areas from Professor Angela Dawson and Professor David Sibbritt.

I take full responsibility for the accuracy of the findings presented in these publications and this thesis.

Published manuscripts in this thesis

1. Negero, M.G., Sibbritt, D. & Dawson, A. How can human resources for health interventions contribute to sexual, reproductive, maternal, and newborn healthcare quality across the continuum in low- and lower-middle-income countries? A systematic review. Human Resources Health 19, 54 (2021). https://doi.org/10.1186/s12960-021-00601-3.

Manuscripts under review in peer-reviewed journals in this thesis

1. Negero, M.G., Sibbritt, D. & Dawson, A. Access to quality antenatal care, intrapartum care, and postnatal care services in Ethiopia: Multilevel analyses. BMC Public Health. 6a43b267-7ffc-4e03-80d6-a8080372b736 | v.1.1

2. Negero, M.G., Sibbritt, D. & Dawson, A. Women's access to quality antenatal care, intrapartum care, and immediate postnatal care services in Ethiopia: Multivariate decomposition analyses of trends over two decades (2001-2019). BMJ Open. bmjopen-2022-063347

3. Negero, M.G., Sibbritt, D. & Dawson, A. Access to maternal healthcare across the continuum in 28 low- and lower-middle-income countries. BMJ Open. bmjopen-2022-067888.

4. Negero, M.G., Sibbritt, D. & Dawson, A. Access to quality maternal healthcare across the continuum in 19 low and lower-middle-income countries: A multilevel analysis. Health Policy and Planning. HEAPOL-2022-Jun-0370.

Conference Presentations

1. Negero, M.G., Sibbritt, D. & Dawson, A. How can human resources for health interventions contribute to sexual, reproductive, maternal, and newborn healthcare quality across the continuum in low- and lower-middle-income countries? A systematic review. Consortium of Universities for Global Health. CUGH 2021. Addressing Critical Gaps in Global Health and Development Conference. March 12-14, 2021. https://cugh.confex.com/cugh/2021/meetingapp.cgi/Session/1160

2. Negero, M.G., Sibbritt, D. & Dawson, A. How can human resources for health interventions contribute to sexual, reproductive, maternal, and newborn healthcare quality across the continuum in low- and lower-middle-income countries? A systematic review. The 2nd International Conference of Health in Preconception, Pregnancy, and Postpartum Early- and Mid-career Researcher Collective (HiPPP EMR-C), 17th November 2021.

3. Negero, M.G., Sibbritt, D. & Dawson, A. How can human resources for health interventions contribute to sexual, reproductive, maternal, and newborn healthcare quality across the continuum

in low- and lower-middle-income countries? A systematic review. Public Health Association of Australia: Preventive Health Conference 2022. Brisbane Convention and Exhibition Centre, QLD. 11-13 May 2022.

Acknowledgements

Acronyms and Abbreviations

ASHA: Accredited Social Health Activist

ANC: Antenatal Care

BEmONC: Basic Emergency Obstetric and Newborn Care

CHW: Community Health Worker

CBCA: Criterion-based clinical audit

CSA: Central Statistics Agency

DHS: Demographic and Health Survey

DiD: The difference-in-differences analysis

EMDHS: Ethiopia Mini Demographic and Health Survey

EPHI: Ethiopian Public Health Institute

HRH: Human Resources for Health

IBF: Input-based financing

ICF: International Classification of Functioning

IPC: Intrapartum care

LLMICs: Low- and lower-middle-income countries

MMR: Maternal mortality ratio

NMR: Neonatal mortality rate

MNH: Maternal and Newborn Health

PNC: Postnatal care

PCC: Preconception care

RCTs: Randomized controlled trials

PP: Percentage points

RAW: Reproductive age women (15-49 years)

RBF: Results-based financing

SPAB: Skilled personnel-assisted birth

SRMNH: Sexual, reproductive, maternal, and newborn health

SSA: Sub-Saharan Africa

SDGs: Sustainable Development Goals

WHO: World Health Organization

Table of Contents

List of Tables

List of Figures

Abstract

Introduction

This study aimed to identify the level, determinants, and inequalities of receiving quality maternal healthcare across the continuum and the role that human resources for health (HRH) can play in improving maternal and newborn health in low-and lower-middle-income countries (LLMICs), with a focus on Ethiopia.

Methods

We conducted a systematic review employing deductive content analysis and secondary data analyses of Demographic and Health Surveys (DHS) across LLMICs. The DHSs data analyses comprised nationally representative data from the four waves of Ethiopia DHSs: 2005 (n= 7307), 2011 (n= 7908), 2016 (n= 7590) and 2019 (n= 3927), and the latest DHSs from 28 LLMICs (2016-2021, n= 513,857) using statistical control charts, equiplots, concentration curves, concentration indices, and the slope index of inequality to measure trends and inequalities in receiving quality maternal healthcare across the continuum, and multilevel mixed-effects and multivariate decomposition regression analyses models to determine the key predictors.

Results

Results-based financing (RBF); community-based recruitment, training, local deployment and modest financial and non-financial incentives for community health workers; skills-based, regular and clinical simulation-assisted in-service training of skilled birth attendants; and facility-based maternal death audits improved quality maternal healthcare across the continuum in LLMICs. In Ethiopia, the uptake of quality maternal healthcare is low, with widening inequality between population subgroups. Private healthcare facilities provided higher-quality antenatal care (ANC) and postnatal care (PNC) but poor-quality intrapartum care. Early and ≥4 ANC visits and advantageous socio-demographics were positive predictors of quality maternal healthcare. Women who received quality ANC and skilled birth assistance were more likely, while teenage mothers were less likely, to receive quality PNC. Only 8.2% of women across LLMICs received quality maternal healthcare across the continuum, with substantial attrition along the care continuum and wider gaps between population subgroups, favouring those with advantageous socio-demographics. First trimester ANC, exposure to mass media, healthcare insurance, lower parity, intended pregnancy, birth spacing, and higher maternal education and household wealth indices were positive predictors of quality care across the continuum. In contrast,

women who had to gain permission to seek medical care and reported a lack of companionship and longer distances to healthcare facilities as barriers to accessing care were less likely to receive quality care across the continuum.

Conclusions

We recommend maternal and perinatal death audits in all healthcare facilities; respectful woman-centred care as a criterion of RBF; local administration of health worker allowances and incentives; expanding quality maternal healthcare for disadvantaged population subgroups, including teenage mothers; promoting early and ≥4 ANC visits, healthcare insurance, birth spacing, reproductive healthcare services, mothers' companionship to healthcare facilities; and ensuring women's autonomy in healthcare decision-making in LLMICs. Women's education and economic empowerment in LLMICs need to be progressed as per the Sustainable Development Goal targets.

Chapter 1: Thesis Structure

This thesis presents our research on women's use of quality maternal healthcare services across the continuum in Low and lower-middle-income countries, focusing on Ethiopia. The thesis is organised into nine chapters that we summarise below.

Chapter one outlines the skeleton of the thesis and presents the key arguments and aims of each study included in the thesis hierarchically, followed by the research questions.

Chapter two provides a background to maternal health, maternal mortality, and the importance of quality maternal healthcare in preventing avoidable maternal mortality worldwide and in low-income settings, focusing on Ethiopia's context. It presents the research context, the burden of maternal and neonatal morbidities and mortalities in sub-Saharan Africa and Central and Southern Asia, including Ethiopia, and defines quality maternal healthcare services across the continuum in LLMICs. It then discusses the critical human resources for health (HRH) who deliver quality maternal healthcare services across the continuum and interventions to improve access to these services. This chapter also describes the health system in Ethiopia, the primary country of this research.

In chapter three, the systematic literature review investigates the state of knowledge concerning the relationship between policy, education, finance, leadership, management and/or partnership-related health workforce interventions and quality sexual, reproductive, maternal, and newborn healthcare (SRMNH) across the continuum from preconception to pregnancy, childbirth, and postpartum in LLMICs. The review aimed to identify those health workforce interventions to support health personnel to improve quality SRMNH across the continuum and provide policymakers and healthcare managers in LLMICs with practical strategies to tackle health workforce-related poor-quality care through enhanced health workers' practices and performance, management, supportive working environments, and community support. The literature review concludes with a list of research questions that emerged from the findings.

The fourth chapter provides an overview of the methods, including the research questions and objectives, the research setting, data source, study design, study variables, statistical analyses, and ethical considerations.

Chapters five to eight present the findings of this research. These four chapters address specific research questions within four connected but independent studies.

Chapter five presents the results of a study that examines the women's use of quality ANC, intrapartum care and PNC services and their determinants in Ethiopia based on the latest nationally representative Ethiopia DHS 2019 data.

Chapter six investigates the trends and inequalities in the women's use of quality ANC, intrapartum care, and immediate PNC services over two decades (2001-2019) and the factors associated with the changes in the receipt of these services over the same period in Ethiopia based on data from the four consecutive waves of Ethiopia DHSs (2005, 2011, 2016, and 2019).

Chapter seven examines the prevalence, determinants, and within and between country socio-demographic inequalities of the women's use of skilled maternal healthcare services across the continuum from pregnancy to childbirth and postpartum for the last birth within two years preceding the latest DHSs across 28 low and lower-middle-income countries.

Chapter eight presents the findings of a study investigating the prevalence, determinants, and between-country socio-demographic inequalities of the women's use of the eighteen WHO-recommended maternal healthcare interventions across the care continuum from pregnancy to childbirth and postpartum for the last birth within five years preceding the latest DHSs across 19 LLMICs.

Chapter nine presents the overall discussion of this thesis research and presents conclusions and recommendations.

1.1 Research questions

This research comprised nine questions that address significant gaps in current knowledge of quality maternal healthcare across the continuum in LLMICs. These are:

1. How can human resources health interventions contribute to quality sexual, reproductive, maternal, and newborn healthcare across the continuum from pre-conception to pregnancy, intrapartum, and postnatal care services in low-and lower-middle-income countries?

2. What are the levels of quality of antenatal care, intrapartum care, and PNC services mothers and/or their newborns with last birth have received in Ethiopia?

3. What are the multilevel determinants of the receipt by mothers and/or their newborns with the last birth of quality ANC, intrapartum care, and PNC services in Ethiopia?

4. How much are the trends in providing quality ANC, quality intrapartum care, and immediate PNC services to mothers and/or their newborns over the last two decades (2001-2019) in Ethiopia?

5. The changes in the distribution, or effects of which socio-demographic and maternal care indicators over the last two decades (2001-2019) contributed to the changes in the prevalence of quality ANC,

quality intrapartum care, and immediate PNC services received by mothers and/or their newborns in Ethiopia?

6. What are the levels of receipt of maternal healthcare across the continuum from pregnancy to childbirth and the postpartum period women across 28 LLMICs have received for their last births within two years preceding the survey?

7. What are the multilevel determinants of the receipt by mothers of maternal healthcare across the continuum from pregnancy to childbirth and the postpartum period across these 28 LLMICs?

8. What are the levels of receipt of quality maternal healthcare across the continuum from pregnancy to childbirth and the postpartum period women across 19 LLMICs have received for their last births within five years preceding the survey?

9. What are the multilevel predictors of the receipt by mothers and/or their newborns of quality maternal healthcare across the continuum from pregnancy to childbirth and the postpartum period across these 19 LLMICs?

Chapter 2: Introduction

Sustainable Development Goal (SDG) three requires reducing the global maternal mortality ratios to fewer than 70 per 100,000 live births and the neonatal mortality rates to fewer than 12 per 1000 live births by 2030 (UN SDGs 2022). Globally, 295,000 women died due to causes related to or aggravated by pregnancy and childbirth in 2017, and 2.4 million children died within their first 28 days of life in 2020 (World Health Organization 2022). However, most of these unacceptably high maternal and neonatal mortalities still persist in low-and lower-middle-income countries (sub-Saharan Africa and Central and Southern Asia countries in particular, including Ethiopia), which account for 94% of the global maternal mortality and more than 80% of the global neonatal mortality (WHO 2021b; World Health Organization 2022). With less than eight years left before the SDGs deadline, the maternal mortality ratio in the sub-Saharan Africa region is 525 per 100,000 live births, and the neonatal mortality rate is 27 per 1000 live births (World Health Organization 2022). To tackle these uphill challenges, the World Health Organization (WHO) and researchers envisioned providing quality maternal healthcare services across the continuum for every pregnant woman everywhere (Koblinsky et al. 2016; Tunçalp et al. 2015a; Wehrmeister et al. 2016). Avoidable maternal and perinatal morbidity and mortality are attributed mainly to the poor quality of care received during pregnancy, childbirth, and the postnatal period (Tunçalp et al. 2015a).

Quality of care is a multi-dimensional concept with varying perspectives from health care providers, managers or patients and the health care system; based on quality characteristics such as safety, effectiveness, timeliness, efficiency, equity and patient-centredness, and the provision and experience of care. No universally accepted definition of quality of care exists (Tunçalp et al. 2015a; WHO 2016b). It is an intangible concept, as care quality can be perceived (patient's experience of quality, perceived quality of care) or practiced (use of key interventions, clinical quality of care), which makes it very difficult to measure. However, as long as preventable deaths and morbidities continue to occur, in part, due to poor quality care, there is an imperative to overcome the difficulties of defining and measuring the quality of care (Hulton, Matthews & Stones 2000; Tunçalp et al. 2015a).

Since the Donabedian model of quality of care was introduced in 1988, WHO and others have developed strategic thinking to operationalise key characteristics of quality of care, using different elements from the provision of care as well as the experience of care, integral to maternal and newborn healthcare services (Hulton, Matthews & Stones 2000; Institute of Medicine . Division of Health Care et al. 1990; Maxwell 1992; Øvretveit 1992; Tunçalp et al. 2015a; WHO 2006a). The three quality of care models most commonly used and clearly defined are the perspective, characteristics and systems models,

which have been used to operationalise the characteristics of quality of care based on various elements (WHO 2016b).

One of the landmark and significant underpinning quality of care models for assessing the quality of care in maternity care services was the Donabedian quality of care framework. Donabedian developed the framework for measuring the quality of care by assessing the elements of structure or process with proven and established connections and/or relationships to key outcomes of interest, describing the quality of care as a linear process comprising the three components: structure, process and outcome (Donabedian 1988). Structure denotes the settings in which care was provided, including material resources, human resources, and organisational structure. Process denotes what is actually done in giving and receiving care, including the patient's activities in seeking care and carrying it out and practitioners' activities in making a diagnosis and recommending or implementing treatment. Outcome denotes the effects of care on the health status of the patient and the community in large, including improvements in the patient's knowledge about its health, salutary change of behaviour, and degree of patient satisfaction with the care (Donabedian 1988). This model has continued to be a dominant framework for assessing the quality of care in healthcare services despite failing to incorporate healthcare antecedents to quality of care, such as patient characteristics and the broader environmental factors (including the patient's cultural, social and political context), as well as factors related to the health profession itself (Coyle & Battles 1999).

In 1990, the Institute of Medicine in the United States of America (USA) described the quality of care as the degree to which health services for individuals and populations increase the likelihood of desired outcomes and are consistent with current professional knowledge (Hulton, Matthews & Stones 2000). Underpinned by this definition of quality of care, quality of maternal healthcare was described as the degree to which maternal healthcare services for individuals and populations increase the likelihood of timely and appropriate treatment to achieve desired outcomes consistent with current professional knowledge and uphold fundamental reproductive rights (Hulton, Matthews & Stones 2000). Based on this definition of quality maternal healthcare, a quality assessment framework was created for maternal healthcare in institutional settings. The quality assessment framework had two constituent parts: the quality of the provision of care within the institution and the quality of care experienced by users. This division recognised the fact that the use of services and outcomes are the result not only of the quality of the provision of care but of women's experience of that care. The care provision may be deemed of high quality against all recognised standards of good practice but unacceptable to the woman and her family. Conversely, certain aspects of provision of care may be popular with women but objectively ineffective or even harmful to health (Hulton, Matthews & Stones 2000). The framework had ten

elements: six for the quality of the provision of care and four for the quality of care experienced by users. The quality of the provision of care elements were: human and physical resources, referral system, maternity information systems, use of appropriate technologies, internationally recognised good practice, and management of emergencies, while the quality of perceived care elements were: human and physical resources, cognition, emotional support, and respect, dignity and equity(Hulton, Matthews & Stones 2000). Details are available elsewhere (Hulton, Matthews & Stones 2000).

In 2001, the Institute of Medicine in the USA unpacked the quality of care concept further and suggested that efforts to improve the quality of care should be focused around six objectives: safety, effectiveness, efficiency, timeliness, equity, and people-centredness. Safety denotes delivering health care that minimises risks and harm to service users, including avoiding preventable injuries and reducing medical errors. Effectiveness denotes providing services based on scientific knowledge and evidence-based guidelines. Efficiency denotes delivering health care in a manner that maximises resource use and avoids wastage. Timeliness denotes reducing delays in providing or receiving health care. Equity denotes delivering health care that does not vary in quality because of personal characteristics such as gender, race, ethnicity, geographical location, or socioeconomic status. People-centredness denotes providing care that considers individual service users' preferences and aspirations and their communities' cultures (Baker 2001; Tunçalp et al. 2015a; WHO 2006a).

The most compelling of all the models was the WHO model, which advanced health systems thinking by identifying six building blocks: service delivery; health workforce; information, medical products, vaccines and technologies; financing, leadership and governance; and a structure for establishing health systems analysis and points of intervention from where health systems analysis and intervention points can be established (De Savigny & Adam 2009). Based on the above analysis and the body of literature, the WHO described the quality of care as the extent to which health care services provided to individuals and patient populations improve desired health outcomes, and in order to achieve this, health care must be safe, effective, timely, efficient, equitable and people-centred (Tunçalp et al. 2015a; WHO 2016b). The quality of care for women and their newborns is, therefore, the degree to which maternal and newborn healthcare services (for individuals and populations) increase the likelihood of timely and appropriate care to achieve desired outcomes that are both consistent with current professional knowledge and take into account the preferences and aspirations of the individual women and their families. This definition considers the characteristics of quality of care and the two important components of quality of care: quality of the provision of care and the quality of care perceived by the women, their families, and their communities (WHO 2016b).

Based on the existing various models used to prepare a conceptual framework to guide healthcare providers, managers, and policymakers in improving the quality of maternal and newborn healthcare services and the WHO health systems approach, the WHO has created its latest quality of maternal and newborn health care framework by identifying elements that should be targeted to assess, improve and monitor the quality of maternal and newborn healthcare in healthcare facilities and the critical role of service users and communities in the context of the health system (Tunçalp et al. 2015a). The WHO framework for the quality of maternal and newborn healthcare has eight elements under the two linked dimensions of the healthcare system quality improvement approach: quality of the provision of care and the quality of care perceived by the women, their families, and their communities. The perceptions of women, their families and their communities on the quality of maternity care services drive their decision to seek care and are essential in increasing demand for and access to high-quality maternal and newborn services (Bohren et al. 2014; Hanefeld, Powell-Jackson & Balabanova 2017). Community engagement is, therefore, an important aspect to be considered beyond healthcare facilities and should be an integral component of improving the quality of maternal and newborn healthcare services.

Quality of the provision of care includes the use of evidence-based practices for routine and emergency care and management of complications, availability of actionable information systems in which record-keeping allows review and auditing, and availability of functional referral systems between different levels of healthcare. The perceived quality of maternal and newborn healthcare services consists of effective communication with women and their families about the care provided, their expectations, and their rights; care with respect and preservation of dignity; and access to the social and emotional support of their choice. The cross-cutting elements of the framework include the availability of competent and motivated human resources and physical resources that are prerequisites for good quality of care in health facilities. These eight elements of the WHO maternal and newborn healthcare quality framework increase the likelihood of the desired individual and facility-level maternal and newborn health outcomes through increased coverage of key maternal and newborn healthcare interventions or improved people-centred outcomes (WHO 2016b). Our studies were based on assessing the quality of the provision of care, measured as the coverage of key maternal and/or newborn healthcare interventions during pregnancy, intrapartum, and/or postnatal care services.

These quality-of-care frameworks have also resulted in multiple ways of measuring and evaluating the quality of maternal and newborn healthcare services. Some used health facility assessment tools associated with inputs and processes to measure and evaluate the quality of maternal and newborn healthcare services, including the Service Provision Assessment (SPA), developed for the DHS programme; the Service Availability and Readiness Assessment (SARA), developed by WHO; the

Needs Assessment of Emergency Obstetric and Newborn Care, developed by the Averting Maternal Death and Disability programme at Columbia University; and the World Bank's Service Delivery Indicator (SDI) and Impact Evaluation Toolkit for Results Based Financing in Health (Brizuela et al. 2019). Some others used the coverage of the use of key interventions during pregnancy, intrapartum care and/or postnatal care services to measure or evaluate the quality of maternal and newborn healthcare services (Arsenault et al. 2018; Lattof et al. 2020).

The Effective Coverage Think Tank Group's paper in the Lancet states that the measure of the proportion of the population with a healthcare need who receive care- does not account for intervention quality. This potentially overestimates the health benefits of the services provided to the population, and the Group has recommended that effective coverage be defined as the proportion of a population in need of a service that resulted in a positive health outcome from the services provided (Marsh et al. 2020). As such, an effective coverage measurement in maternal and newborn healthcare consists of the quality-adjusted coverage of timely, appropriate, responsive, and respectful care and treatment during antenatal care, intrapartum care, and postnatal care services (Marsh et al. 2020).

The DHS program also proposed that the quality of care indicators drawn from the Service Provision Assessment (SPA) Surveys for antenatal care, family planning, and child healthcare services be based on facility audits, observations of client consultations, and interviews with providers and clients (DHS Program 2023c). Accordingly, the indicators of the quality of ANC include the availability of anaemia testing and iron/folate in the healthcare facility; availability of sulfadoxine + pyrimethamine (SP) in the healthcare facility; ANC clients who were tested for anaemia; ANC clients who received iron/folate; ANC clients who were counseled about danger signs of pregnancy; ANC clients at least eight months pregnant who were counseled about family planning use after childbirth; Pregnant women who were administered a dose of SP after the first trimester during a consultation; and ANC clients who were very satisfied with the ANC services received (DHS Program 2023c). In addition, the DHS program has also proposed a quality of care index to measure the quality of family planning, antenatal care, delivery care, and child healthcare services (DHS Program 2023b). Accordingly, quality ANC involves blood pressure measurement, counselling on iron/folate, and counselling on breastfeeding. Quality delivery care consists of the availability of Basic Emergency Obstetric Care (BEmOC), essential drugs, and newborn resuscitation in the healthcare facility (DHS Program 2023b). Across these multiple methods of measuring the quality of maternal and newborn healthcare services, measures of women's care experience were lacking. Measuring the quality of maternal and newborn healthcare services should involve both the quality of the provision of care and the quality of care as experienced by the service user.

Expanding this universal access to quality maternal healthcare services across the continuum, especially to disadvantaged population subgroups, requires the availability, retention, and equitable distribution of a skilled, motivated, and compassionate health workforce (Koblinsky et al. 2016; WHO 2016a). Accordingly, identifying those health workforce interventions to support health personnel to improve quality maternal healthcare services across the continuum in LLMICs may provide policymakers and healthcare managers with practical strategies to tackle health workforce-related poor-quality care through enhanced health workers' practices and performance, supportive working environments, and community support.

In Ethiopia, there is a lack of evidence providing a comprehensive and standard view of the level and trends of quality maternal healthcare across ANC, intrapartum care, and PNC services in Ethiopia to inform health service planning and improve outcomes. Therefore, investigating the level, trends, inequalities in, and determinants of receiving quality maternal healthcare across ANC, intrapartum care and postnatal care services at a country level, using the nationally representative demographic and health surveys (DHSs) data, can identify gaps in care and provide insight into reducing maternal and newborn morbidity and mortality.

Women's receipt of maternal healthcare across the continuum from pregnancy to childbirth and postpartum significantly decreases the risks of maternal, neonatal, and infant mortalities (Usman, Banerjee & Srivastava 2021; WHO 2022b). However, there is little research examining the uptake of maternal healthcare across the continuum, its socio-demographic inequalities, and determinants across multiple countries in LLMICs. Therefore, investigating the current level, socio-demographic inequalities, and multifaceted determinants of receiving maternal healthcare across the continuum across 28 LLMICs, including Ethiopia, using nationally representative data, can provide evidence for policymakers, healthcare providers, and researchers in LLMICs to assess implementation fidelity, plan services, allocate resources and execute to improve maternal and newborn health outcomes.

Reducing maternal and neonatal morbidity and mortality substantially and eliminating the preventable causes of maternal and neonatal mortality in low-income countries, including Ethiopia, requires increased coverage of maternal healthcare services accompanied by improved quality throughout the continuum of care (Campbell, Graham & Lancet Maternal Survival Series steering 2006). In the SDGs era, the WHO envisions a world where every pregnant woman and her newborn receives quality care throughout pregnancy, childbirth, and postnatal (Tunçalp et al. 2015a). Understanding the level, between-country socio-demographic inequalities, and determinants of receiving quality maternal healthcare services across the continuum using nationally representative data from 19 LLMICs can

provide evidence for policymakers and healthcare managers in LLMICs to improve maternal and newborn health.

2.1 The emphasis on skilled birth attendance to tackle the unacceptably high maternal and neonatal morbidity and mortality over the last two decades

The global efforts over the past two decades to reduce adverse outcomes of pregnancy and childbirth have been directed at increasing skilled birth attendance (Campbell, Graham & Lancet Maternal Survival Series steering 2006; Ki-Moon 2010). This has resulted in higher rates of skilled birth attendance and health facility birth in all the World Health Organization (WHO) regions (WHO 2021b). Globally, based on data from 2014-2020, 83% of births were assisted by skilled personnel, including medical doctors, nurses, and midwives: an increase of about 30% compared to 2000-2006 (WHO 2021b). As a result, deaths from complications during pregnancy, childbirth, and postnatal have declined by 38%. However, an average reduction of 3% per year is too slow to achieve the required Sustainable Development Goal (SDG) targets by 2030 (WHO 2022b).

2.2 Maternal and neonatal mortality globally and in LLMICs over the last two decades

Despite the significant progress made over these two decades to address maternal mortality worldwide, an estimated 295,000 women died in 2017 from causes related to or aggravated by pregnancy and childbirth, with a maternal mortality ratio (MMR) of 211 maternal deaths per 100,000 live births. Furthermore, an estimated 2.4 million children died globally within the first 28 days of life (the neonatal period) in 2019, with a neonatal mortality rate of 17 deaths per 1000 live births (WHO 2021b). The Millennium Development Goal Five (MDG5) target to reduce maternal mortality by 75% was not achieved. The gap between countries with the highest and lowest mortality has increased despite the increased use of maternity care (Koblinsky et al. 2016). Low-income and lower-middle-income countries accounted for 94% of the global maternal deaths in 2017, with an MMR of 462 and 254 per 100,000 live births, respectively. The highest burden of maternal mortality is in sub-Saharan Africa, followed by Central and Southern Asia. Sub-Saharan Africa and Central and Southern Asia accounted for over 80% of the global under-five deaths in 2019 (WHO 2021b).

With the increasing utilisation of health services, a higher proportion of avoidable maternal and perinatal morbidity and mortality are now found in health facilities. Avoidable maternal and perinatal morbidity and mortality are attributed mainly to the poor quality of care mothers and/or their newborns receive during pregnancy, childbirth, and the postnatal period (Tunçalp et al. 2015a).

2.3 Research Aim and Scope of this Research

In low-income countries, including Ethiopia, to reduce maternal and neonatal morbidity and mortality, and eliminate the preventable causes of maternal and neonatal death, the coverage of maternal healthcare services should be increased equitably alongside rapid improvement in quality maternal healthcare across the continuum (Campbell, Graham & Lancet Maternal Survival Series steering 2006). Maternal healthcare across the continuum refers to the continuity of skilled care throughout pregnancy, birth, and after delivery—that is, the use of antenatal care (ANC), intrapartum care, and postnatal care (PNC) services provided by skilled personnel (Wang & Hong 2013b).

In Ethiopia in 2017, 49% of 1010 reported maternal deaths occurred after women arrived at health facilities. Fourteen percent of these maternal deaths were attributed to a lack of supplies and equipment, 11% to delays in patient management at the facility, 6% to healthcare provider error and mismanagement, and 28% to referral delays from other facilities (WHO 2019a). Therefore, increasing access to and utilization of maternal healthcare alone is insufficient to improve maternal health outcomes (The Harvard Chan School Centre of Excellence in Maternal and Child Health 2021). In Ethiopia, the pooled maternal mortality ratio has decreased by 53%, from 871 to 412 maternal deaths per 100,000 live births, and the pooled neonatal mortality rate has also reduced by 39%, from 49 to 30 neonatal deaths per 1000 live births over 20 years (1996-2016). However, these death rates remain among the highest globally (CSA-Ethiopia 2001; CSA-Ethiopia & I. C. F. I 2016; CSA-Ethiopia 2012; Macro 2006).

A study conducted in 32 health facilities in Ethiopia revealed that most did not meet the national maternal and neonatal healthcare (MNH) quality standards (Biadgo et al. 2021). A mother's receipt of the maternal healthcare continuum significantly reduces the risk of neonatal and infant mortality (Usman, Banerjee & Srivastava 2021). Women from disadvantaged population subgroups (e.g., women who: have a low or no formal education, are poor, are unemployed, live in rural areas, or are teenage mothers) in Ethiopia account for the most of poorest access to maternal healthcare services and poor health outcomes, including maternal and neonatal mortalities (Gebre, Worku & Bukola 2018; Kassa et al. 2021; Yaya et al. 2014). Most maternal and neonatal deaths are preventable with timely management by skilled health personnel across the continuum working in a supportive environment (Negero, Sibbritt & Dawson 2021a; WHO 2022b).

In the SDGs era, the WHO envisions a world where every pregnant woman and newborn receives quality care throughout pregnancy, childbirth, and the postnatal (Tunçalp et al. 2015b; WHO 2014a, 2015b, 2016c, 2022d; World Health Organization 2018). Every pregnant woman and her newborn need skilled care during pregnancy, childbirth, and postnatal period birth with evidence-based interventions

delivered across the continuum in a humane, supportive environment (Tunçalp et al. 2015b). Enhancing the availability, equitable distribution, retention, skills, and motivation of the health workforce improves quality maternal healthcare services across the continuum (Kruk et al. 2018; Kruk, Larson & Twum-Danso 2016; Lassi et al. 2016). Therefore, identifying health workforce interventions to support health personnel to improve maternal healthcare in LLMICs may provide policymakers, healthcare managers, and researchers with practical strategies to improve health workers' practices and performance, supportive working environments, and community support.

Measuring the existing maternal healthcare quality and identifying its multifaceted determinants at a national level using the nationally representative DHS data can identify gaps in care and provide insight into reducing maternal and newborn morbidity and mortality (Dettrick et al. 2016; Raven et al. 2012). Such knowledge can assist ministries of health in planning health services and interventions, including those for HRH.

The comprehensive assessment of trends and inequalities in quality ANC, intrapartum care, and immediate PNC services and the determinants in accessing these services over an extended period can help healthcare providers, managers, and policymakers identify inequity among sub-populations to improve access to quality maternal healthcare services and outcomes.

There is a lack of evidence examining the uptake of maternal healthcare across the continuum, the associated socio-demographic inequalities, and determinants across the LLMICs. There were only a few studies investigating quality maternal healthcare services across the continuum across multiple countries. The studies will provide evidence for policymakers, healthcare providers, and researchers in LLMICs to assess implementation fidelity, plan services, allocate resources, and execute to improve maternal and newborn health outcomes.

2.3.1 Overview of Ethiopia

Ethiopia, officially the Federal Democratic Republic of Ethiopia, is a landlocked country located in the North-Eastern part of Africa, also known as the Horn of Africa. Sudan and South Sudan border it on the west, Eritrea and Djibouti on the northeast, Somalia on the East and Southeast, and Kenya on the south. Ethiopia lies between the Equator and Tropic of Cancer, between the 30^0 N and 150^0 N Latitude and 330^0 E and 480^0 E longitude. Low-income countries are those with a Gross National Income (GNI) per capita per year of US $1,045 or less, while lower-middle-income countries are those with a GNI per capita per year of US $1046-4,125, as of 2016. Ethiopia's GNI per capita per year as of 2016 was US$650 (**Figure 2.1**).
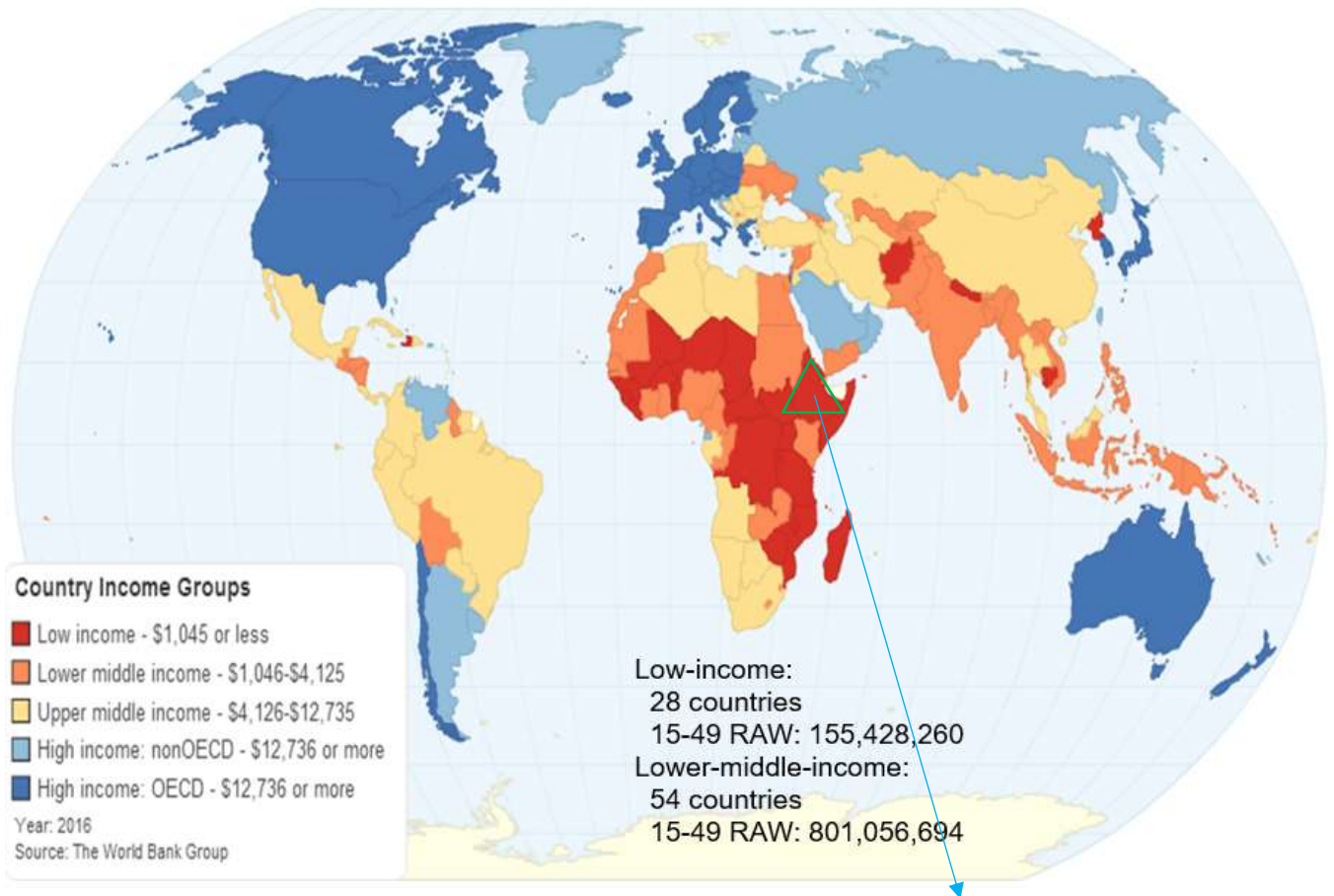
Figure 2.1 1: Map of the world by country income groups along with Ethiopia.

Source: Country Income Groups (World Bank Classification) (World Bank 2016).
RAW= Reproductive age women (15-49 years)

The country occupies an area of 1,100,000 km^2, and water bodies occupy 7,444 km^2. Ethiopia is a country with rich geographical diversity that includes rugged mountains, flat-topped plateaus, deep gorges, and river valleys. Over the ages, erosion, volcanic eruptions, and tectonic movements have contributed to the nation's diverse topography. More than half of the country's geographic area lies 1,500 m above sea level. The highest altitude is at Ras Dashen (4,620 m above sea level), and the lowest altitude is at Danakil (Dallol) Depression (148 m below sea level) (HSTP II Ethiopia 2021). Ethiopia is divided into nine administrative regions: Afar, Amhara, Benishangul-Gumuz, Gambela, Harari, Oromia, Somali, and Southern Nations, Nationalities Peoples' Region, and Tigray, and two chartered city administrations: Addis Ababa and Dire Dawa (**Figure 2.2**).
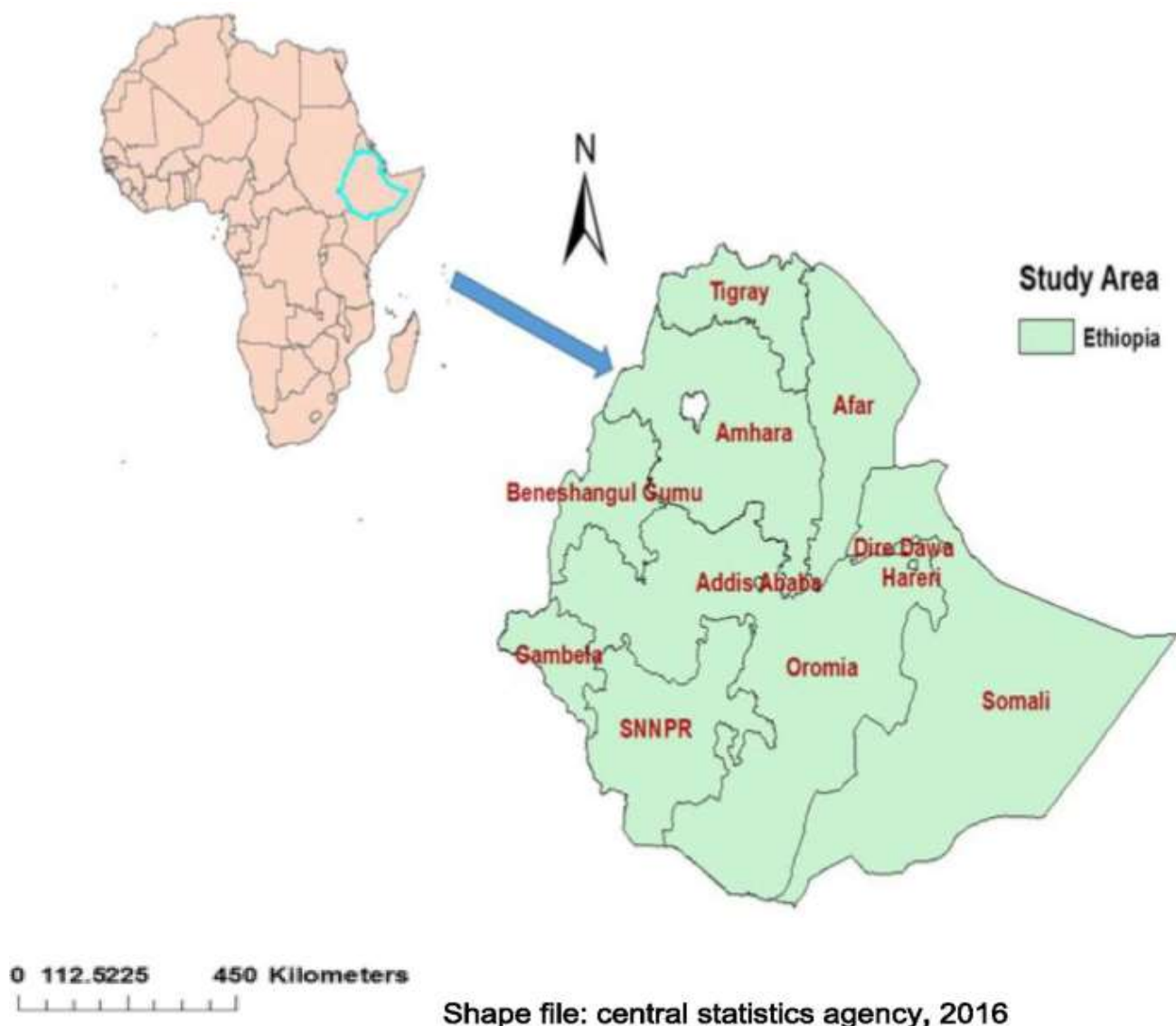
Figure 2.2 1: Map of Ethiopia Along With Its Administrative Regions (CSA-Ethiopia 2016).

With a population of about 101 million in 2020, Ethiopia is the second most populous country in Africa and ranks twelfth in the world. Ethiopia is home to various ethnicities, with more than 80 spoken languages. The country is characterized by rapid population growth, with an annual population growth rate as of 2021 of 2.6%, a young age structure, a high dependency ratio, and a high rural-urban differential (Ethiopia Ministry of Health 2021; World Bank 2023). Ethiopia has a high total fertility rate of 4.6 births per woman (2.3 in urban and 5.2 in rural areas) and a corresponding crude birth rate of 32 per 1000 in 2016 (CSA-Ethiopia & I. C. F. I 2016). By 2024, the population is projected to reach 109.5 million and will reach 122.3 million by 2030 (Ethiopia Ministry of Health 2021). Nearly 80% of the population lives in rural areas mainly depend on subsistence agriculture (Central Statistics Agency, July 2013). Ethiopia is a low-income country with a gross domestic product (GDP) per capita (current US$) of $772 in 2018, up from about $340 in 2010 (Ethiopia Ministry of Health 2021).

2.3.2 The Ethiopian Healthcare System

The Ethiopian healthcare system is structured into three level tiers: primary, secondary, and tertiary. The primary healthcare unit (PHU) comprises health posts, health centres, and primary hospitals. The PHU encompasses two platforms, the health extension programme (HEP) and healthcare service delivery at health centres and primary hospitals, to accelerate progress toward universal health coverage (UHC) (Ethiopia Ministry of Health 2021). The HEP is an innovative community-based health policy launched in 2003 to accelerate the expansion of community-based health facilities and provide basic healthcare services (preventive, health promotion, and certain curative care services) to all Ethiopians, mainly to women and children, at health posts or through home-to-home visits in the rural communities with limited access to healthcare services (FMOH Ethiopia 2005). Underpinned by the core principle of community ownership to empower communities to manage health problems specific to their communities, thus enabling them to safeguard their own health, the HEP provides 18 primary care packages for family health, health promotion and disease prevention, hygiene, and environmental sanitation. As of 2019, more than 10% of the Ethiopian population does not have access to primary healthcare (Ethiopia Ministry of Health 2021).

In a PHU, one health centre is attached to five satellite health posts to serve approximately 25,000 people. According to the HEP optimization roadmap, revision of the existing HEP to make more essential health services accessible to the population, health posts are either comprehensive or basic. The comprehensive health posts (HPs) would be staffed by health extension workers (HEWs), nurses, midwives, and other health professionals to provide more comprehensive service, while the basic HPs would be staffed by health extension workers and will provide various preventive and health promotion services, in addition to treating cases such as malaria, pneumonia, scabies, trachoma, and other mild illnesses. Both health post types would also refer clients to health centres for services requiring higher-level care. The HEWs are supported by volunteer community-level workers to reach every household and execute their package of interventions. Health centres provide both preventive and curative services and also serve as referral centres and practical training sites for HEWs. Primary hospitals offer inpatient and ambulatory services to about 100,000 people and provide emergency surgery (including caesarean sections and blood transfusions). General hospitals are categorized under the second tier of healthcare. These hospitals offer similar services to those of primary hospitals and serve, on average, one million people. They are referral centres for primary hospitals and training centres for health officers, nurses, and emergency surgeons. The third tier in the Ethiopian healthcare system, tertiary health care, consists of a specialized hospital covering approximately five million population. It also serves as a referral centre for general hospitals (HSTP II Ethiopia 2021) (**Figure 2.3**).
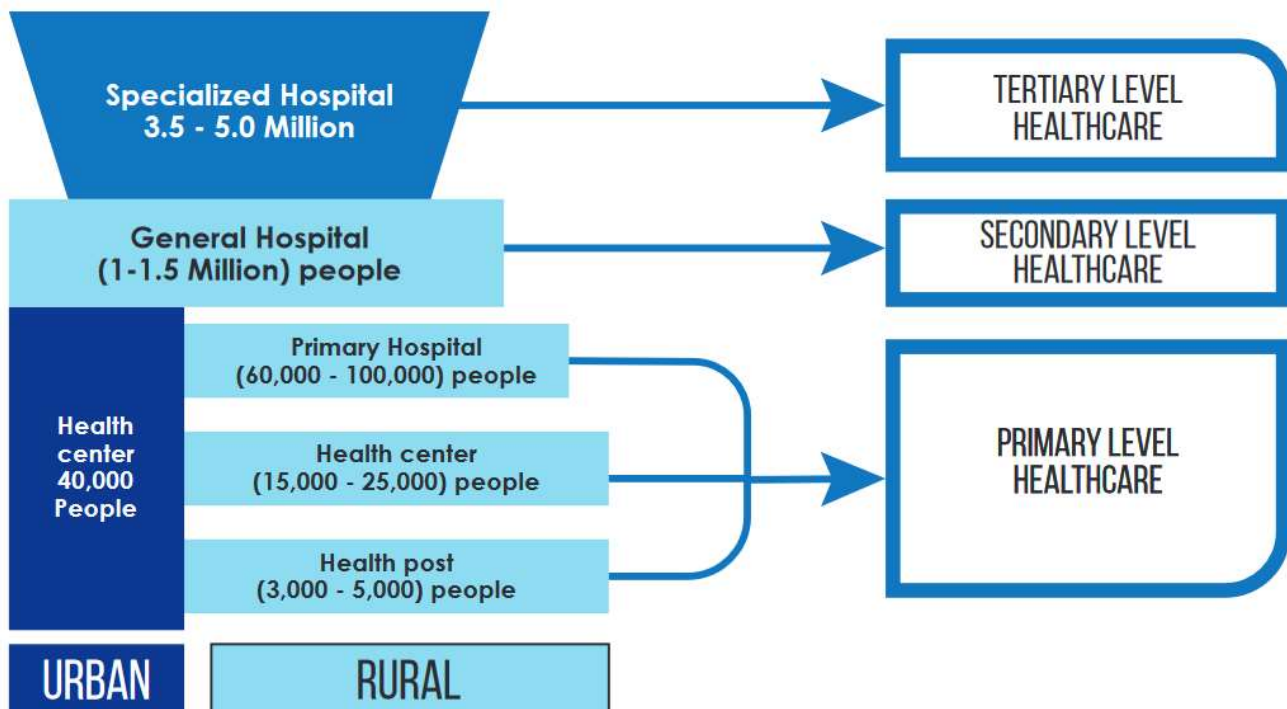
Figure 2.3 1: Three tiers of the healthcare system in Ethiopia (HSTP II Ethiopia 2021).

Attaining universal health coverage (UHC) by 2035, with Primary Health Care as the principal means to advance toward UHC, is the direction for Ethiopia's health sector development by guaranteeing access to all the essential services for everyone in need while protecting against financial risk. However, out-of-pocket spending, which incurred catastrophic household expenditures, remains high in Ethiopia (UNHC 2022). According to the Ethiopia 2019 Mini DHS report, 28% of households in Ethiopia are enrolled in the community-based health insurance scheme with the aim to promote equitable access to sustainable quality healthcare, increase financial protection, and enhance social inclusion for Ethiopian families via the health sector. The insurance scheme covers all outpatient and inpatient services at the health centre and hospital levels other than procedures related to dentures, eyeglasses, and cosmetics (EPHI and ICF 2021).

The next chapter will provide a detailed overview of the current knowledge as it relates to health workforce interventions that have been implemented to improve quality maternal healthcare services across the continuum.

Chapter 3: Systematic Review

This chapter presents an updated and comprehensive review of the literature published over the last two decades (2000-2019) examining HRH interventions' contribution to lay and/or skilled health personnel's performance to improve quality SRMNH care across the continuum from preconception to pregnancy, intrapartum and postnatal care in LLMICs. This systematic review has been published in the journal: Human Resources for Health.

Negero, M.G., Sibbritt, D. & Dawson, A. How can human resources for health interventions contribute to sexual, reproductive, maternal, and newborn healthcare quality across the continuum in low- and lower-middle-income countries? A systematic review. Human Resources for Health 19, 54 (2021). https://doi.org/10.1186/s12960-021-00601-3

Abstract

Background: Well-trained, competent, and motivated human resources for health (HRH) are crucial to delivering quality service provision across the sexual, reproductive, maternal, and newborn health (SRMNH) care continuum to achieve the 2030 Sustainable Development Goals (SDGs) maternal and neonatal health targets. This review aimed to identify HRH interventions to support lay and/or skilled personnel to improve SRMNH care quality along the continuum in low- and lower-middle-income countries (LLMICs).

Methods: A structured search of CINAHL, Cochrane Library/trials, EMBASE, PubMed, SCOPUS, Web of Science, and HRH Global Resource Centre databases was undertaken, guided by the PRISMA framework. The inclusion criteria sought to identify papers with a focus on 1. HRH management, leadership, partnership, finance, education, and/or policy interventions; 2. HRH interventions' impact on two or more quality SRMNH care packages across the continuum from preconception to pregnancy, intrapartum and postnatal care; 3. Skilled and/or lay personnel; and 4. Reported primary research in English from LLMICs. A deductive qualitative content analysis was employed using the World Health Organization -HRH action framework.

Results: Out of identified 2157 studies, 24 intervention studies were included in the review. Studies where ≥4 HRH interventions had been combined to target various healthcare system components were more effective than those implementing ≤3 HRH interventions. In primary care, HRH interventions involving skilled and lay personnel were more productive than those involving either skilled or lay personnel alone. Results-based financing (RBF) and its policy improved the quality of targeted maternity services but had no impact on client satisfaction. Local budgeting and its policy to deliver incentives to health workers and improve operational activities were more efficacious than donor-driven initiatives. Community-based recruitment, training, deployment, empowerment, supportive supervision, access to m-Health technology, and modest financial and non-financial incentives for community health workers (CHWs) improved the quality of care continuum. Skills-based, regular, short, focused, onsite, clinical simulation, and/or mobile phone-assisted in-service training of skilled personnel were more productive than knowledge-based, irregular, and donor-funded training. Facility-based maternal death reviews, coupled with training and certification of skilled personnel, positively affected SRMNH care quality across the continuum. Preconception care, an essential component of the SRMNH care continuum, lacks studies and services in LLMICs.

Conclusions: We recommend maternal death audits in all health facilities; respectful, woman-centreed care as a critical criterion of RBF initiatives; local administration of health worker allowances and

incentives; and integration of CHWs into the healthcare system. There is an urgent need to include preconception care in the SRMNH care continuum and studies in LLMICs.

Background

Approximately 810 women die from preventable causes related to pregnancy and childbirth daily, and more than 94% of these deaths occur in LLMICs (WHO). In the last two decades, deaths from complications during pregnancy, childbirth, and the postnatal period have declined by 38%. However, an average reduction of 3% per year is too slow to achieve the required SDGs target in 2030 (WHO 2022b). Avoidable maternal and perinatal morbidity and mortality are attributed mainly to the poor quality of care received in health facilities (Tunçalp et al. 2015a). In low-income countries, the 2030 SDGs target of reducing the global maternal mortality ratio to less than 70/100000 live births and the global neonatal mortality rates to less than 12/1000 live births requires a rapid improvement in the quality of SRMNH care. This involves enhancing the availability, skills, and motivation of healthcare providers (Kruk et al. 2018; Kruk, Larson & Twum-Danso 2016; Lassi et al. 2016).

The SRMNH care continuum is an integrated and continuous care package with evidence-based interventions that are to be delivered over the preconception, pregnancy, birth, and postnatal periods (Kerber et al. 2007a). The recommended preconception care (PCC) services include family planning, abortion care, sexually transmitted diseases prevention and treatment, and health counselling during the pre-pregnancy period (WHO 2010).

During pregnancy, quality antenatal care (ANC) involves nutritional counselling and multivitamin supplements, adequate visits with skilled personnel (eight and above), blood and urine tests, preventive antibiotics, tetanus toxoid injections, and health education on pregnancy and birth danger signs (WHO 2015a, 2016c). Quality intrapartum care (IPC) involves: respectful care, clear and compelling communication between the women and health workers, the option of a companion during labour and childbirth, health facility birth attended by skilled personnel, appropriate pain relief strategies, mobility in labour where possible, and choice of birth position, the use of uterotonics and delayed cord clamping (after a minute), immediate kangaroo care and breastfeeding, delayed bathing of the newborn (24 hours), and the care of mother and newborn in a health facility for at least 24 hours after birth (WHO 2015a, 2018b). Quality postnatal care (PNC) includes immediate PNC within 24 hours after birth and at least three additional postnatal visits within 42 days after birth for the mother and newborn, home visits in the first week after birth, exclusive breastfeeding, cord care, prophylactic antibiotics for the mother, and health education on maternal and newborn health danger signs (WHO 2014b, 2015a).

According to the World Health Organization (WHO), the quality of care provided to women and newborns must be safe, effective, timely, efficient, equitable, and people-centred (Tunçalp et al. 2015a; WHO 2016b). Safe care is care that minimizes risk and harm to recipients, including avoiding

preventable injuries and reducing medical errors. Effective care focuses on the provision of services that are based on scientific knowledge and evidence-based standards. Timely care avoids harmful delays in giving and receiving care, while efficient care maximizes resource use and avoids wastage. Equitable care does not discriminate based on personal characteristics or socioeconomic status, while people-centred care is care that considers the desire, values, culture, and aspirations of care recipients (Tunçalp et al. 2015a; WHO 2016b; Wolfe 2001).

According to the WHO, human resources for health are "all people engaged in actions whose primary intent is to enhance health". This includes a range of professionals from clinical to managers, technicians, and researchers (WHO 2006b, 2012b). Well-trained, competent, and motivated HRH is crucial to delivering SRMNH care quality across the continuum from PCC to PNC. Therefore, improving health worker performance is key to achieving the SDGs maternal and neonatal health targets (WHO 2016b). Low-income countries are experiencing a chronic shortage of healthcare providers; many are not geographically distributed according to health service needs and are performing below required standards (Harvey et al. 2007; Lassi et al. 2016; Rowe et al. 2005; WHO 2019c). A systematic review by Lassi et al. conducted in 2016 concluded that improving the management, capacity, and motivation of existing HRH is vital to improving maternal healthcare quality (Lassi et al. 2016).

A synthesis by Munabi-Babigumira et al. [2017] found that pre-service and in-service training, adequate staffing, supervision, incentives, leadership and management support, adequate equipment and supplies, and teamwork and collaboration improved the ability of skilled personnel to deliver quality IPC and PNC services (Munabi-Babigumira et al. 2017). Althabe et al. [2008] demonstrated that interactive workshops and reminders, educational outreach visits, audit and feedback, mass-media and patient-mediated interventions, financial incentives, and/or organizational and regulatory interventions had a moderately positive effect on healthcare provider performance and the quality of ANC, IPC, PNC, and neonatal care services in low- and middle-income countries (Althabe et al. 2008). Sibley et al. [2009] found that training in advice on ANC, IPC, and PNC; management of normal delivery; advice on breast-feeding; and timely detection and referral of women with obstetric complications by traditional birth attendants (TBAs) had a positive effect on the increment of timely referrals and reduction of maternal, perinatal and neonatal mortalities, and stillbirth rates (Sibley, Sipe & Barry 2012). However, no reviews examined HRH interventions' contribution to lay and/or skilled personnel's performance to improve SRMNH care quality across the continuum in LLMICs. The review by Lassi et al. focused on skilled personnel only and lacked an examination of HRH interventions contributing

to SRMNH care quality across the continuum (Lassi et al. 2016). We, therefore, undertook an updated and comprehensive review to examine HRH interventions and SRMNH outcomes.

Methods

In consultation with two public health research librarians from the University of Technology Sydney (UTS), we applied the Population, Interventions, Comparators, Outcomes, and Study design (PICOS) design to develop the review question: In LLMICs, how can HRH interventions contribute to SRMNH care quality across the continuum? We defined a quality SRMNH care package as one that contained a safe, effective, timely, efficient, equitable, and people-centred package of interventions that comprised PCC, ANC, IPC, and/or PNC (maternal and/or newborn) services as described by the WHO (WHO 2010, 2016b).

A deductive qualitative content analysis of HRH interventions and their effects on SRMNH care quality along the continuum was undertaken using an a priori conceptual framework to help direct and define the study and deliver practical insights for health policy and practice decision-making (Dawson 2018; Kyngäs & Kaakinen 2020). We used the WHO-HRH Action Framework (WHO-HRH action framework 2012; WHO, USAID & Global Health Workforce Alliance 2020) to define HRH interventions (**See figure 3.1**). The framework identifies six action fields (Management, Leadership, Partnership, Finance, Education, and Policy) (WHO-HRH action framework 2012; WHO, USAID & Global Health Workforce Alliance 2020). The Enhancing transparency in reporting the synthesis of qualitative research (ENTREQ) guidance was followed in this review (Tong et al. 2012), which is registered in the International Prospective Register of Systematic Reviews (PROSPERO Registration Record Number: CRD42020145038) (Negero, Sibbritt & Dawson 2021c).
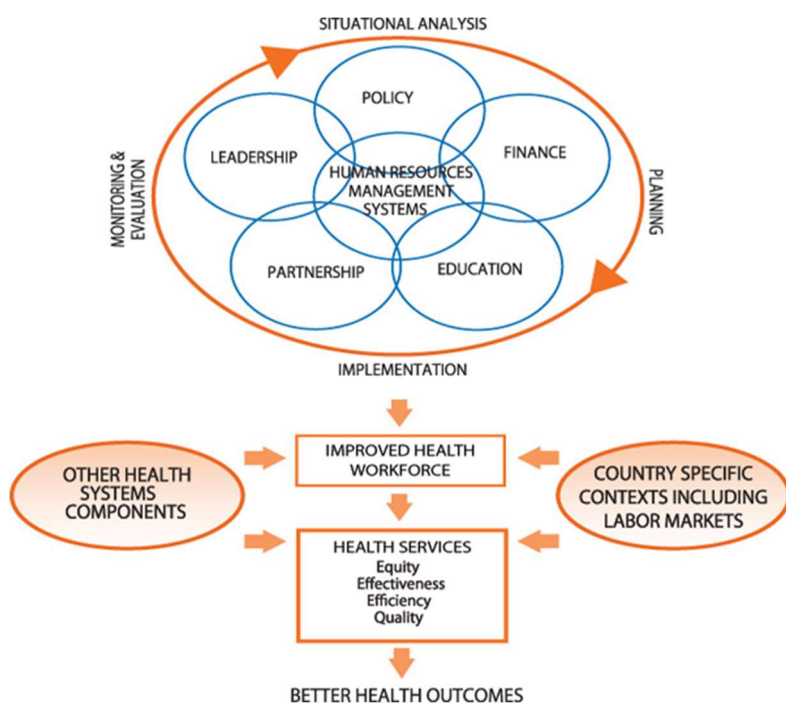
Figure 3.1 1: HRH Action Framework, WHO ([WHO-HRH action framework 2012](#)).

Search protocol

Included studies were those that described: (a) an HRH management, leadership, partnership, finance, education, and/or policy intervention (see definitions in [Table A1](#)); (b) one or more HRH interventions' effect on two or more consecutive quality SRMNH care packages across the continuum (a study reporting HRH interventions delivered in conjunction with one or more non-continuous SRMNH care packages was excluded since it was not a continuum); (c) the role of skilled and/or lay personnel (see definitions at [Table A2](#)); and (d) primary research studies in English (other languages were excluded due to resource constraints) conducted in LLMICs (see inclusion criteria at [Table A3](#)). Studies that did not include any of the six HRH interventions were excluded.

Search strategy

Six bibliographic databases (PubMed, Web of Science/Core Collection, SCOPUS, CINAHL, EMBASE/OVID, and Cochrane Library/trials) were systematically searched in consultation with two public health research librarians from the UTS ([Table A4](#)). The search engine: HRH Global Resource Centre was searched for grey literature. Quantitative, qualitative, and mixed-method studies published between 01 January 2000 and 31 December 2019 were retrieved. This period was chosen to evaluate progress over time in SRMNH care quality along the continuum in relation to HRH interventions since the end of the Alma Ata Health for All Declaration in 2000, the Millennium Development Goals (MDGs) era, and in the first five years of implementation of the SDGs. The Preferred Reporting Items

for Systematic Reviews and Meta-Analyses (PRISMA) 2009 guideline was used to outline the review process (Moher et al. 2009).
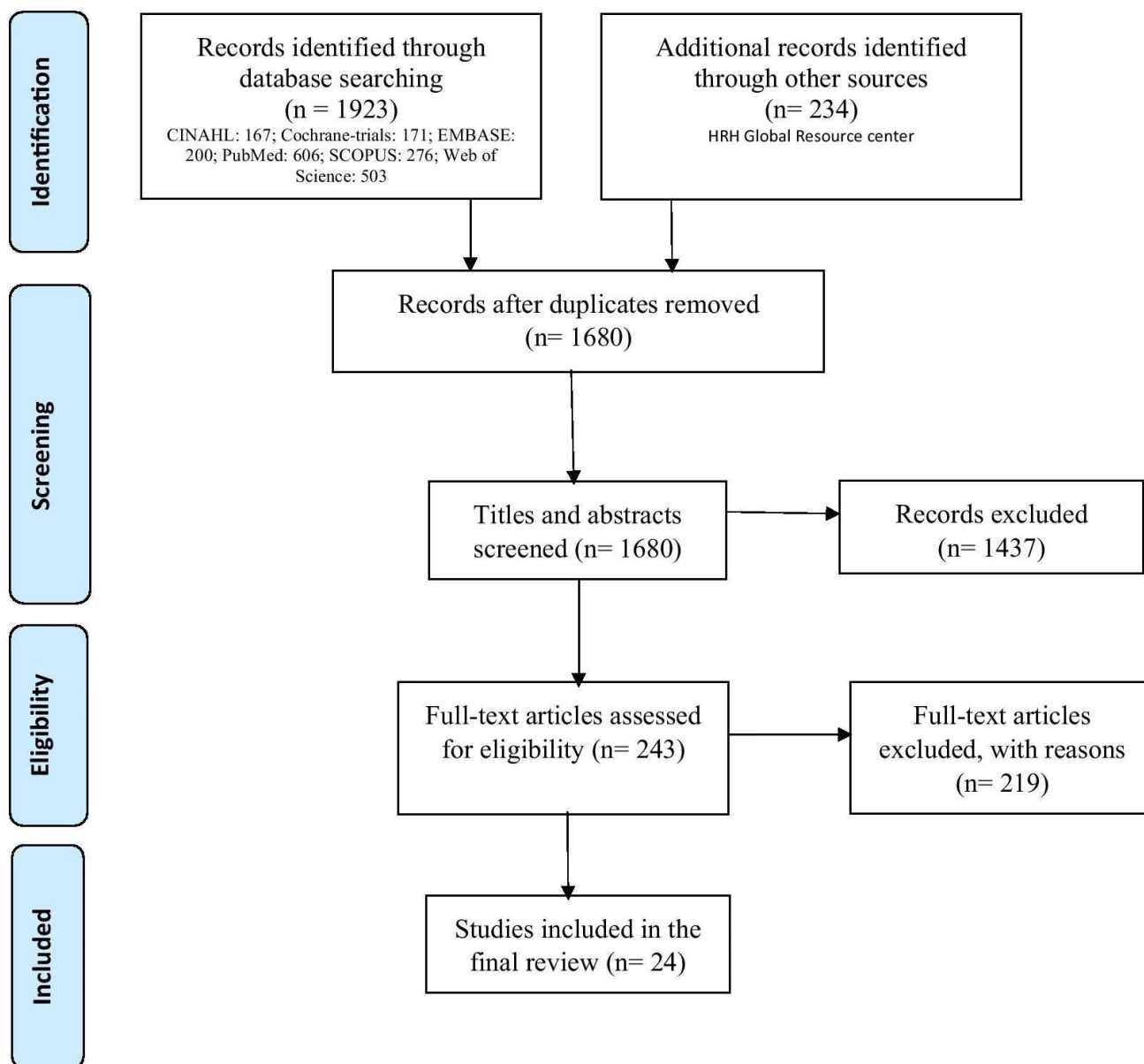
Figure 3.2 1: Overview of the literature review process, PRISMA 2009 (Moher et al. 2009).

Two reviewers (MG and AD) independently used the Covidence online production tool for the title and abstract screening, full-text screening, data abstraction, and quality assessment. Differences in decisions regarding the final papers for review and quality assessment were resolved through a review by the third author (DS), and a consensus was reached. A total of 1437 and 219 articles were excluded during the title and abstract screening and full-text eligibility assessment, respectively, because they did not meet the inclusion criteria.

Quality appraisal

Two reviewers (MG and AD) independently appraised the methodological quality of 25 studies that met the inclusion criteria to describe their methodological quality and ensure that there was enough methodological detail to ensure rigour to be included in the review. The Cochrane methods were applied to appraise the quality of randomized controlled trials (RCTs) using the Risk of Bias (RoB2) Tool 2.0 (Table A5) (Higgins et al. 2016). Each RCT was evaluated for internal validity and quality of reporting. Quality of quasi-experimental, prospective (pre/post), post-only and comparison, and post-only studies were appraised using the Joanna Briggs Institute (JBI) critical appraisal checklist for quasi-experimental studies (non-randomized experimental studies) (Table A6) (Joanna Briggs Institute 2017). Studies collecting qualitative or mixed data were appraised using the United Kingdom's National Health Service Critical Appraisal Skills Programme (CASP) qualitative checklist (Table A7) (CASP 2018). We included intervention studies with a methodologically low risk of bias or moderate to high quality for the review. One pre/post-test study was excluded during the quality appraisal because it has a low-quality score (3 out of 9). Using the quasi-experimental studies' quality appraisal tool, a study with "yes" responses for the 9 signalling questions of less than 4 was considered low quality (Rob & Alam 2014).

Data abstraction and synthesis

Data from the 24 studies were systematically extracted into tables using templates based on the Cochrane methods to integrate qualitative and implementation evidence within intervention effectiveness reviews (Harden et al. 2018).

A deductive qualitative content analysis of the extracted text related to each implemented HRH intervention from each included study was undertaken through coding texts according to emergent descriptions and labelling and structured along with the four categories of SRMNH care continuum (Hsieh & Shannon 2005; Mayring 2014). Tables and concept maps were used to plot patterns and relationships across these categories, and robustness was assessed through critical reflection and discussion between the three authors.

Results

A total of 2157 studies were identified, including 1923 from six bibliographic databases and 234 from the HRH Global Resource Centre (**Figure 3.2**), with 477 duplicates being identified and removed using the endnote de-duplication guidelines ([Bramer et al. 2016](#)). Twenty-four intervention studies were included in thes review and are summarised in Table 3.1. According to the World Bank Country and Lending Groups' Classification 2019-2020 ([World Bank 2016](#)), 11 studies were from low-income countries ([Ayalew et al. 2017](#); [Basinga et al. 2011](#); [Binyaruka et al. 2015](#); [Bonfrer, Van de Poel & Van Doorslaer 2014](#); [Engineer et al. 2016](#); [Kambala et al. 2017](#); [Larson et al. 2019](#); [Magge et al. 2017](#); [Maru et al. 2017](#); [Okuga et al. 2015](#); [Waiswa et al. 2015](#)), 11 were from lower-middle-income countries ([Agarwal et al. 2019](#); [Balakrishnan et al. 2016](#); [Edwards & Saha 2011](#); [Ghosh et al. 2019](#); [Gomez et al. 2018](#); [McDougal et al. 2017](#); [Mwaniki et al. 2014](#); [Okawa et al. 2019](#); [Rahman et al. 2011](#); [Satti et al. 2012](#); [Zeng et al. 2018](#)), and two were conducted in both low-income and lower-middle-income countries ([Duysburgh et al. 2016](#); [Pirkle et al. 2013](#)) ([Supplementary table A8](#)).

The included studies described interventions that had been implemented in a range of settings: primary care (n=13) ([Agarwal et al. 2019](#); [Balakrishnan et al. 2016](#); [Basinga et al. 2011](#); [Bonfrer, Van de Poel & Van Doorslaer 2014](#); [Duysburgh et al. 2016](#); [Engineer et al. 2016](#); [Ghosh et al. 2019](#); [Larson et al. 2019](#); [McDougal et al. 2017](#); [Okuga et al. 2015](#); [Satti et al. 2012](#); [Waiswa et al. 2015](#); [WHO 1978](#); [Zeng et al. 2018](#)), secondary care hospitals (n=1) ([Gomez et al. 2018](#)), primary care, and secondary care hospitals (n=8) ([Ayalew et al. 2017](#); [Binyaruka et al. 2015](#); [Edwards & Saha 2011](#); [Kambala et al. 2017](#); [Magge et al. 2017](#); [Maru et al. 2017](#); [Mwaniki et al. 2014](#); [Okawa et al. 2019](#)), primary care, and secondary and tertiary care hospitals (n=1) ([Rahman et al. 2011](#)), and referral hospitals (n=1) ([Pirkle et al. 2013](#)).

The interventions involved different cadres of health personnel ([WHO 2012b](#)). Twelve studies included skilled personnel (doctors, nurses, nurse-midwives, midwives, auxiliary nurses, auxiliary midwives, auxiliary nurse midwives, and/or health officers) ([Ayalew et al. 2017](#); [Basinga et al. 2011](#); [Binyaruka et al. 2015](#); [Bonfrer, Van de Poel & Van Doorslaer 2014](#); [Duysburgh et al. 2016](#); [Engineer et al. 2016](#); [Ghosh et al. 2019](#); [Gomez et al. 2018](#); [Larson et al. 2019](#); [Okawa et al. 2019](#); [Pirkle et al. 2013](#); [Zeng et al. 2018](#)), three focused on lay personnel (CHWs and/or TBAs) ([Agarwal et al. 2019](#); [Edwards & Saha 2011](#); [Maru et al. 2017](#)). Five studies included skilled and lay personnel ([McDougal et al. 2017](#); [Okuga et al. 2015](#); [Rahman et al. 2011](#); [Satti et al. 2012](#); [Waiswa et al. 2015](#)), one involved skilled personnel, lay personnel, and lady health supervisors ([Balakrishnan et al. 2016](#)). One study focused on skilled personnel and healthcare managers ([Kambala et al. 2017](#)), one involved skilled personnel, community health supervisors, data officers, and healthcare managers ([Magge et al. 2017](#)), and one study focused on skilled personnel, lay personnel, and healthcare managers ([Mwaniki et al. 2014](#)).

All studies included in the review were intervention studies, with 22 collecting quantitative data, one collecting qualitative data, and one collecting mixed data.

Fifteen studies had policy-related interventions (Agarwal et al. 2019; Basinga et al. 2011; Binyaruka et al. 2015; Bonfrer, Van de Poel & Van Doorslaer 2014; Duysburgh et al. 2016; Engineer et al. 2016; Gomez et al. 2018; Kambala et al. 2017; Maru et al. 2017; McDougal et al. 2017; Mwaniki et al. 2014; Okuga et al. 2015; Satti et al. 2012; Waiswa et al. 2015; Zeng et al. 2018), 19 had finance-related interventions (Ayalew et al. 2017; Balakrishnan et al. 2016; Basinga et al. 2011; Binyaruka et al. 2015; Bonfrer, Van de Poel & Van Doorslaer 2014; Duysburgh et al. 2016; Engineer et al. 2016; Gomez et al. 2018; Kambala et al. 2017; Magge et al. 2017; Maru et al. 2017; McDougal et al. 2017; Okawa et al. 2019; Okuga et al. 2015; Pirkle et al. 2013; Rahman et al. 2011; Satti et al. 2012; Waiswa et al. 2015; Zeng et al. 2018), 16 had education-related interventions (Agarwal et al. 2019; Ayalew et al. 2017; Balakrishnan et al. 2016; Edwards & Saha 2011; Ghosh et al. 2019; Gomez et al. 2018; Kambala et al. 2017; Larson et al. 2019; Magge et al. 2017; McDougal et al. 2017; Okawa et al. 2019; Okuga et al. 2015; Pirkle et al. 2013; Rahman et al. 2011; Satti et al. 2012; Waiswa et al. 2015), 16 had partnership-related interventions (Ayalew et al. 2017; Balakrishnan et al. 2016; Basinga et al. 2011; Duysburgh et al. 2016; Edwards & Saha 2011; Ghosh et al. 2019; Kambala et al. 2017; Magge et al. 2017; Maru et al. 2017; McDougal et al. 2017; Mwaniki et al. 2014; Okuga et al. 2015; Pirkle et al. 2013; Rahman et al. 2011; Satti et al. 2012; Waiswa et al. 2015), 9 had leadership-related interventions (Ayalew et al. 2017; Basinga et al. 2011; Binyaruka et al. 2015; Edwards & Saha 2011; Magge et al. 2017; Mwaniki et al. 2014; Okawa et al. 2019; Okuga et al. 2015; Pirkle et al. 2013), and 18 had management-related interventions (Agarwal et al. 2019; Ayalew et al. 2017; Balakrishnan et al. 2016; Basinga et al. 2011; Bonfrer, Van de Poel & Van Doorslaer 2014; Duysburgh et al. 2016; Edwards & Saha 2011; Ghosh et al. 2019; Gomez et al. 2018; Larson et al. 2019; Maru et al. 2017; McDougal et al. 2017; Mwaniki et al. 2014; Okawa et al. 2019; Okuga et al. 2015; Pirkle et al. 2013; Satti et al. 2012; Waiswa et al. 2015). Of the ten studies that had been conducted during the MDGs era, eight featured finance, partnership, and management related, seven policy-related, and six education-related HRH interventions (Basinga et al. 2011; Binyaruka et al. 2015; Bonfrer, Van de Poel & Van Doorslaer 2014; Edwards & Saha 2011; Mwaniki et al. 2014; Okuga et al. 2015; Pirkle et al. 2013; Rahman et al. 2011; Satti et al. 2012; Waiswa et al. 2015), while of 14 studies conducted during the five years SDGs era (2016-2020), 11 papers studied education and finance-related, ten management related, eight policy and partnership related, and three leadership related HRH interventions (Agarwal et al. 2019; Ayalew et al. 2017; Balakrishnan et al. 2016; Duysburgh et al. 2016; Engineer et al. 2016; Ghosh et al. 2019; Gomez et al. 2018; Kambala et al. 2017; Larson et al. 2019; Magge et al. 2017; Maru et al.

2017; McDougal et al. 2017; Okawa et al. 2019; Zeng et al. 2018). The HRH interventions that involved education and finance positively affected SRMNH care quality along the continuum. Of the studies conducted during the MDGs era, five investigated HRH interventions implemented to provide SRMNH care quality across ≥3 components of the SRMNH care continuum (Binyaruka et al. 2015; Edwards & Saha 2011; Okuga et al. 2015; Rahman et al. 2011; Waiswa et al. 2015). In the studies conducted during the five years of the SDGs era, ten featured HRH interventions implemented to provide quality SRMNH care across ≥3 components of the SRMNH care continuum (Agarwal et al. 2019; Ayalew et al. 2017; Balakrishnan et al. 2016; Engineer et al. 2016; Kambala et al. 2017; Magge et al. 2017; Maru et al. 2017; McDougal et al. 2017; Okawa et al. 2019; Zeng et al. 2018). HRH interventions that had an effect on SRMNH care quality across the continuum are outlined as follows.

PCC, ANC, IPC, and PNC continuum

Two cluster-randomized trials involving skilled personnel were identified (Engineer et al. 2016; Zeng et al. 2018). Engineer et al. (Engineer et al. 2016) described the effect of payment for performance (P4P) on the quality of maternal and child health (MCH) services in Afghanistan. Doctors and mid-level cadres were provided with quarterly bonuses based on the delivery of nine MCH-related indicators. There was no direct communication with health workers about the bonuses, nor were there any demand-side interventions (raising or creating demand in communities). The intervention positively affected history taking and physical examinations, and client counseling quality of care indices across the SRMNH care continuum. The intervention, however, had no significant impact on equitable access to the targeted MCH services use between poor and rich families or on the adequacy of time spent with a client along the SRMNH care continuum. It did not also improve client satisfaction and the perceived quality of care along the SRMNH care continuum.

Zeng et al. (Zeng et al. 2018) investigated the effect of results-based financing (RBF), an approach to incentivize healthcare providers and operational activities based on performance, on SRMNH care quality in line with input-based financing (IBF), a traditional approach of increasing funding not tied to performance, in Zambia. Both the RBF and IBF interventions significantly improved the quality of injectable contraceptives, ANC, IPC, and PNC services, respectively, compared to their respective controls (without additional financing). Pregnant women and children in RBF districts gained 604 and 14,574 quality-adjusted life years (QALYs), respectively, while pregnant women and children in IBF districts gained 302 and 8,274 QALYs, respectively, as compared to the controls.

ANC, IPC, and PNC continuum

Thirteen studies focused on improving SRMNH care quality across ANC, IPC, and PNC continuum. Six studies featured interventions to improve the performance of CHWs. Okuga et al. and Waiswa et al. (Okuga et al. 2015; Waiswa et al. 2015) evaluated the effect of community-based recruitment, training, deployment, supervision, modest financial and non-financial incentives for CHWs, and their integration into the healthcare system on maternal and newborn healthcare in rural Uganda. Health facility strengthening was undertaken at all facilities. Qualitative interviews with key stakeholders found that CHWs were positively received and used their social networks to identify and refer pregnant women and involve men in health education. Okuga et al. [2015] showed reduced delays in healthcare service delivery at health facilities; and improvements in compassionate and respectful care, and cord care. In addition, there were improvements in the early initiation of breastfeeding and feeding newborns on colostrum and delayed bathing of newborns. (Okuga et al. 2015). Waiswa et al. [2015] found improved maternal and essential newborn care practices among poorer families. Significant, positive impacts of the intervention were identified, including increased health worker home visiting during pregnancy and the first week after birth. There were improvements in early breastfeeding initiation, delayed bathing of newborns (≥24 hours), and cord care (Waiswa et al. 2015).

In the study by Edwards et al. (Edwards & Saha 2011), village and community health workers recruited from their respective communities were given skills-based training on maternal and newborn health (MNH) and primary healthcare. They received monthly supportive supervision in rural Bangladesh. Health workers from villages to the general hospital and the community worked in collaboration and team. Confidential, no-blame perinatal and maternal death audit was also implemented. In intervention areas, a higher proportion of poor women received ANC skilled personnel-assisted birth (SPAB), caesarean section, and PNC services than poor women living in the non-intervention national sampled study areas across the SRMNH care continuum. There was also a reduction in the gap in service use between the poorest and richest women in intervention areas than in the national sampled study areas along the SRMNH care continuum. In the study by Agarwal et al. (Agarwal et al. 2019), Accredited Social Health Activists (ASHAs) were trained to provide health education and connect women to healthcare facilities and providing home-based ANC and PNC. Exposure to ASHA program compared to non-exposure had no significant effect on completing all services across ANC, IPC, and PNC care continuum.

Mobile technology was the focus of study by Balakrishnan et al. ([Balakrishnan et al. 2016](#)), who examined the effect of a mobile phone app (mHealth platform) used by trained community-based frontline health workers (ASHAs, Anganwadi Workers and Auxiliary nurse-midwives) to track services that were delivered to women and their newborns in India. The intervention villages were found to have an increased uptake of ≥ 90 iron and folic acid tablets during pregnancy, early initiation of breastfeeding, and PNC home visits as compared to the non-intervention control areas. There was equity in the coverage of all quality indicators of SRMNH care across all casts (scheduled vs. others). However, there were no differences between intervention and control areas regarding the uptake of tetanus toxoid injections during pregnancy after a year of intervention. Maru et al. ([Maru et al. 2017](#)) evaluated the effect of a public-private partnership that involved developing an accountable care framework that integrated CHWs through companion and home visits to deliver health facility-based care in rural Nepal. The intervention showed an increase in ≥4 ANC visits by 6.4 pp, health facility birth by 11.8 pp, and postnatal contraception by 27.5 pp. Ninety-five percent of pregnant mothers received an ultrasound examination by month 8 or 9 of pregnancy. Infant mortality decreased from 18.3/1000 to 12.5/1000 live births.

Seven studies featured interventions to improve the performance of skilled personnel. Out of these, educational interventions were focused on five studies. Okawa et al. ([Okawa et al. 2019](#)) examined the effect of doctors and mid-level cadres training and supervision on adequate contacts and SRMNH care quality in rural Ghana. The intervention had a significant, positive effect on the quality of PNC (p=0.02). The intervention, however, did not significantly improve the quality of ANC or IPC. Having adequate contact with healthcare providers did not guarantee a high quality of care. In the study by McDougal et al. ([McDougal et al. 2017](#)), community-based frontline workers were trained, mobilized, and empowered to improve the quality and effectiveness of home visits in India. The intervention had a significant, positive effect for nothing applied to cord after birth, kangaroo mother care, and postnatal contraception use. Ayalew et al. ([Ayalew et al. 2017](#)) examined the effect of multi-faceted interventions, including the Basic Emergency Obstetric and Newborn Care (BEmONC) training, supportive supervision, audit and site mentoring, and health facility-based quality improvement teamwork in Ethiopia. It had a significant, positive impact on healthcare provider performance during labour and birth (p=0.002) and immediate PNC services (p=0.001) compared to the comparison facilities. Magge et al. ([Magge et al. 2017](#)) studied the effect of clinical mentorship, training, and collaborative district-wide learning and leadership on maternal and newborn care quality in Rwanda. Post- versus pre-intervention outcomes showed pregnant women with premature rupture of membrane (PROM) treated with antibiotics of (38% vs. 24%); pregnant women with preterm labour treated with corticosteroids

of (75% vs. 26%); waiting time to C-section in minutes (72 vs. 99); immediate kangaroo mother care (87% vs. 19%); and newborns checked for danger signs within 24 hr of birth (98% vs. 47%). Rahman et al. (Rahman et al. 2011) assessed an effect of an integrated packaged interventions, including community participation and onsite training on the management of deliveries and newborn complications on perinatal mortality in Bangladesh. Early pregnancy ANC home visits, caesarean section rates, early initiation of breastfeeding, colostrum as first newborn food, and delayed first newborn bathing were significantly, positively higher in the post-intervention period as compared to two years pre-intervention (p<0.001). In intervention areas, perinatal mortality decreased by odds of 36%; less than 24 hours timing of first newborn bath and preterm births significantly decreased.

Two studies examined financial and policy interventions. Binyaruka et al. [2015] and Kambala et al. (Binyaruka et al. 2015; Kambala et al. 2017) described the effect of the P4P program (Tanzania) and RBF (rural Malawi) on SRMNH care quality along the continuum. The P4P had a significant, positive impact on one of the eight targeted indicators: anti-malarial treatment during ANC visits (p=0.001). However, there was no evidence of the effect of the P4P program on women's satisfaction with care. There was no significant effect on non-targeted services either (satisfaction with interpersonal care and waiting and consultation times) (Binyaruka et al. 2015). Kambala et al. (Kambala et al. 2017) showed that the RBF had no significant, positive impact on women's perceptions of technical care, quality of amenities, or interpersonal relations during ANC, IPC, and PNC. Women reported instances of neglect, disrespect, and verbal abuse by health personnel while receiving care. The health personnel noted an increased workload due to the increased number of women seeking care at intervention facilities.

ANC and IPC continuum

Six studies focused on improving outcomes across ANC and IPC continuum. Five studies featured interventions to enhance the performance of skilled personnel. Of these, financial and policy interventions were the focus of the two studies. In the study by Basinga et al. (Basinga et al. 2011), the Rwandan government launched a national P4P scheme in health centres based on 14 key MCH-care quality indicators. Quarterly audits of care were made at each health centre based on direct observation and a review of patients' records using a standardized assessment tool on an unannounced, randomly chosen day. The intervention had the greatest effect on indicators that only had the highest payment rates and needed the least effort from the service provider. The intervention had a significant, positive impact on standardized total ANC's quality, the number of high-risk pregnancies referred to district hospital for delivery during pregnancy, and the number of emergency transfers to hospitals for obstetric care during delivery. The intervention, however, didn't improve the uptake of tetanus toxoid injections

during ANC visits. Bonfrer et al. (Bonfrer, Van de Poel & Van Doorslaer 2014) assessed the effect of the performance-based financing (PBF) policy and quarterly quality assessment by local regulatory authorities on the quality of pregnancy and IPC in Burundi. The PBF policy is the one with financial incentives for healthcare providers based on their performance, excluding operational activities. The program had a significant, positive effect on the coverage of ≥1 tetanus toxoid injection during ANC; and SPAB among the non-poor (p<0.028) but the poor in provinces with PBF program as compared to those without it.

Two studies focused on partnership and management interventions. Mwaniki et al. (Mwaniki et al. 2014) evaluated the effect of a collaborative health worker advisory grouping in improving maternal healthcare quality in rural Kenya. The intervention, at the end line compared to the baseline, had significantly increased ANC contacts per month with standardized care (p<0.001), and pregnant mothers were actively referred from the community to health facilities for ANC and IPC services (p=0.012). Duysburgh et al. (Duysburgh et al. 2016) reported on the effect of a computer-assisted clinical decision support system and performance-based financial and non-financial incentives in Burkina Faso, Ghana, and Tanzania. The intervention showed a significant improvement in the number of lab proteinuria examinations during ANC, history taking on vaginal bleeding during pregnancy, births with correctly completed partograph, blood pressure monitoring during childbirth, and oxytocin for women after childbirth. Larson et al. (Larson et al. 2019) focused on educational and management interventions in rural Tanzania. Providers from 12 primary care clinics received in-service training, mentoring, supportive supervision and infrastructure support, and community members received peer outreach services. The intervention had a significant, positive, and negative effect on ANC's quality and obstetric care cost, respectively.

The TBA educational and management interventions were featured in a study by Satti et al. (Satti et al. 2012) in rural Lesotho. In this research, one hundred women, mostly TBAs, were trained and provided with incentives to identify pregnant women in the community and accompany them to a health centre for ANC and delivery. A nurse-midwife was deployed to the health centre to provide care and supervise the TBAs. Pregnant women from isolated communities were accommodated at a maternal waiting room two weeks before delivery. The intervention resulted in that the HIV testing, syphilis testing, and haemoglobin testing during ANC visit increased, as did the number of women with complications who were successfully transferred to the district hospital for obstetric care during delivery. There were no maternal deaths among the women in the program.

IPC and PNC continuum

Three studies focused on improving outcomes across the IPC and PNC continuum that featured educational and management interventions. Ghosh et al. (Ghosh et al. 2019) studied the effect of a multi-faceted, onsite nurse-mentoring and simulation program on nurses' and midwives' skills in the diagnosis and management of intrapartum asphyxia and postpartum haemorrhage (PPH) in India. The mentoring had a significant, positive effect on the diagnosis of asphyxia and PPH and management of asphyxia per additional week of mentoring. Gomez et al. (Gomez et al. 2018) investigated the impact of onsite, low-dose, high-frequency, and clinical simulation-assisted midwives' BEmONC training in Ghana. The intervention significantly reduced the intrapartum stillbirth and 24-hr newborn mortality rates by 52% and 70%, respectively, during the 7-12 months of implementation compared to the baseline. Pirkle et al. (Pirkle et al. 2013) evaluated the effect of maternal death reviews in 32 referral hospitals on the quality of obstetrical care in Mali and Senegal. Women treated at intervention hospitals had, on average, higher quality of care scores than those treated at control hospitals.

Table 3.1 1: Summary of studies about effects of HRH interventions on SRMNH care quality across the continuum in LLMICs, 2020.

Reference	HRH Intervention						The SRMNH care continuum			
	Policy	Finance	Education	Partnership	Leadership	Management	PCC	ANC	IPC	PNC
(Agarwal et al. 2019) (Agarwal et al. 2019)	X		X			X		X	X	X
(Ayalew et al. 2017) (Ayalew et al. 2017)		X	X	X	X	X		X	X	X
(Balakrishnan et al. 2016) (Balakrishnan et al. 2016)		X	X	X		X		X	X	X
(Basinga et al. 2011) (Basinga et al. 2011)	X	X		X	X	X		X	X	
(Binyaruka et al. 2015) (Binyaruka et al. 2015)	X	X			X			X	X	X
(Bonfrer et al. 2014) (Bonfrer, Van de Poel & Van Doorslaer 2014)	X	X				X		X	X	
(Duysburgh et al. 2016) (Duysburgh et al. 2016)	X	X		X		X		X	X	
(Edwards et al. 2011) (Edwards & Saha 2011)			X	X	X	X		X	X	X
(Engineer et al. 2016) (Engineer et al. 2016)	X	X					X	X	X	X
(Ghosh et al. 2019) (Ghosh et al. 2019)			X	X		X			X	X
(Gomez et al. 2018) (Gomez et al. 2018)	X	X	X			X			X	X
(Kambala et al. 2017) (Kambala et al. 2017)	X	X	X	X				X	X	X

(Larson et al. 2019) ([Larson et al. 2019](#))			X			X		X	X	
(Magge et al. 2017) ([Magge et al. 2017](#))		X	X	X	X			X	X	X
(Maru et al. 2017) ([Maru et al. 2017](#))	X	X		X		X		X	X	X
(McDougal et al. 2017) ([McDougal et al. 2017](#))	X	X	X	X		X		X	X	X
(Mwaniki et al. 2014) ([Mwaniki et al. 2014](#))	X			X	X	X		X	X	
(Okawa et al. 2019) ([Okawa et al. 2019](#))		X	X		X	X		X	X	X
(Okuga et al. 2015) ([Okuga et al. 2015](#))	X	X	X	X	X	X		X	X	X
(Pirkle et al. 2013) ([Pirkle et al. 2013](#))		X	X	X	X	X			X	X
(Rahman et al. 2011) ([Rahman et al. 2011](#))		X	X	X				X	X	X
(Satti et al. 2012) ([Satti et al. 2012](#))	X	X	X	X		X		X	X	
(Waiswa et al. 2015) ([Waiswa et al. 2015](#))	X	X	X	X		X		X	X	X
(Zeng et al. 2018) ([Zeng et al. 2018](#))	X	X					X	X	X	X
Total number of Xs	15	19	16	16	9	18	2	21	24	18

Discussion

This study represents the first systematic review to examine HRH interventions and their impact on SRMNH care quality across the continuum in LLMICs. Our findings identified the key elements to successful HRH interventions and the areas for future research regarding HRH interventions.

Respectful, woman-centred care as a criterion of RBF

The RBF, based on a pre-defined and communicated set of indicators and its policy, significantly improved the quality of targeted SRMNH care services across the continuum given the increasing human resources, equipment, and supply demands are fulfilled (Basinga et al. 2011; Bonfrer, Van de Poel & Van Doorslaer 2014; Engineer et al. 2016; Kambala et al. 2017; Zeng et al. 2018). However, these interventions had no significant, positive effect on clients' perception of quality or equity in care (Basinga et al. 2011; Binyaruka et al. 2015; Bonfrer, Van de Poel & Van Doorslaer 2014; Engineer et al. 2016; Kambala et al. 2017). The RBF scheme had the greatest effect on indicators that only had the highest payment rates and needed the least effort from the service provider (Basinga et al. 2011). The RBF scheme can also lead to neglect, disrespect, and abuse of women by healthcare providers due to an increased workload resulting from an increased number of women seeking services at rewarding RBF facilities (Kambala et al. 2017). These signal the critical importance of including respectful, woman-centred care. A systematic review suggests that continuous, personalized care provided by the usual midwife and delivered within a family or a specialized setting, generates the highest level of satisfaction (Macpherson et al. 2016). Woman-centred care fosters the woman's psychological and physiological recovery, often surpassing clinical action, and is associated with lower intervention rates (Macpherson et al. 2016; Waldenström & Turnbull 1998). A systematic review from low- and middle-income countries states a positive effect of P4P on history taking, physical examination, blood pressure measurement, and blood and urine testing during ANC visits, and on provider's adherence to explaining medicine intake for children under five years, children are given medicines and children follow-up treatment. However, there was weak evidence for P4P's positive effect on maternal and neonatal health outcomes and out-of-pocket expenses (Das, Gopalan & Chandramohan 2016).

Local budgeting and management to deliver financial incentives

This review revealed that local budgeting to deliver financial incentives and improve operational activities and its policy, were more effective than mobilizing direct funds from donors for financial incentives, operational activities and incentivizing users, and its policy in improving the quality of SRMNH care and maternal and/or neonatal health outcomes. (Basinga et al. 2011; Binyaruka et al. 2015; Bonfrer, Van de Poel & Van Doorslaer 2014; Duysburgh et al. 2016; Engineer et al. 2016; McDougal et al. 2017;

Satti et al. 2012). Reliance on donor funding and donor-driven initiatives may reduce the responsibility for the delivery of care and increase dependence on outside funds. Another study found that despite extensive investment from donors, in-service training and supportive supervision to improve health workers' performance in providing quality antenatal and sick child care in seven countries in sub-Saharan Africa (SSA) did not improve the quality of care (Leslie et al. 2016).

Training, empowerment, and integration into the healthcare system of the lay health workers

Community-based recruitment, training, deployment, empowerment, supportive supervision, technology assistance, and modest financial and non-financial incentives for CHWs in rural, hard-to-reach areas had a significant, positive effect on the quality and equity of SRMNH care services. The social networks that CHWs had were a valuable asset enabling the building of rapport and relationships with pregnant women to facilitate referral to nearby health facilities and the provision of home-based life-saving ANC and PNC services (Agarwal et al. 2019; Balakrishnan et al. 2016; Maru et al. 2017; McDougal et al. 2017; Okuga et al. 2015; Satti et al. 2012). This finding identifies the importance of training for CHWs, and policy initiatives to ensure their empowerment and integration into the healthcare system. A Cochrane trial's review demonstrates that TBA training significantly reduced stillbirth and perinatal and neonatal deaths (Sibley, Sipe & Barry 2012). There is a need for policy to recognize the important cultural and social roles CHWs fulfill in their local communities that can positively affect maternal and neonatal health outcomes (Kruske & Barclay 2004).

BEmONC training, supportive supervision, teamwork, and collaboration for skilled personnel

In-service BEmONC training, supportive supervision, mentoring, audit, quality improvement advisory team, collaboration with CHWs, and community participation for skilled personnel had a significant, positive effect on quality ANC and IPC, and decreased perinatal mortality and preterm births (Ayalew et al. 2017; Magge et al. 2017; Mwaniki et al. 2014; Rahman et al. 2011). In a review from Africa, implementing comprehensive interventions that strengthen the health system's different components, both in the community and at the health facilities, directly or indirectly improved the quality of maternal healthcare and morbidity and mortality outcomes (Wekesah et al. 2016).

Skills-based, onsite, regular, and clinical simulation training for nurses and midwives

On-site, short, frequent, regularly run, and clinical simulation-assisted training and mentorship of nurses and midwives had a significant, positive effect on the quality of ANC, IPC, and PNC. This, in turn, significantly reduced intrapartum stillbirth and 24-hr newborn mortality rates (Ghosh et al. 2019; Gomez et al. 2018; Magge et al. 2017). On the other hand, in-service training, orientation, mentoring

and supportive supervision, and peer outreach services implemented in two studies in support of the continuum of care package had only a modest effect on the quality of ANC, IPC, or PNC (Larson et al. 2019; Okawa et al. 2019). Analysis of the Service Provision Assessment data from seven countries in SSA shows that in-service training and supportive supervision had a modest effect on ANC and sick child care quality. Providers were observed performing fewer than half of the recommended clinical actions for pregnant women and sick children on average (Leslie et al. 2016). Accordingly, skills-based, regular, focused, onsite, and clinical simulation and/or mobile technology-assisted in-service training of skilled personnel are more effective than the knowledge-based, irregular, and ineffective donor-funded training or supervision in LLMICs.

Maternal death audits in all health facilities

Maternal death reviews in 32 referral hospitals in Mali and Senegal, coupled with training and certification of skilled personnel, had a significant, positive effect on ANC and IPC's quality (Pirkle et al. 2013). A systematic review of effective non-drug interventions for improving outcomes and quality of maternal healthcare in SSA also found that facility-based clinical audits and maternal death reviews supported by demand and supply-side financial incentives, health systems strengthening interventions, community mobilization and peer-based programs, and task shifting directly or indirectly improved quality of maternal healthcare and morbidity and mortality outcomes in SSA (Wekesah et al. 2016).

Involving skilled and lay personnel in primary care

In primary care, HRH interventions involving both skilled and lay personnel were more effective than those involving either skilled or lay personnel alone in improving quality or health outcomes (Balakrishnan et al. 2016; Bonfrer, Van de Poel & Van Doorslaer 2014; Duysburgh et al. 2016; Engineer et al. 2016; Larson et al. 2019; Okuga et al. 2015; Waiswa et al. 2015). A systematic review that focused on IPC found that increasing the use of skilled personnel where TBAs are providers of birth care suggested that deploying midwives closer to communities, financial incentives for providers and users, mobilizing the community, and partnering with TBAs decreased maternal mortality (Vieira et al. 2012).

Comprehensive HRH interventions targeting different components of the healthcare system

There is no single effective HRH intervention: ≥4 comprehensive HRH interventions had a more positive effect on quality SRMNH care continuum and/or health outcomes than those studies with fewer HRH interventions (Ayalew et al. 2017; Balakrishnan et al. 2016; Edwards & Saha 2011; Engineer et al. 2016; Gomez et al. 2018; Larson et al. 2019; Magge et al. 2017; McDougal et al. 2017;

Mwaniki et al. 2014; Okuga et al. 2015; Pirkle et al. 2013; Satti et al. 2012; Waiswa et al. 2015), suggesting a cumulative effect. A systematic review from SSA also indicates that comprehensive HRH interventions implemented in the healthcare system's different components, both in the community and health facilities, improve maternal health (Wekesah et al. 2016).

Inclusion of PCC in the SRMNH care continuum

The PCC, any intervention to optimize a woman's health before pregnancy to improve maternal, newborn, and child health outcomes, effectively improves pregnancy outcomes: including smoking cessation; increased use of folic acid; breastfeeding; greater odds of obtaining ANC; and lower rates of neonatal mortality (Dean et al. 2014; WHO). This vital component of the SRMNH care continuum lacks our studies reviewed. This review suggests an urgent need to include PCC in the SRMNH care continuum and studies in LLMICs.

The review has several limitations. Despite the inclusion of methodologically moderate to high-quality intervention studies retrieved from seven databases, some studies may have been missed as our search terms may not have been sufficient to retrieve them. The use of a deductive qualitative content analysis guided by the WHO-HRH action framework may have resulted in the loss of contextual nuances that may have provided insight into the processes that enabled the successful delivery of HRH interventions across the SRMNH care continuum. On the other hand, the number of studies with HRH interventions having a positive effect on SRMNH care quality across the continuum was more than those reporting negative effects, and hence there might be a potential publication bias.

Conclusions

Policy-makers in LLMICs should include respectful, woman-centred care as a key part of RBF initiatives and ensure healthcare workers' incentives are locally administered and CHWs are integrated into the healthcare system. Skills-based, regularly run, effectiveness-focused, onsite, clinical simulation and/or mobile phone-assisted in-service training of skilled personnel are needed. Besides, facility-based maternal death audits in all health facilities involving skilled and lay personnel, the implementation of ≥4 HRH interventions that target the different components of the healthcare system, and the inclusion of PCC in the SRMNH care continuum and studies are recommended.

2.1. Chapter Summary

Chapter two conducted a systematic review of primary studies investigating effective HRH interventions to support lay and/or skilled health personnel to improve quality SRMNH care across the continuum in LLMICs. The review identified a diversity of policy, education, finance, management,

leadership, and partnership-related HRH interventions that influenced the quality of SRMNH care services across the continuum in LLMICs. The chapter also highlighted the research and practice gaps in pre-conception care, an essential component of the SRMNCH-care continuum in LLMICs. The methods and materials used to address research questions 2-10 are discussed in the next chapter.

CHAPTER 4: Methods and Materials

4.1. Data source and study design

We undertook secondary analyses of data from the four waves of Ethiopia DHSs (EDHS 2005, EDHS 2011, EDHS 2016, and Ethiopia Mini DHS (EMDHS 2019)) conducted in 2005, 2011, 2016 and 2019, respectively, and the 27 most recent DHSs conducted between 2016 and 2021 from 27 other countries across the LLMICs. The data for all the study analyses were extracted from the individual countries' children's recode (KR) files. The DHS is a nationally representative survey conducted in over 85 low-income and middle-income countries across the globe since 1984 (Corsi et al. 2012). The DHS is conducted every five years to evaluate health and social indicators, including maternal and child healthcare services. The DHS employs a multi-stage cluster sampling technique to select women of reproductive age (15–49 years) and children younger than five years for inclusion, with a detailed sampling process provided in the literature (Aliaga & Ruilin 2006; Corsi et al. 2012). The DHS contains information on household characteristics, reproductive health, women's and children's health, nutrition, and mortality, whose data are publicly and freely available with no identifying information (Corsi et al. 2012). Standardised interviewer-administered questionnaires were used to collect data from the respondents. Anthropometry measurements, anaemia testing, and HIV tests were also performed for eligible women and children. The two studies using Ethiopia DHSs data presented in this thesis included a total weighted sample of 7307, 7908, 7590, and 3927 women of reproductive age with the most recent live birth within the previous five years to the Ethiopia DHSs 2005, 2011, 2016, and 2019, respectively. These data were used in the analyses of quality ANC, intrapartum care and PNC services, and the trends in chapters 5 and 6. The study on LLMICs included data on 197,958 women of reproductive age with the most recent live birth within two years preceding each DHS in 28 study countries. These data were used in the analyses of maternal healthcare across the continuum in chapter 7. Data on 296,581 women of reproductive age with the most recent live birth within five years preceding each DHS in 19 study countries were analysed in another study on LLMICs in the analyses of quality maternal healthcare across the continuum, presented in chapter 8.

4.2. Outcome variables

The outcome variables investigated in the studies presented in chapter 5 are: quality ANC (as having blood pressure measurement, urine and blood tests, informed of danger signs, iron supplementation, and nutritional counselling); quality intrapartum care (as having a health facility birth, skilled birth assistance, and newborn put to the breast within one hour of birth); and quality PNC services (as having PNC within two days of birth, cord examination, temperature measurement, and counselling on danger

signs and breastfeeding of the newborn, and healthcare provider's observation of breastfeeding). The data were analysed using multilevel models on women's access to quality ANC, intrapartum care and PNC services study in Ethiopia. The outcome variables investigated in chapter 6 are: quality ANC (a mother received five recommended interventions during her ANC visits: blood pressure measurement, blood and urine testing, iron supplementation, and being informed of pregnancy-related complications), quality intrapartum care (a mother and/or her newborn received three recommended interventions during the intrapartum: a health facility birth, birth assisted by skilled personnel, and newborn put to the breast within one hour of birth), and immediate PNC services (maternal and newborn PNC within 24 hours of birth). The data were analysed using multivariate decomposition trend analyses models on women's access to quality ANC, intrapartum care and immediate PNC services over two decades (2001-2019) in Ethiopia.

The outcome variables investigated in the studies presented in chapters 7-8 are: maternal healthcare across the continuum, referred to as the continuity of skilled care throughout pregnancy, birth, and after delivery (a mother received at least one skilled ANC visit, skilled intrapartum care, and maternal and/or newborn PNC within two days of birth for the last birth within 24 months preceding the latest DHS) in 28 LLMICs; and quality maternal healthcare across the continuum (a woman received eighteen recommended interventions during pregnancy, childbirth, and the postnatal period for the last birth within five years preceding the survey: at least one skilled ANC visit, four or more ANC visits, blood pressure measurement, urine and blood tests, iron supplementation, and newborn protection against neonatal tetanus during pregnancy; health facility birth, skilled intrapartum care, newborn weighed at birth, newborn's put to the breast within one hour of birth, and child's put on mother's bare skin immediately after birth during childbirth; and maternal and/or newborn PNC within two days of birth, maternal PNC within 24 hrs of birth, newborn PNC within 24 hrs of birth, stayed in a health facility for at least 24 hours, health provider counselled mother on newborn's health danger signs and health provider counselled mother on breastfeeding during the postnatal period).

4.3. Explanatory variables

The explanatory variables included in these studies were selected based on their significant associations with the outcome variable of interest in the literature and their availability in the DHS dataset (Singh, Story & Moran 2016; Tunçalp et al. 2015a; Wang & Hong 2013b). The explanatory socio-demographic and maternal healthcare variables included in the first study in Ethiopia DHS data analyses (chapter 5) were: whether commenced ANC during the first trimester, the number of ANC visits, mother's education level, health facility where ANC was received, household wealth quintile, and urban-rural area of residence. The explanatory variables included in the second study in Ethiopia

DHS data analyses (chapter 6) were as well socio-demographic and maternal healthcare variables: maternal education level, mother's age at birth, area of residence, household wealth quintile, whether commenced ANC during the first trimester, number of ANC visits, health facility where ANC service was received, whether received quality ANC, and whether received quality intrapartum care.

The explanatory variables included in the study in the 28 DHS data analyses (chapter 7) were: whether they commenced ANC during the first trimester, whether they had ≥4 ANC visits, whether they had received quality ANC, parity, duration of preceding birth interval, mother's age at birth, whether the pregnancy was wanted, whether mother had to get permission to seek care, whether mother had to have a companion to a healthcare facility to access care, whether distance to a healthcare facility was a barrier to access care, whether mother had access to mass media at least once a week, whether mother had healthcare insurance, mother's education level, and household wealth quintile. The explanatory variables included in the study in the 19 DHS data analyses (chapter 8) were: whether they commenced ANC during the first trimester, parity, duration of preceding birth interval, whether the pregnancy was wanted, whether the mother had to get permission to seek care, whether mother had to have a companion to a healthcare facility to access care, whether mother had access to mass media at least once a week, whether mother had healthcare insurance, mother's education level, and household wealth quintile.

4.4. Statistical analyses

Equiplots, concentration curves and concentration indexes, and the slope index of inequality were employed to measure within- and between-country socio-demographic inequalities in accessing quality maternal healthcare services, maternal healthcare across the continuum, and quality maternal healthcare across the continuum in the study countries (Leventhal et al. 2021; O'Donnell et al. 2016; Wagstaff et al. 2007). We fitted multilevel mixed-effects logistic regression models to determine the predictors of quality maternal healthcare services, maternal healthcare across the continuum, and quality maternal healthcare services across the continuum in the study countries. In addition, analyses of four waves of consecutive Ethiopia DHSs data employed statistical control charts and multivariate regression decomposition analyses. Several statistical software programs were utilised to undertake the analyses presented in this thesis, including Stata/SE 16.1, SPSS version 27, and Excel Office 2019. All analyses employed sampling weights and were adjusted for sampling design via Stata's survey commands.

4.5. Ethical Approval

As the studies presented in this thesis used secondary data from the DHS program, the research was declared by the University of Technology Sydney (UTS) Human Research Ethics Committees "ETH20-4827 - Quality of care in maternal health in Ethiopia" to be of negligible risk under the National Statement on Ethical Conduct in Human Research.

4.6. Chapter Summary

Chapter four outlined the methodology for the secondary data analyses of the four waves of DHSs from Ethiopia and the latest DHSs from 28 LLMICs. The DHS is a nationally representative cross-sectional study conducted every five years based on data collected using standardised interviewer-administered questionnaires, and anthropometry measurements and specimen collections from eligible women or children. The outcome variables comprise quality ANC, intrapartum care, and PNC services. These outcome variables were analysed to measure the level of women's use of quality maternal healthcare services across pregnancy, childbirth, and postpartum in Ethiopia, as well as maternal healthcare services across the continuum in 28 LLMICs; and quality maternal healthcare services across the continuum in 19 LLMICs. The next chapter discusses the level and determinants of receipt of quality ANC, intrapartum care, and PNC services in Ethiopia based on the latest Ethiopia DHS 2019 data.

Chapter 5: Women's use of quality antenatal care, intrapartum care and postnatal care services in Ethiopia: a population-based study using the demographic and health survey data.

This chapter investigates the women's use of quality ANC, intrapartum care and PNC services and their determinants in Ethiopia based on the latest nationally representative Ethiopia DHS 2019 data. This study is currently under the second round of review in the journal: BMC Public Health.

Negero, M.G., Sibbritt, D. & Dawson, A. Women's use of quality antenatal care, intrapartum care, and postnatal care services in Ethiopia: Multilevel analyses. BMC Public Health. 6a43b267-7ffc-4e03-80d6-a8080372b736 | v.1.1 (This is under review in the BMC Public Health Journal).

Abstract

Background:

The quality of care a woman receives during antenatal care (ANC), intrapartum care, and postnatal care (PNC) affects the health of the woman and her child and her likelihood of seeking care in the future. This study aimed to assess the recommended interventions received by a mother and/or her newborn during ANC, intrapartum care and PNC, and their determinants in Ethiopia using data from the nationally representative 2019 Mini Demographic and Health Survey.

Methods:

We defined quality ANC as having: blood pressure measurement, urine and blood tests, informed of danger signs, iron supplementation, and nutritional counselling; quality intrapartum care as having: a health facility birth, skilled birth assistance, and newborn put to the breast within one hour; and quality PNC as having: PNC within two days; cord examination; temperature measurement, and counselling on danger signs and breastfeeding of the newborn; and healthcare provider's observation of breastfeeding. We used multilevel mixed-effects logistic regression analyses specifying three-level models: a woman/household, a cluster, and an administrative region to determine predictors of each care quality. The analyses employed sampling weights and were adjusted for sampling design.

Results:

Thirty-six percent (n=1,048), 43% (n=1,485), and 21% (n=374) women received quality ANC, intrapartum, and PNC, respectively. Private health facilities provided higher-quality ANC and PNC but poor intrapartum care quality compared to public health facilities. Receiving ≥4 ANC contacts and commencing this during the first trimester, higher levels of women's education and household wealth were positive predictors of quality ANC. Government health posts were less likely to provide quality ANC. Richer, urban residing women with education and ≥4 ANC contacts were more likely to receive quality intrapartum care. Women who received quality ANC and skilled birth assistance were more likely to receive quality PNC. Teenage mothers were more likely to receive quality intrapartum care but were less likely to receive quality PNC than mothers aged 20-49.

Conclusions:

We recommend standardizing the components of maternal healthcare provided in all health facilities; and promoting early and ≥4 ANC contacts, effectiveness, sensitivity, and vigilance of care provided to teenage mothers, digital clinical decision support tools, and women's education and economic empowerment.

Background

Reducing the unacceptably high maternal and perinatal morbidity and mortality rates in low-income countries requires considerable investment to increase access to, demand for, and use of skilled maternity care, alongside enhancing the quality of care delivered (WHO 2016b). In Ethiopia in 2017, 49% of 1010 reported maternal deaths occurred after women arrived at health facilities. Fourteen percent of these maternal deaths were attributed to a lack of supplies and equipment, 11% to delays in patient management at the facility, 6% to healthcare provider error and mismanagement, and 28% to referral delays from other facilities (WHO 2019a). Therefore, increasing access to, and utilization of, maternal healthcare alone is insufficient to improve maternal health outcomes (The Harvard Chan School Centre of Excellence in Maternal and Child Health 2021). The quality of care a woman receives across ANC, intrapartum care, and PNC affects the health of the woman and her child and her likelihood of seeking care in the future (The Harvard Chan School Centre of Excellence in Maternal and Child Health 2021; Wehrmeister et al. 2016). Measuring the quality of existing maternal healthcare and identifying its determinants are essential for planning improvements in current and future care (The Harvard Chan School Centre of Excellence in Maternal and Child Health 2021).

While there has been a strong focus on improving access to healthcare during pregnancy, labour and delivery, and postnatal periods, there has been less emphasis on ensuring effective coverage or contact with the provision of all the recommended interventions during antenatal, intrapartum, and PNC services. This has resulted in missed opportunities to alleviate maternal and newborn morbidities and mortalities (Carvajal–Aguirre et al. 2017). Reaching the 2030 Sustainable Development Goals (SDGs) target of reducing the global maternal mortality ratio to less than 70/100,000 live births and the global neonatal mortality rates to less than 12/1,000 live births in Ethiopia requires a rapid improvement in maternal healthcare quality (Kruk et al. 2018).

Maximizing the life-saving potential of ANC in low-resource settings requires a focus on quality. For many women around the globe, an ANC visit may be their first adult contact with the healthcare system. ANC, therefore, serves as a gateway to health services both during and beyond maternity care. In addition to diagnosing and managing pregnancy-related complications, ANC provides an opportunity to screen for and treat other chronic conditions and non-communicable diseases (The Harvard Chan School Centre of Excellence in Maternal and Child Health). However, in low-income settings, the mere focus on the proportion of mothers receiving four or more ANC contacts as a global benchmark indicator to track maternal health program performance than on the content and process of

ANC is limiting the ability to early identify and address complications and maximize health outcomes (Hodgins & D'Agostino 2014).

Over the last two decades, women have been encouraged to give birth in health facilities to ensure access to skilled personnel and timely referral if required. However, giving birth in a health facility may not guarantee quality care (Bohren et al. 2014). Disrespectful care has been reported in facilities that not only violate a woman's human rights but are a significant barrier to accessing future intrapartum care services (Asefa & Bekele 2015b; Bohren et al. 2014).

A negative experience in childbirth is associated with post-traumatic stress disorder, disruption to interpersonal relationships, and dysfunctional maternal-infancy bonding (Di Blasio, Camisasca & Miragoli 2018; Shiva et al. 2021).

Women and their newborns require support and careful monitoring after birth. Most maternal and infant deaths occur in the first six weeks after delivery, yet this remains a neglected area of care (WHO 2021a). Basic care for all newborns should include promoting and supporting early and exclusive breastfeeding if possible, keeping the baby warm, increasing handwashing, and providing hygienic umbilical cord and skincare. Families should be counselled to identify danger signs, understand the care that both the woman and newborn need, and where to reach services when needed. Promoting a healthy lifestyle and good nutrition, detecting and preventing diseases, supporting women who may be experiencing intimate partner violence, and ensuring access to sexual and reproductive health, including postpartum family planning, are also key to quality postnatal care (WHO 2021a).

Quality prenatal, intrapartum, and postnatal care are vital maternal healthcare services that should be delivered by skilled personnel (**Figure 5.1**). Quality ANC, according to the World Health Organization (WHO), includes nutritional counselling and multivitamin supplements, frequent visits (eight or above ANC contacts), blood and urine tests, preventive antibiotics, tetanus toxoid injections, and health education on pregnancy and birth danger signs (WHO 2015a, 2016c). Respectful care, clear and compelling communication between the woman and her healthcare provider, the option of a companion during labour and delivery, delivery at a health facility, skilled personnel assistance, appropriate pain relief strategies, mobility in labour where possible, choice of birth position, use of uterotonics, delayed cord clamping (after a minute), immediate kangaroo care and breastfeeding, delayed bathing of the newborn (24 hours), and the care of mother and newborn in a health facility for at least 24 hours after delivery are all components of quality intrapartum care (WHO 2015a, 2018b). Immediate PNC within 24 hours of birth and at least three additional PNC visits for the mother and the newborn within 42 days of birth, home visits in the first week after birth, exclusive breastfeeding,

cord care, prophylactic antibiotics for the mother, and health education on maternal and newborn health danger signs are all components of quality PNC (WHO 2014b, 2015a).
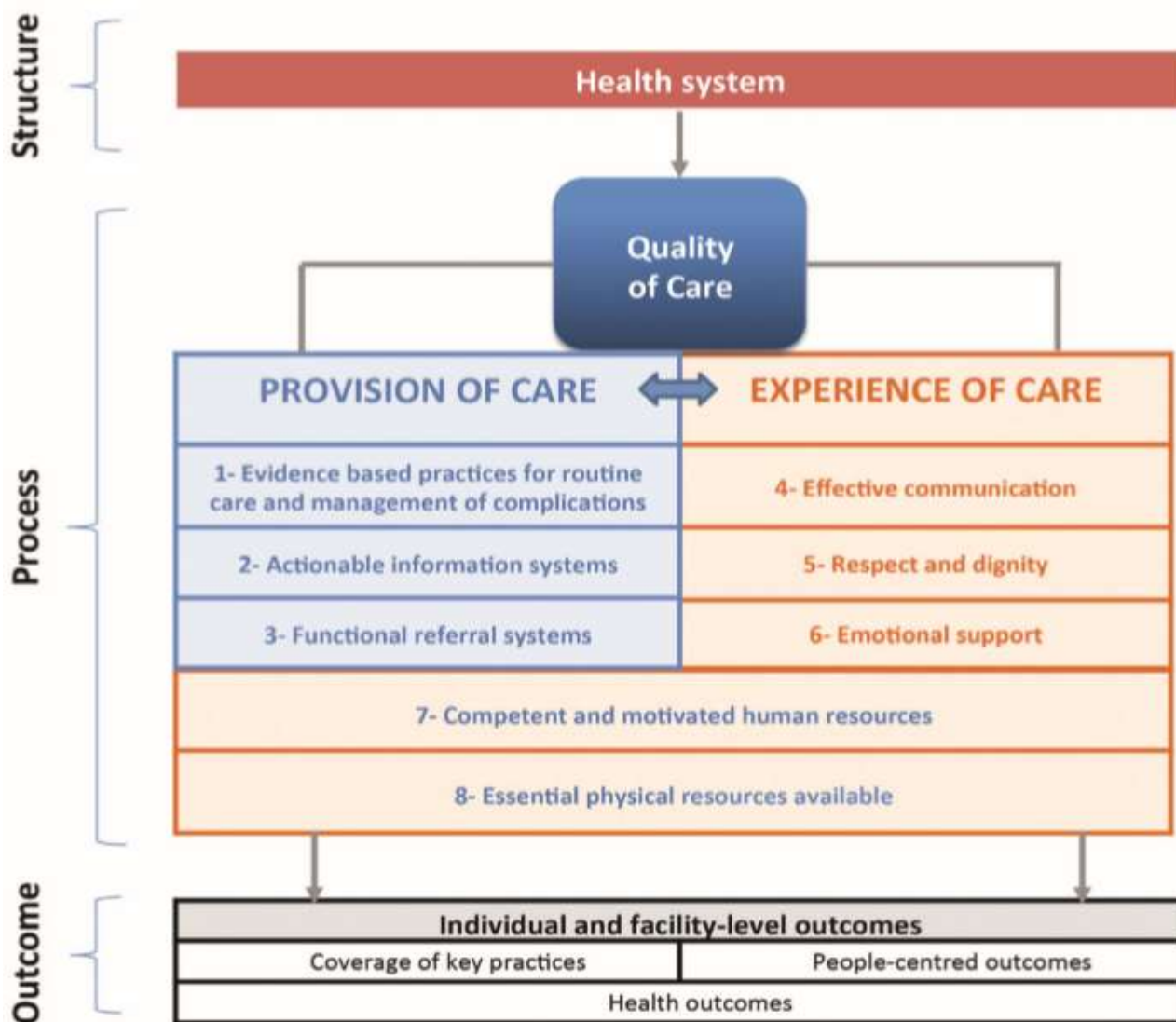
Figure 5.1 1: WHO Quality of Care Framework for maternal and newborn health (WHO 2016b).

Measuring the existing maternal healthcare quality and its determinants at a country level, using the nationally representative demographic and health survey (DHS) data, can identify gaps in care and provide insight into reducing maternal and newborn morbidity and mortality (Dettrick et al. 2016; Raven et al. 2012). There is currently no research that provides a comprehensive and standard view of quality maternal healthcare across ANC, intrapartum care, and PNC services in Ethiopia to inform health service planning and improve outcomes.

One study focused on the quality of ANC and PNC in 20 sub-Saharan African countries, including Ethiopia. This research, based on a secondary analysis of DHSs data, revealed that while 51% of mothers received four or more ANC visits with at least one visit from skilled personnel, only 5%

received eight ANC interventions (blood pressure measurement, urine and blood test, iron supplementation, tetanus protection, counselling on pregnancy complications, HIV testing and results, and three doses of intermittent preventive treatment of malaria in pregnancy). While 65% of births in this study were attended by skilled personnel, no data is provided concerning the interventions provided during intrapartum care. Only 3% of women received all seven PNC interventions (newborn weighed at birth, early initiation of breastfeeding, no pre-lacteal feed, BCG and polio vaccines, and PNC for mother and newborn within two days of birth) (Carvajal–Aguirre et al. 2017).

While no research has examined the quality of care across the three packages of maternal healthcare, two studies by Bayou et al. (2016) and Gebrekirstos et al. (2021) have assessed adequate ANC among slum residents in Addis Ababa, and Southern Ethiopia. These authors defined quality ANC as commencing ANC during the first trimester, four or more ANC contacts, weight, height and blood pressure measurements, urine and blood tests, tetanus injection, iron supplementation, and counselling on pregnancy complications. In this study, only 11% and 23% had adequate ANC in Addis Ababa and Southern Ethiopia, respectively (Bayou, Mashalla & Thupayagale-Tshweneagae 2016; Gebrekirstos et al. 2021). Based on the then most recent (2007–16) DHS and Multiple Indicator Cluster Surveys data in 91 low and middle-income countries, Arsenault et al. (2018) described quality ANC according to the receipt of three essential services (blood pressure measurement, urine examination, and blood testing) among women who had at least one visit with a skilled ANC provider (Arsenault et al. 2018).

This study aimed to assess the quality of antenatal (ANC), intrapartum care, and PNC services and to identify their multifaceted determinants in Ethiopia using data from the 2019 Ethiopia Mini DHS (MDHS). We therefore comprehensively assessed the recommended interventions during ANC, intrapartum care, and PNC services a mother and/or her newborn received and the associated socio-demographic determinants at a national level in Ethiopia using the 2019 Ethiopia MDHS data.

Methods

Data and study sample

We used the 2019 Ethiopia Mini Demographic and Health Survey (EMDHS) data conducted by the Ethiopian Public Health Institute (EPHI) from March 21, 2019, to June 28, 2019, with permission from the DHS program. The main objectives of the 2019 EMDHS were to collect nationally representative high-quality data house to house and provide up-to-date estimates on key demographic and health indicators in Ethiopia: breastfeeding; maternal and child health (ANC, delivery, and PNC); infant, child, and neonatal mortality levels; child nutrition; and other health issues relevant to the achievement of the SDGs (EPHI and ICF 2021).

The 2019 EMDHS used the sampling frame of all census enumeration areas (EAs) created for the 2019 Ethiopia Population and Housing Census (EPHC) and conducted by the Central Statistical Agency (CSA). The census frame was a complete list of 149,093 EAs created for the 2019 EPHC. An EA is a geographic area covering an average of 131 households. The 2019 EMDHS sample provides estimates of key indicators for the country as a whole, for urban and rural areas separately, and each of the nine regions and the two administrative cities (EPHI and ICF 2021).

The 2019 EMDHS employed a two-stage cluster sampling technique. In the first stage, 305 EAs (93 in urban areas and 212 in rural areas) were selected with probability proportional to EA size and with independent selection in each sampling stratum. A household listing operation was then carried out in all selected EAs from January through April 2019. In the second stage of selection, a fixed number of 30 households per cluster were selected with an equal probability of systematic selection from the newly created household listing. All women aged 15-49 years, who were either permanent residents of the selected households or visitors and who slept in the household the night before the survey, were eligible to be interviewed. In the interviewed households, 9,012 eligible women were identified for individual interviews; interviews were completed with 8,885 women, yielding a response rate of 99% (EPHI and ICF 2021). We used information on 3,979 women surveyed with the most recent live births within five years preceding the 2019 EMDHS for the analyses.

Outcome measures

The outcome measures used in this study were the quality of provisions of antenatal, intrapartum, and maternal and/or newborn postnatal care services defined by the World Health Organization (WHO) (WHO 2014b, 2016c; WHO, UNPF & UNICEF 2015; World Health Organization 2018). Specifically, the quality of ANC was defined as: blood pressure measurement; urine tests for detecting bacteriuria and proteinuria; blood tests for infection and anaemia; informed of danger signs of pregnancy; provision of iron supplements; and provision of nutritional counselling. A woman would need to receive all six of these interventions to be considered to have received good quality ANC (WHO 2016c; WHO, UNPF & UNICEF 2015).

Quality intrapartum care was defined as receiving all three interventions: a health facility birth; skilled personnel assisted birth; and the newborn put to the breast within one hour of birth (WHO, UNPF & UNICEF 2015; World Health Organization 2018). In the context of a shortage of skilled personnel in low-resource settings, the over-medicalization of normal childbirth can overburden front-line health workers, resulting in poor birth outcomes. Therefore, it is crucial that intrapartum clinical interventions are implemented only when there is clear evidence that they can improve outcomes and minimize

potential harms (Hofmeyr 2005). The non-clinical aspects of labour and childbirth care, including emotional support through labour companionship, effective communication, and respectful care, are essential components of the care experience that should complement any necessary clinical interventions to optimize the quality of care provided to the woman and her family (World Health Organization 2018).

Quality PNC was defined as the receipt of all six of the following components of PNC: postnatal check for the mother and/or newborn within two days of birth at home or health facilities; cord examination for the newborn; temperature measurement for the newborn; counselling on danger signs of newborn health; counselling on breastfeeding; and healthcare provider's observation of breastfeeding (WHO 2014b; WHO, UNPF & UNICEF 2015).

Other measures

Information about the individual mothers included their age at birth (i.e., 10-19, 20-34 years, and 35-49 years), an education level (i.e., no formal education, primary school education, secondary school, and tertiary), preceding birth interval (i.e., <24 months, and ≥24 months), and household wealth index (i.e., richest, richer, middle, poorer, and poorest).

Information about the birth included type of healthcare provider (i.e., doctor, nurse, midwife, others), the place where care was received (public sector, private sector, NGO, home), area of residence (i.e., urban or rural: urban areas include all capitals of administrative regions, zones, and districts; rural areas are all areas that are not urban.), as well as cities (i.e., Addis Ababa and Dire Dawa) and administrative regions (i.e., Tigray, Afar, Amhara, Oromia, Somali, Benishangul-Gumuz, South Ethiopia, Gambela, and Harari).

Statistical analyses

Multilevel mixed-effects logistic regression (melogit) models were used to determine the association between the study characteristics at different levels and measures of quality of maternity care services. The melogit fits mixed-effects models for binary and binomial responses. The conditional distribution of the response given the random effects is assumed to be Bernoulli, with success probability determined by the logistic cumulative distribution function:

melogit y x [iw=sw] || psu:|| ssu:, or

The 2019 EMDHS sample was stratified and selected in multiple stages generating hierarchically nested data: individual women were nested within EAs (clusters), and EAs (clusters) were nested

within the administrative regions. Hence, the likelihood of women seeking quality ANC, intrapartum care, or PNC services is likely to be correlated to the EA (cluster) members and residents of an administrative region. The utilization patterns of quality ANC, intrapartum care, or PNC services are influenced by the characteristics of different levels (individual women, EAs (clusters), and administrative regions) (Babalola & Fatusi 2009; Sepehri et al. 2008; Tsui et al. 2003; Worku, Yalew & Afework 2013). Assumptions of independence within a cluster (group) and equal variance across clusters (groups) are invalid for nested data (Worku, Yalew & Afework 2013). The melogit modelling techniques allow us to simultaneously assess the variation of an outcome variable at several levels (individual women, EAs, and administrative regions). Aggregating or disaggregating variables to a single common level using the standard binary logistic regression model leads to bias (loss of power or Type I error) (Babalola & Fatusi 2009; Rabe-Hesketh & Skrondal 2008; Sepehri et al. 2008; Tsui et al. 2003; Worku, Yalew & Afework 2013). The melogit modelings allow us to consider the individual women level, EA (cluster) level, and administrative region level variables in the same analysis rather than having to choose one of the three (Babalola & Fatusi 2009; Sepehri et al. 2008; Tsui et al. 2003; Worku, Yalew & Afework 2013). Hence, the melogit modelling is the appropriate analytical technique for such data (Hox, Moerbeek & Van de Schoot 2017). Accrodingly, three-level models were specified. The level-one variables refer to individual women/household-level determinants, including socio-demographic and economic characteristics. We adjusted for clustering (EA) at level two and included a primary sampling unit for analyses. While at level three, we adjusted for an administrative region where two cities and nine administrative regions were included in the analyses (**Figure 5.2**). The melogit analyses were started from the intercept-only (null) models to test the null hypotheses that there were no variations in the women's utilisation of quality ANC, intrapartum care, or PNC services between administrative regions or between primary sampling units (EAs) in Ethiopia. For each outcome variable, we estimated two models: the null model (intercept-only model), an empty model with no independent variables, and a full model containing the individual women, EA (cluster), and administrative region level predictors. The null model was used to estimate the overall log of odds of each outcome variable across all individual, level-two, and level-three variables. It was used to check the significance of the association between each outcome variable and all individual women, EA (cluster) and administrative region level variables (fixed effects), and to estimate the intra-class correlation coefficient (Rho). Intra-class correlation coefficient (ICC) is the extent of the between classes variation influencing individual-level outcomes (random effects) (Babalola & Fatusi 2009; Girmaye & Berhan 2016). The ICC informs the researcher whether the variation in the scores is primarily within or between groups (Babalola & Fatusi 2009; Girmaye & Berhan 2016). The explanatory variables

included in this study were selected based on their significant associations with the women's use of maternity care services from the literature and their availability in the DHS dataset (Bayou, Mashalla & Thupayagale-Tshweneagae 2016; Bobo et al. 2021; Corsi et al. 2012; DHS Program 2023a; Fekadu, Ambaw & Kidanie 2019; Gebrekirstos et al. 2021; Tunçalp et al. 2015a).

Our study's quality ANC analyses included six explanatory socio-demographic and maternal healthcare variables: woman's education level (i.e., no formal education, primary education, or secondary and above), household wealth index (i.e., richest, richer, middle, poorer, or poorest: the DHS wealth index is a composite indicator which divides the households into five categories: poorest, poorer, middle, richer and the richest, and were derived using principal component analysis based on information from housing characteristics and ownership of durable household goods) (Rutstein & Johnson 2004), area of residence (i.e., urban or rural: urban areas include all capitals of administrative regions, zones, and districts; rural areas are all areas that are not urban.), as well as cities (i.e., Addis Ababa and Dire Dawa) and administrative regions (i.e., Tigray, Afar, Amhara, Oromia, Somali, Benishangul-Gumuz, South Ethiopia, Gambela, and Harari), whether the woman received first ANC during the first trimester, number of ANC visits received (1-3, or ≥4), and type of health facility where ANC was attended (government health post, public or private hospital, government health centre, or private clinic/NGO healthcare facility).

The study's quality intrapartum care analyses included six explanatory socio-demographic and maternal healthcare variables: woman's education level, mother's age at birth (i.e., 10-19, 20-34 years, or 35-49 years), household wealth index, area of residence, whether the woman received four or more ANC visits during the pregnancy, and whether the woman received quality ANC during the pregnancy. Quality ANC was defined as having: blood pressure measurement, urine and blood tests, iron supplementation, informed of danger signs of pregnancy, and provision of nutritional counselling during the ANC visits for the last birth.

Our study's quality postnatal care analyses included eight explanatory socio-demographic and maternal healthcare variables: woman's education level, household wealth index, area of residence, mother's age at birth, preceding birth interval (i.e., <24 months, or ≥24 months), whether the woman received first ANC during the first trimester, whether the woman received quality ANC during the pregnancy, and whether the woman received skilled-personnel-assisted birth during intrapartum care. Skilled personnel includes doctors, nurses, midwives, health officers, and/or health extension workers (EPHI and ICF 2021). However, we were unable to include other potential explanatory variables, including nulliparity/multiparity, singleton/multiple pregnancy, and distance from healthcare facility to our

regression models because they were missing from the 2019 Ethiopia demographic and health survey data. Using the statistical software programme, Stata/SE 16.1, all analyses employed sampling weights and were adjusted for sampling design (i.e., clustering and stratification). Statistical significance was set at $p<0.05$. We also performed multicollinearity checking during each analysis to rule out any interaction between the potential predictors included using the vif command in the Stata program.

```
┌─────────────────────────────────────────────────────────────────────────┐
│ Women of reproductive age who had at least one live birth within five     │
│ years preceding the 2019 EMDHS                                            │
└─────────────────────────────────────────────────────────────────────────┘
                                    │
                                    ▼
┌─────────────────────────────────────────────────────────────────────────┐
│               Total women samples interviewed: n=5,527                     │
└─────────────────────────────────────────────────────────────────────────┘
```

n=2,604 women samples were excluded: n=1,600 were excluded because they didn't report birth history for the last birth n= 1004 were excluded because they didn't receive ANC sevices	n= 2,099 women samples were excluded: n=1,600 were excluded because they didn't report birth history for the last birth n= 499 were excluded because they didn't receive intrapartum care sevices	n=3,742 women samples were excluded: n=1,600 were excluded because they didn't report birth history for the last birth n= 2,142 were excluded because they didn't receive PNC sevices
n=2,923 women samples were included in the models for the six recommended interventions during ANC contacts	n=3,428 women samples were included in the models for the three recommended intervenitons during intrapartum care	n=1,785 women samples were included in the models for the six recommended intervenitons during PNC services
1. n=2,923 women samples were level-1 (individual level) 2. 305 were level-2 clusters (primary sampling units) 3. 11 were level-3 (administrative states)	1. n=3,428 women samples were level-1 (individual level) 2. 305 were level-2 clusters (primary sampling units) 3. 11 were level-3 (administrative states)	1. n=1,785 women samples were level-1 (individual level) 2. 285 were level-2 clusters (primary sampling units) 3. 11 were level-3 (administrative states)

Figure 5.2 1: Schematic presentation showing included samples for quality ANC, intrapartum, and PNC analyses, Ethiopia MDHS 2019.

Results

A total of 5,527 reproductive-age women (15-49 years) were included in the analyses. The majority of these women (75%) resided in rural areas, had no formal education (54%), were from poor households (45%), and gave their last birth at 20-34 years of age (74%) (Tables 5.4, 5.5 and 5.6).

Quality ANC

In Ethiopia, 74% of women aged 15-49 years received at least one ANC visit for their last birth within five years preceding the 2019 Ethiopia MDHS, but only 43% of the women received four or more ANC visits for the last birth. In addition, only 28% of the women commenced their ANC contact during the first trimester. Of the women who attended at least one ANC visit for the last birth within five years preceding the 2019 Ethiopia MDHS, 88% reported blood pressure measurement, 79% reported blood tests to screen anaemia or infections, 77% received iron supplementation, 74% reported urine examination, 71% received nutritional counselling, and 60% were informed of pregnancy-related complications. All six of the recommended interventions were received by 36% of women during their ANC visits (**Table 5.1**). The majority (53%) of women who had their ANC visits for their last birth at private clinics/NGOs received all the six recommended interventions during ANC visits, while only 18% of those who had their ANC visits for their last birth at government health posts received all the six recommended interventions during ANC visits (**Figure 5.3**).

Table 5.1 1: Quality antenatal care during pregnancy of the most recent live birth within five years preceding the survey, Ethiopia MDHS 2019 (n=2,923).

ANC interventions	Frequency	Percent	(95% CI.)
Blood pressure measured	2,575	88.1	(85.7, 90.2)
Urine sample taken	2,160	73.9	(69.5, 77.8)
Blood sample taken	2,305	78.9	(74.8, 82.4)
Informed of pregnancy complications	1,751	59.9	(56.1, 63.6)
Iron supplemented	2,249	77.0	(73.5, 80.1)
Nutritional counselling provided	2,077	71.0	(67.7, 74.2)
Received all the six ANC components	1,048	35.8	(32.1, 39.8)
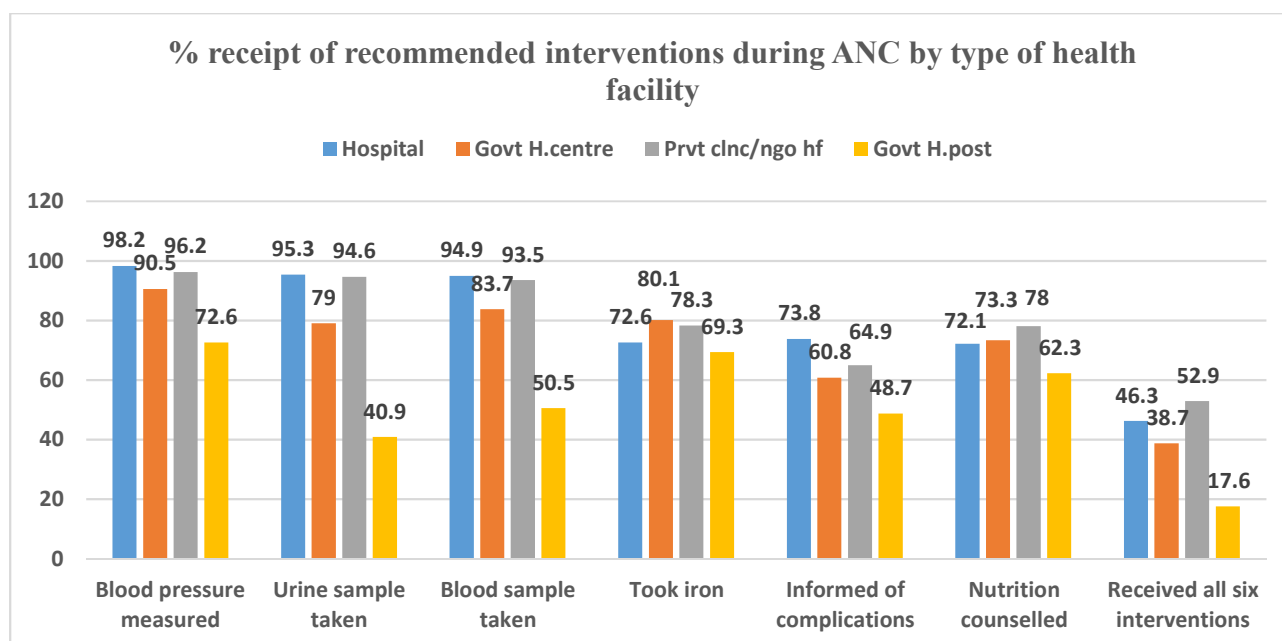
Figure 5.3 1: The percentage of women who received the recommended interventions during ANC by the type of healthcare facility, Ethiopia MDHS 2019.

Of the women who received intrapartum care during labour and delivery for their most recent live births within five years preceding the 2019 Ethiopia DHS, 59% gave birth in healthcare facilities. Of these women, 62% had skilled personnel-assisted birth, and 72% had their newborn put to their breast within one hour of birth. All three of these recommended interventions were received by 43% of women during intrapartum care (T**able 5.2**). The majority (75%) of mothers who gave their last birth at government health centres received all the three recommended interventions during intrapartum care, while 65% of mothers who gave their last birth at private health facilities received all the three recommended interventions during intrapartum care (**Figure 5.4**).

Table 5.2 1: Three recommended interventions during intrapartum care for the most recent live birth within five years preceding the survey, Ethiopia MDHS 2019 (n= 3,428).

Intrapartum care interventions	Frequency	Percent	(95% CI.)
Health facility birth	2,018	58.9	(53.3, 64.3)
Skilled personnel assisted birth	2,120	61.8	(56.3, 67.1)
Newborn put to the breast within 1hr of birth	2,464	71.9	(68.9, 74.6)
Received the three recommended interventions during the intrapartum care	1,485	43.3	(38.6, 48.2)
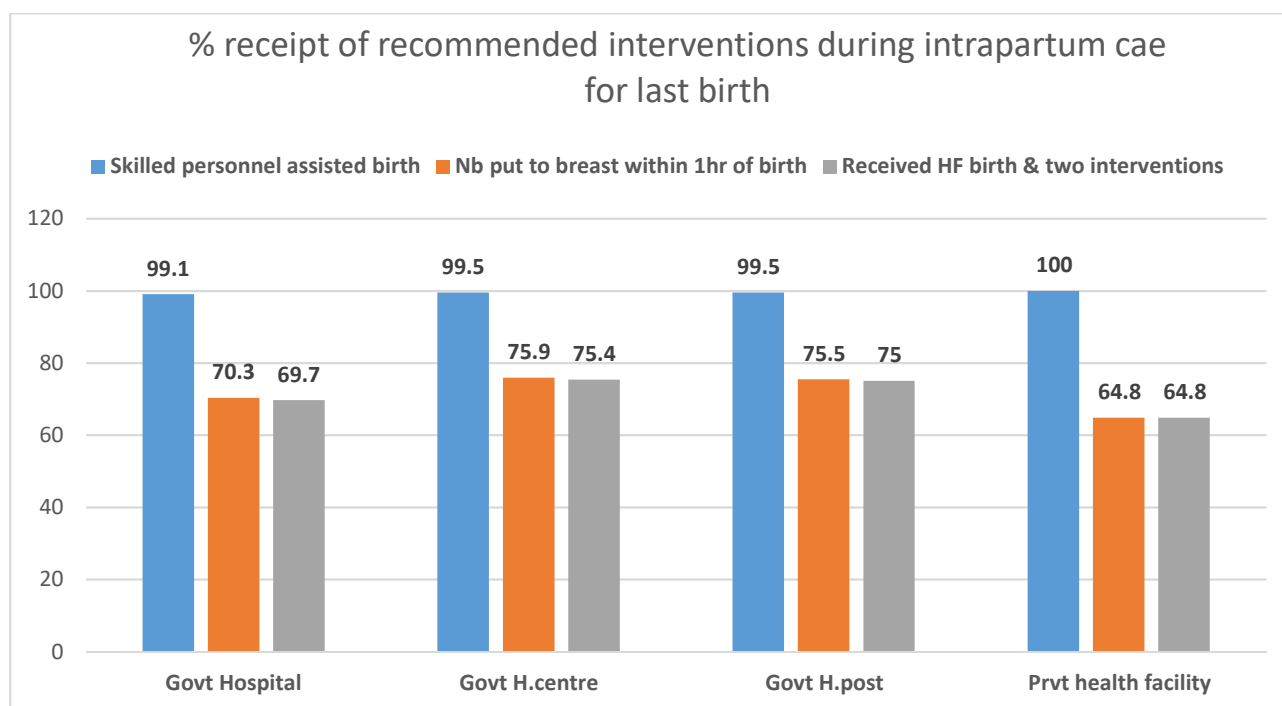
Figure 5.4 1: The percentage of women who received the recommended interventions during intrapartum care by the type of healthcare facility, Ethiopia MDHS 2019.

Among mothers and/or their newborns who received PNC at home or in health facilities for the most recent live births within five years preceding the 2019 Ethiopia MDHS, 87% received maternal and/or newborn PNC within two days of birth; a healthcare provider counselled the mother on breastfeeding in 63% of births; a healthcare provider observed the newborn breastfeeding in 59% of births; a healthcare provider measured the newborn's temperature in 51% of births; a healthcare provider examined the newborn's cord in 49% of births, and a healthcare provider counselled the mother on newborn danger signs in 39% of births. All six of the recommended interventions were received by 21% of women and/or their newborns during postnatal care (**Table 5.3**). Forty-four percent of mothers who gave their last birth at private health facilities received all the six recommended interventions during their PNC services, while only 9% of mothers who gave their last birth at government health posts received all the six recommended interventions during their PNC services(**Figure 5.5**).

Table 5.3 1: Quality maternal and/or newborn PNC for the most recent live birth within five years preceding the survey, Ethiopia MDHS 2019 (n= 1,785).

PNC interventions	Frequency	Percent	(95% CI.)
Maternal and/or newborn PNC within two days of birth	1,559	87.3	84.7, 89.6
The health provider examined the newborn cord	877	49.2	44.7, 53.6
The health provider measured newborn temperature	902	50.6	46.4, 54.7

Health provider counselled mother on newborn's health danger signs	691	38.7	34.4, 43.2
Health provider counselled on breastfeeding	1,124	63.0	59.1, 66.7
The health provider observed breastfeeding	1,046	58.6	54.8, 62.4
Received all the six components of PNC	374	20.9	18.0, 24.2
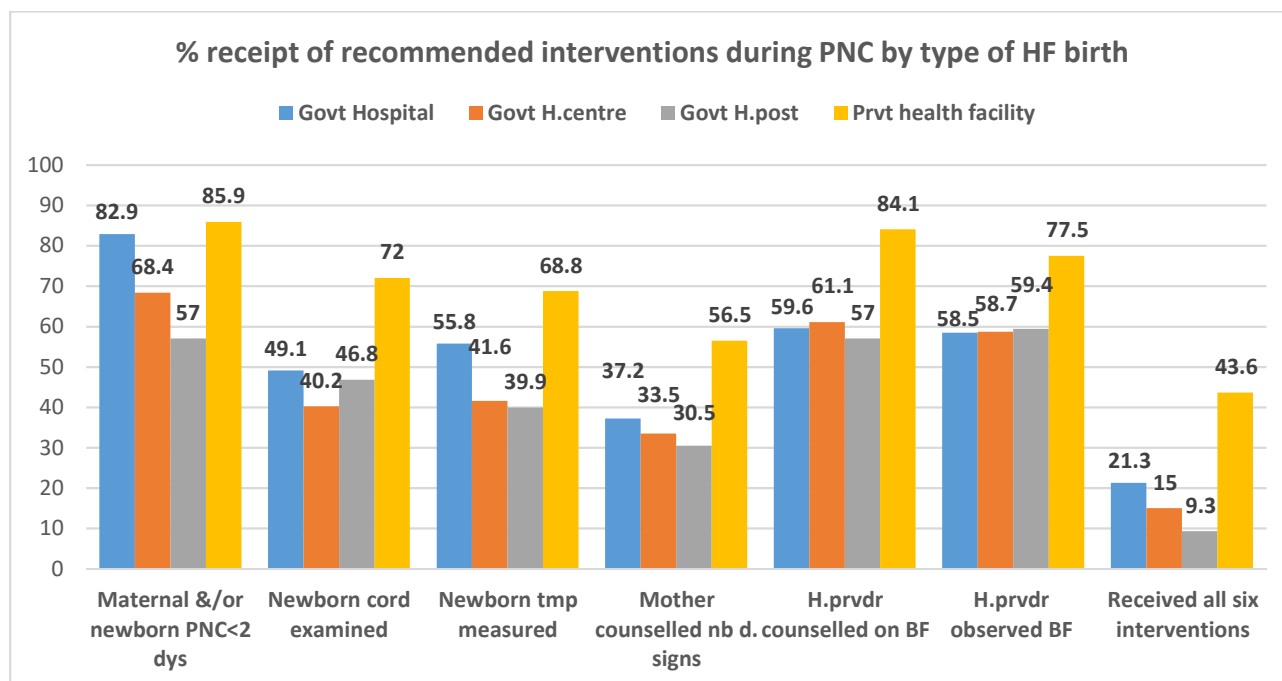
Figure 5.5 1: The percentage of mothers and/or their newborns who received the recommended interventions during PNC by the type of healthcare facility where the birth occurred, Ethiopia MDHS 2019.

Of the women who received ANC for their most recent live births within five years preceding the survey, 63% commenced ANC during the first trimester, 58% received at least four ANC visits, while 3% attended their ANC in private clinics/NGO health facilities and 66% in government health centres (**Table 5.4**).

Factors associated with the receipt of all six recommended interventions during ANC

Mothers who had their first ANC contact during the first trimester were 30% more likely (AOR=1.30; 95% CI=1.07, 1.59) to receive all the six recommended interventions during ANC visits, compared to women who had no or late ANC contact. Mothers who had four or more ANC visits for the last birth were 88% (AOR=1.88; 95% CI=1.54, 2.29) more likely to receive all the six recommended interventions during ANC visits than women who had fewer ANC contacts. Receipt of all the six recommended interventions during ANC was 11 percentage points and 33 percentage points higher among mothers with primary education and secondary or higher education levels, respectively, compared with mothers with no education. With increasing levels of mother's education, the likelihood

of receiving all the six recommended interventions during ANC significantly increased; mothers with secondary or higher education were 58% (AOR= 1.58; 95% CI=1.18, 2.12) more likely to receive all six recommended interventions, compared to mothers who had no formal education. Mothers who received ANC for their last birth from government health posts were less likely to receive all the six recommended interventions; mothers who received their ANC at private clinics and/or NGOs, at hospitals, and at government health centres were 3.54 times (AOR=3.54; 95% CI= 1.87,6.72), 2.19 times (AOR=2.19; 95% CI= 1.44, 3.32) and 2.12 times (AOR= 2.12; 95% CI= 1.57, 2.87) more likely to receive the six recommended interventions during ANC than mothers who received ANC at government health posts, respectively. The receipt of all the six recommended interventions during ANC visits was 39 percentage points higher among the richest mothers compared with poorest mothers. With decreasing indices of households' wealth index, the likelihood of receiving all six recommended interventions during ANC visits also significantly decreased; mothers from households with the poorest wealth indices were 66% (AOR=0.34; 95% CI=0.21, 0.55) less likely, compared to mothers from households with the richest wealth indices (**Table 5.4**).

Table 5.4 1: Determinants of receipt of all the six recommended components of ANC for the most recent live birth within five years preceding the survey, Ethiopia MDHS 2019 (n=2,923).

Study variables	Total number of women (%)	Women who received all the six interventions during ANC (%)	Unadjusted Odds Ratio (95% CI.)	p-value	* Adjusted Odds Ratio (95% CI.)	p-value
First trimester ANC						
No	1,831 (62.6)	565 (30.9)	1.00		1.00	
Yes	1,092 (37.4)	483 (44.2)	2.66 (2.21, 3.19)	<0.001	1.30 (1.07, 1.59)	0.009
Number of ANC visits						
1-3	1,225 (42.0)	304 (24.8)	1.00		1.00	
≥4	1,688 (58.0)	739 (43.8)	2.23 (1.85, 2.68)	<0.001	1.88 (1.54, 2.29)	<0.001
Mother's level of education						
No education	1,282 (43.9)	377 (29.4)	1.00		1.00	
Primary education (1-8)	1,153 (39.5)	416 (36.1)	1.82 (1.50, 2.21)	<0.001	1.31 (1.06, 1.63)	0.012
Secondary or higher	487 (16.7)	255 (52.3)	3.51 (2.69, 4.59)	<0.001	1.58 (1.18, 2.12)	0.002
Place where the woman received ANC						
Government H. post	559 (19.4)	98 (17.6)	1.00		1.00	
Hospital (public/private)	342 (11.9)	159 (46.3)	3.49 (2.37, 5.14)	<0.001	2.19 (1.44, 3.32)	<0.001
Government H. centre	1,902 (65.9)	736 (38.7)	2.58 (1.92, 3.46)	<0.001	2.12 (1.57, 2.89)	<0.001
Private clinic/NGO HF	82 (2.8)	43 (52.9)	5.52 (3.00, 10.30)	<0.001	3.54 (1.87, 6.72)	<0.001
Household wealth quintile						
Richest	399 (13.7)	84 (20.9)	1.00		1.00	
Richer	587 (20.1)	160 (27.2)	0.37 (0.27, 0.51)	<0.001	0.56 (0.39, 0.82)	0.002
Middle	589 (20.1)	206 (34.9)	0.34 (0.24, 0.47)	<0.001	0.64 (0.43, 0.95)	0.028
Poorer	578 (19.8)	198 (34.3)	0.23 (0.16, 0.32)	<0.001	0.47 (0.31, 0.71)	<0.001
Poorest	770 (26.4)	401 (52.0)	0.12 (0.08, 0.17)	<0.001	0.34 (0.21, 0.55)	<0.001
Mother's place of residence						
Rural	2,052 (70.2)	664 (32.4)	1.00		1.00	
Urban	871 (29.8)	384 (44.1)	2.44 (1.56, 3.80)	<0.001	0.74 (0.46, 1.18)	0.201

* Odds ratio adjusted for all study variables listed in the table.

Quality intrapartum care

In Ethiopia, 87% of women aged 15-49 years received assistance during labour and delivery (intrapartum care) for the last birth within five years preceding the 2019 Ethiopia MDHS. However, of the women who received intrapartum care during labour and delivery for their most recent live births within five years preceding the 2019 Ethiopia MDHS, only 59% gave birth in health facilities. Furthermore, of these women, only 62% had skilled personnel-assisted birth, and 72% had their newborn put to their breast within one hour of birth. In addition, all three of these recommended interventions were received by only 43% of the women during intrapartum care (Table 2). The majority (75%) of women who had their intrapartum care for their last birth at government health centres received all the three recommended intrapartum care interventions, while only 65% of those who had their intrapartum care for the last birth at private healthcare facilities received all the three recommended intrapartum care interventions (Figure 5.4).

Of the women who received intrapartum care during labour and delivery for their most recent live births within five years preceding the survey, 47% had received at least four ANC visits, and 29% had received the six recommended interventions during ANC visits (**Table 5.5**).

Factors associated with the receipt of all three recommended interventions during intrapartum care

Mothers who had four or more ANC visits for the last birth were 80% (AOR= 1.80; 95% CI=1.50, 2.17) more likely to receive all the recommended three interventions during intrapartum care than mothers who had no or fewer ANC contacts during pregnancy. The likelihood of receiving all the three recommended interventions during intrapartum care increased with the mother's education: mothers with secondary or higher education levels were two times (AOR=2.00; 95% CI=1.49, 2.67) more likely than mothers who had no formal education. The likelihood of receiving all the three recommended interventions during intrapartum care decreased with increasing maternal age: advanced age mothers (35-49 years) were 37% less likely than teenage mothers (AOR=0.63; 95% CI=0.45, 0.88). With decreasing indices of households' wealth index, the likelihood of receiving all three interventions during intrapartum care also decreased; where mothers from households with the poorest wealth indices being 68% (AOR=0.32; 95% CI=0.21, 0.50) less likely, compared to mothers from households with the richest wealth indices. Mothers residing in an urban area were 66% (AOR=1.66; 95% CI=1.04, 2.64) more likely to receive all three interventions during intrapartum care than rural mothers (**Table 5.5**).

Table 5.5 1: Determinants of receipt of all the three recommended components of intrapartum care for the most recent live birth within five years preceding the survey, Ethiopia MDHS 2019 (n=3,428).

Study variables	Total number of women (column %)	Women who received the three interventions during intrapartum care (%)	Unadjusted Odds Ratio (95% CI.)	p-value	*Adjusted Odds Ratio (95% CI.)	p-value
Four or more ANC visits						
No	1,828 (53.3)	562 (30.7)	1.00		1.00	
Yes	1,600 (46.7)	923 (57.7)	2.16 (1.81, 2.57)	<0.001	1.80 (1.50, 2.17)	<0.001
Received quality ANC for last birth						
No	2,429 (70.8)	907 (37.3)	1.00		1.00	
Yes	1,000 (29.2)	578 (57.8)	1.64 (1.35, 1.98)	<0.001	1.22 (0.99, 1.49)	0.058
Mother's level of education						
No education	1,650 (48.1)	521 (31.6)	1.00		1.00	
Primary education (1-8)	1,287 (37.5)	638 (49.6)	1.88 (1.55, 2.27)	<0.001	1.57 (1.29, 1.93)	<0.001
Secondary or higher	492 (14.4)	325 (66.1)	3.12 (2.37, 4.10)	<0.001	2.00 (1.49, 2.67)	<0.001
Mother's age at birth (years)						
12-19	501 (14.6)	244 (48.8)	1.00		1.00	
20-34	2,474 (72.2)	1,085 (43.9)	0.75 (0.59, 0.95)	0.016	0.73 (0.57, 0.93)	0.012
35-49	453 (13.2)	156 (34.4)	0.52 (0.38, 0.71)	<0.001	0.63 (0.45, 0.88)	0.007
Household wealth quintile						
Richest	788 (23.0)	526 (66.8)	1.00		1.00	
Richer	624 (18.2)	317 (50.9)	0.55 (0.40, 0.76)	<0.001	0.78 (0.55, 1.10)	0.159
Middle	677 (19.7)	235 (34.8)	0.28 (0.20, 0.40)	<0.001	0.45 (0.31, 0.66)	<0.001
Poorer	687 (20.1)	274 (39.9)	0.37 (0.26, 0.52)	<0.001	0.62 (0.42, 0.92)	0.017
Poorest	652 (19.0)	132 (20.2)	0.17 (0.11, 0.24)	<0.001	0.32 (0.21, 0.50)	<0.001
Mother's place of residence						
Rural	2,462 (71.8)	934 (37.9)	1.00		1.00	
Urban	966 (28.2)	551 (57.0)	3.84 (2.39, 6.16)	<0.001	1.66 (1.04, 2.64)	0.034

* Odds ratio adjusted for all study variables listed in the table.

Quality PNC

In Ethiopia, 45% of women aged 15-49 years and/or their newborns received PNC for the last birth within five years preceding the 2019 Ethiopia MDHS. However, only 33% of women aged 15-49 years and 32% of newborns, respectively, received PNC within two days of birth for the last birth within five years preceding the 2019 Ethiopia MDHS. Among mothers and/or their newborns who received PNC at home or in healthcare facilities for the most recent live births within five years preceding the 2019 Ethiopia MDHS, 87% received maternal and/or newborn PNC within two days of birth; a healthcare provider counselled the mother on breastfeeding in 63% of births; a healthcare provider observed the newborn breastfeeding in 59% of births; a healthcare provider measured the newborn's temperature in 51% of births; a healthcare provider examined the newborn's cord in 49% of births, and a healthcare provider counselled the mother on newborn danger signs in 39% of births. All these six recommended interventions were received by 21% of women and/or their newborns during postnatal care (Table 3). Among women who gave birth at private healthcare facilities, 44% received all six recommended PNC interventions. In contrast, among those who gave birth at government health posts, only 9% received all six recommended PNC interventions (Figure 5.5).

Among mothers with the most recent live births within five years preceding the survey and who received maternal and/or newborn PNC services, 90% had skilled personnel-assisted birth; 87% had a preceding birth interval of 24 or more months; 41% had commenced ANC during the first trimester, and 40% had received all the six recommended interventions during ANC visits (**Table 5.6**).

Factors associated with the receipt of all six recommended interventions during maternal and/or newborn PNC services

Mothers who had commenced ANC contact during the first trimester were 2.2 times (AOR=2.20; AOR=1.56, 3.11) more likely to receive all six interventions during PNC services, compared to women who had had no or late ANC contact. Mothers who had received the six recommended interventions during ANC for pregnancy of last birth were 2.52 times (AOR=2.52; 95% CI=1.79, 3.55) more likely to receive all the six recommended interventions during maternal and/or newborn PNC than mothers who had received less or no interventions during their ANC. Mothers who received skilled personnel-assisted birth were 5.55 times (AOR=5.55; 95% CI=2.54, 12.17) more likely to receive all six interventions during the PNC than mothers who did not receive skilled personnel assistance during labour and delivery. Mothers aged 20-34 years and the elderly (35-49 years) were 5.44 times (AOR=5.44; 95% CI=1.90, 15.56) and 4.72 times (AOR=4.72; 95% CI=1.56, 14.27) more likely to receive all the six recommended interventions during PNC, respectively than teenage mothers. Mothers with 24 or more months of preceding birth intervals were 59% (AOR=0.41; 95% CI=0.26, 0.66) less likely to receive all six interventions during maternal and/or newborn PNC services than mothers with shorter preceding birth intervals (**Table 5.6**).

Table 5.6 1: Determinants of receipt of all the six recommended components of maternal and/or newborn PNC services for the most recent live birth within five years preceding the survey, Ethiopia MDHS 2019 (n=1,785).

Study variables	Total number of women (column %)	Women who received all the six interventions during PNC (%)	Unadjusted Odds Ratio (95% CI.)	p-value	*Adjusted Odds Ratio (95% CI.)	p-value
First trimester ANC						
No	1,057 (59.2)	181 (17.1)	1.00		1.00	
Yes	728 (40.8)	193 (26.5)	1.72 (1.32, 2.26)	<0.001	2.20 (1.56, 3.11)	<0.001
Received quality ANC for last birth						
No	1,065 (59.7)	151 (14.2)	1.00		1.00	
Yes	720 (40.3)	223 (30.9)	2.59 (1.98, 3.40)	<0.001	2.52 (1.79, 3.55)	<0.001
Skilled personnel assisted birth						
No	184 (10.3)	12 (6.6)	1.00		1.00	
Yes	1,601 (89.7)	362 (22.6)	4.34 (2.26, 8.35)	<0.001	5.55 (2.54, 12.17)	<0.001
Mother's age at birth (years)						
12-19	262 (14.7)	24 (9.3)	1.00		1.00	
20-34	1,302 (72.9)	302 (23.2)	2.85 (1.78, 4.55)	<0.001	5.44 (1.90, 15.56)	0.002
35-49	221 (12.4)	48 (21.6)	2.44 (1.38, 4.32)	0.002	4.72 (1.56, 14.27)	0.006
Mother's level of education No education	652 (36.5)	133 (20.5)	1.00		1.00	
Primary (1-8)	738 (41.4)	120 (16.3)	0.80 (0.59, 1.12)	0.179	0.74 (0.50, 1.11)	0.145
Secondary or higher	395 (22.1)	121 (30.5)	1.54 (1.07, 2.22)	0.019	1.17 (0.69, 1.98)	0.568
Preceding birth interval						
<24 months	169 (13.4)	53 (31.6)	1.00		1.00	
≥24 months	1,096 (86.7)	237 (21.6)	0.54 (0.35, 0.83)	0.005	0.41 (0.26, 0.66)	<0.001
Household wealth quintile Richest	611 (34.2)	161 (26.4)	1.00		1.00	
Richer	373 (20.9)	64 (17.1)	0.85 (0.52, 1.37)	0.501	1.47 (0.75, 2.86)	0.263
Middle	325 (18.2)	62 (18.9)	0.89 (0.54, 1.47)	0.652	1.50 (0.74, 3.04)	0.255
Poorer	294 (16.5)	52 (17.8)	0.79 (0.47, 1.32)	0.373	0.95 (0.46, 1.97)	0.894
Poorest	182 (10.2)	35 (19.2)	0.82 (0.46, 1.46)	0.497	1.30 (0.57, 2.95)	0.530
Mother's place of residence Rural	1,126 (63.1)	214 (19.0)	1.00		1.00	
Urban	659 (36.9)	159 (24.2)	1.05 (0.62, 1.79)	0.855	0.87 (0.41, 1.82)	0.708

* Odds ratio adjusted for all study variables listed in the table.

Discussion

This study revealed that among mothers who accessed maternal healthcare for their most recent live birth in Ethiopia, only 36% received all the six recommended interventions during their ANC. Forty-six percent received all the three recommended interventions during intrapartum care, and 21% received all the six recommended interventions during the maternal and/or newborn PNC, while only 10% received all the recommended interventions during antenatal, intrapartum and postnatal care services.

Quality ANC

Our study showed that commencing ANC early (during the first trimester) and having four or more ANC contacts had a significant positive association with receiving all six recommended interventions during ANC. Antenatal care is the routine care of pregnant women provided between conception and the onset of labour, and is an opportunity to provide care to prevent and manage existing and potential causes of maternal and newborn morbidity and mortality. The timing of the first ANC contact is paramount for ensuring optimal health outcomes for a woman and her child, and it is recommended that the first ANC contact takes place within the first trimester (i.e., gestational age of <12 weeks) (Moller et al. 2017; WHO 2016c). The early and more frequently a mother seeks routine care during pregnancy, the more she receives recommended interventions during pregnancy intended to improve maternal and newborn health outcomes. The critical interventions during pregnancy: dietary interventions (counselling about healthy eating, nutrition education and screening, and keeping physically active during pregnancy); iron and folic acid supplementation; calcium supplementation (for those with low dietary calcium intake); vitamin A supplementation (in vitamin A deficiency endemic areas); blood testing to screen anaemia, gestational diabetes mellitus, HIV/AIDS and syphilis; urine testing to screen asymptomatic bacteriuria; early clinical screening (high caffeine intake, tobacco, drug use, intimate partner violence, tuberculosis screening in high prevalence areas, and ultrasound scan) are all recommended to be commenced or provided during the first visit and in the first trimester (WHO 2016c). Our finding concurs with a study based on the secondary data analysis of the latest demographic and health surveys (2013-2018) from nine East African countries, including Ethiopia, by Bobo et al. (2021), which showed that women who commenced ANC during the first trimester were 29% more likely to receive six recommended interventions during ANC than those who commenced ANC lately, while women who had received four or more ANC visits were 37% more likely to receive the six recommended interventions during ANC than those who received less ANC visits (Bobo et al. 2021). Secondary data analysis of Rwanda's 2020 DHS by Sserwanja et al. [2022] also revealed that women who commenced ANC during the first trimester were 45% more likely to

receive six recommended interventions during ANC than those who commenced ANC lately, while women who had received four or more ANC visits were 52% more likely to receive the six recommended interventions during ANC than those who received less ANC visits (Sserwanja, Nuwabaine, et al. 2022).

Significant and positive associations also exist between increasing the mother's education level or household's wealth quintile and receiving the six recommended interventions during ANC. The knowledge and skills attained through education positively affect a person's cognitive functioning, make one more receptive to health education messages, or enable one to communicate with and access appropriate health services. It captures the long-term influences of both early life circumstances on adult health and the influence of adult resources (e.g., through employment status) on health (Solar & Irwin 2010). Household income is a proximate indicator of access to scarce material resources or a standard of living that allows a mother to directly access health services, which may improve health (Solar & Irwin 2010).

In the study by Bobo et al. (2021), secondary or higher maternal education level and highest household wealth index improved the likelihood of a mother receiving all the six recommended interventions during ANC visits by 28%, and 26% compared to no education, and poorest household wealth index, respectively (Bobo et al. 2021). Our findings are also similar to another population-based study using the 2011 Nepalese demographic and health survey by Joshi et al. [2014], which found that women with higher levels of education and those from higher wealth index households had higher odds of receiving all the recommended ANC components (Joshi et al. 2014).

In Ethiopia, government health posts appear to be providing poor-quality ANC. This might be due to the lack of access to adequate equipment and supplies, lack of readiness, and lack of required expertise and skills among health providers in the health posts at village levels. These healthcare facilities are nearest to communities in need. Assessing a health facility's readiness and their health providers' knowledge of maternal and immediate newborn care to perform specific functions may assist in identifying those facilities in need of strengthening. A systematic review by Negero et al. (2021) revealed that in primary care settings in LLMICs, community-based or onsite health workforce interventions involving both skilled and lay personnel were more effective in improving Sexual, reproductive, maternal, and newborn health (SRMNH) care quality along the continuum than those involving either skilled or lay personnel alone (Negero, Sibbritt & Dawson 2021a). These workforce interventions include education and training, policy, management and leadership strategies, partnership, and results-based financing initiatives. The regular deployment of experienced personnel, equipment, and supplies from higher levels of care (health centres and hospitals) to the nearby health

posts to reach out to less advantaged mothers and sharing skills and expertise is critical. A study in a rural district of Nepal showed that facility readiness to provide quality maternal and newborn care in rural districts was low, but changes including regular monitoring, improving staffing and supply chains, supportive supervision, and refresher training initiatives improved maternal and newborn healthcare quality (Lama et al. 2020). In our study, private health facilities had higher odds of providing quality ANC and PNC. This corroborates with two studies conducted in Addis Ababa, Ethiopia, and Southern Ethiopia, where clients at private health facilities were two times more likely to receive all the recommended ANC components than those of public health facilities (Bayou, Mashalla & Thupayagale-Tshweneagae 2016; Gebrekirstos et al. 2021). The limited availability of equipment, medications and trained staff due to underfunding and poor management, the redirection of highly skilled staff to private health facilities, and lack of timeliness and hospitality pose a threat to optimal care at public health facilities (Basu et al. 2012).

Quality intrapartum care

In our study, frequent ANC visits (four or more ANC) improved the likelihood of receiving all the three recommended interventions during intrapartum care. This might be because the more frequently a mother encounters the healthcare system during pregnancy, the better her healthcare-seeking behaviour, birth preparedness, and complication readiness planning will be. This is also likely to lead to an increased demand for quality intrapartum care. A study based on Bangladesh DHS 2014 data similarly showed a significant and positive association between having four or more ANC visits during pregnancy and receiving skilled personnel-assisted birth and health facility delivery (Ryan et al. 2019). Our study also showed significant and positive associations between higher women's education level, higher household wealth index and urban residence, and receipt of all the three recommended interventions during intrapartum care. Education empowers women, and creates increased awareness and knowledge about maternal healthcare interventions that can improve maternal and/or newborn health outcomes by enhancing women's desire to use health services and access to quality maternity care services (Kea et al. 2018; Mordal et al. 2021; Singh et al. 2022; Solar & Irwin 2010; Wang et al. 2021). A review based on primary studies in Ethiopia by Kebede et al. [2016] showed significant and positive associations between urban residence, primary and above-level women's education, and health facility delivery service utilization (Kebede, Hassen & Nigussie Teklehaymanot 2016). In our study, teenage mothers had higher odds of receiving all the three recommended interventions during intrapartum care than mothers aged 20-49 years. This may be because healthcare providers were more vigilant during the birth of a teenager's baby since teenage pregnancy is significantly related to adverse maternal and/or perinatal outcomes, including eclampsia, puerperal endometritis, systemic infections, preterm

delivery, small for gestational age birth, stillbirth, and neonatal death. Preventing these poor health outcomes through increased use of skilled ANC, intrapartum, and PNC services for teenagers is recommended (Bakwa-Kanyinga et al. 2017; WHO 2011; Zhang et al. 2020). However, this finding contradicts a study from India where women aged 25-29, 30-34, and 35-39 years of age at birth, respectively, were 21% (AOR=1.21; 95% CI=1.00, 1.47), 71% (AOR=1.71; 95%CI= 1.36, 2.15), and 51% (AOR=1.51; 95%CI=1.12, 2.03) more likely to receive quality intrapartum care services compared to teenage mothers (Singh et al. 2022).

Quality PNC

Our study also revealed that commencing ANC contacts early (during the first trimester), receiving all the six recommended interventions during ANC visits and skilled personnel-assisted birth improved the likelihood of receiving all the six interventions during PNC. Commencing ANC early, receiving the recommended interventions during ANC visits, and skilled personnel assistance at birth implies that the mother is more likely to be informed about complications that may occur after delivery and thus recognize the importance of seeking optimal care during postnatal care. Fekadu et al. (2019) showed that Ethiopian mothers who had four or more ANC contacts and received more content of care during ANC visits had higher odds of receiving PNC services (Fekadu, Ambaw & Kidanie 2019). Further, teenage mothers were disproportionately less likely to receive the recommended interventions during PNC than mothers aged 20-49 years. The significantly lower quality care during PNC services for teenage mothers might be due to the providers' lack of knowledge about vulnerable groups of women and their associated judgmental attitudes, particularly towards unmarried teenagers. A teenage mother's emotional or intellectual immaturity, low education, or inexperience could also hinder her from seeking optimal care after birth. Therefore, it is necessary to provide teenage-friendly services to teenage mothers and their newborns after birth (Bylund et al. 2020; Mazur, Brindis & Decker 2018). Teenage mothers have, until recently, been overlooked in global health and social policy (Patton et al. 2016).

This study has revealed that there is much opportunity for improving the quality of antenatal, intrapartum, and PNC services in Ethiopia. Unfortunately, Ethiopia is presently facing significant challenges to healthcare delivery brought on by the COVID-19 pandemic and the conflict in northern Ethiopia. Quality maternal healthcare services that respond to the local need and meet emerging challenges, including nomadic-pastoralists, Covid-19, and conflicts, are critical. Mobile clinics and hospitals and mobile health (mHealth) digital solution services should be available near needy communities. Universal coverage of maternal healthcare quality should be promoted, including for the most vulnerable: poor, uneducated, rural women, and teenage mothers. The resilience and strength of

the healthcare system in Ethiopia should be increased by optimizing the health workforce, equipment and supplies, and improving lower-level health facility capability. The use of digital clinical decision support tools by health providers, guaranteeing sustainable finances for maternal and perinatal healthcare, and accelerating progress in maternal healthcare quality through evidence, advocacy, and accountability are needed (Campbell, Graham & Lancet Maternal Survival Series steering 2006; Dickson et al. 2014; Koblinsky et al. 2016; Negero, Sibbritt & Dawson 2021b; Nigussie et al. 2021; Usmanova et al. 2021). In addition to evaluating the receipt of the recommended interventions during care services, assessing mothers' experiences and perceptions of the care services is also important and is likely to have a major effect on satisfaction and uptake of services (Mordal et al. 2021).

This study had several limitations. We used the recommended components of maternal healthcare services mentioned in the WHO's guidelines to measure the quality of each maternal healthcare, which may not equate with the experience of care by the mother, i.e., client satisfaction. The mother reported the responses to the survey questionnaire with regard to her most recent live birth within five years preceding the survey, with potential recall bias and lack of ability to identify between the different care providers (e.g., doctors, nurses). Due to the lack of data availability, some recommended components of each care service, including ANC contact schedules, ultrasound scan during the first 24 weeks of gestation, the experience of care (respectful care), effective communication, a companion of choice during labour and delivery, and delayed umbilical cord clamping were missing. The study also shares the limitations of a cross-sectional study design, which makes it difficult to demonstrate cause-and-effect relationships.

Conclusions

This study shows that the recommended healthcare interventions women and their newborns receive during antenatal, intrapartum, or PNC services in Ethiopia are inadequate. Policy-makers, managers, and healthcare providers in Ethiopia should increase the quality of care provided to mothers and/or their newborns during antenatal, intrapartum, and PNC services as per the WHO's guidelines. Investment in human resources for health, equipment, and supplies is required alongside efforts to standardize and improve the quality of care at private and public health facilities in Ethiopia. In addition to strengthening health systems, community-based initiatives such as women's groups to raise awareness of the importance of early and frequent ANC contacts and linking pregnant mothers to the healthcare system are needed. There is a need to promote education for girls and women and enable women's economic empowerment. We also recommend that the DHS program incorporate pertinent questions to assess and promote other critical interventions, including early ultrasound scan during the

first 24 months of pregnancy, delayed umbilical cord clamping, and care experience, including respectful care during care services.

5.1 Chapter Summary

Chapter five investigated the level and key determinants of women's receipt of quality ANC, intrapartum care and PNC services in Ethiopia based on WHO's recommended maternal healthcare interventions during pregnancy, childbirth, and postpartum. The study found that receiving quality maternal healthcare services across pregnancy, childbirth, and postpartum by mothers and/or their newborns in Ethiopia is low and favours advantageous population subgroups. Government health posts were less likely to provide quality ANC services. Teenage mothers were less likely to receive quality PNC services in Ethiopia. The study also indicated the missing of some WHO-recommended maternal healthcare interventions from the DHS data, including ANC contact schedules, ultrasound scan during the first 24 weeks of gestation, the experience of care (respectful care), effective communication, a companion of choice during labour and delivery, and delayed umbilical cord clamping. The next chapter examines the trends and inequalities in women's use of quality ANC, intrapartum care, and immediate PNC services from 2001-2019 in Ethiopia, and the socio-demographic and maternal healthcare determinants that had attributed to the changes in the receipt of the services over the same period.

Chapter 6: Women's use of quality antenatal care, intrapartum care, and immediate postnatal care services in Ethiopia: Multivariate decomposition analyses of trends over two decades (2001-2019).

This chapter investigates the trends and inequalities in women's receipt of quality ANC, intrapartum care and immediate PNC services over two decades in Ethiopia (2001-2019), and the factors that had attributed to changes in the receipt of these services over the same period based on data from the four consecutive waves of Ethiopia DHSs (2005, 2011, 2016, and 2019). The study is currently under review in the journal: BMJ Open.

Negero, M.G., Sibbritt, D. & Dawson, A. Women's use of quality antenatal care, intrapartum care, and immediate postnatal care services in Ethiopia: Multivariate decomposition analyses of trends over two decades (2001-2019). BMJ open. bmjopen-2022-063347.

Abstract

Objective:

This study aimed to examine trends and inequalities in women's use of quality ANC, intrapartum care, and immediate PNC services and determinants that had contributed to changes in receiving the services from 2001-2019 in Ethiopia using the four waves of Ethiopia DHSs data.

Design, outcomes, setting, and analysis:

Secondary data analyses of four waves of nationally-representative EDHSs from 2005 to 2019 were conducted. We defined quality ANC according to the five recommended interventions during ANC: blood pressure measurement, blood and urine testing, iron supplementation, and informing pregnancy-related complications. Quality intrapartum care included a health facility birth, birth assisted by skilled personnel, and newborn put to the breast within one hour of birth. Immediate PNC included maternal and newborn PNC within 24 hours of birth. We used statistical control charts, multivariate logistic regression decomposition analysis, and equiplots to measure and analyse trends and inequalities over two decades using data from EDHSs 2005-2019.

Results:

Over the period 2001-2019, there were increases in accessing quality ANC (3.7% to 39.6%), quality intrapartum care (3.9% to 43.3%), and immediate PNC (2.6% to 22.1%) services. However, there were widening inequalities between these services received by women, favouring those with advantageous socio-demographic characteristics. From 2001-2019, the largest significant increases in accessing quality ANC and immediate PNC services were due to changes in the distribution of socio-demographic and maternal care characteristics, while the largest significant increase in accessing quality intrapartum care was due to changes in the effects of these characteristics.

Conclusions:

The healthcare system in Ethiopia should expand access to all recommended maternal healthcare interventions to disadvantaged population subgroups. Universal coverage of quality maternal and newborn healthcare across the continuum is needed. There is also a need to promote ≥4 ANC, early initiation of ANC, girls' and women's education, and enabling women's economic empowerment.

Introduction

Quality maternal healthcare, which includes receiving the recommended contents of ANC, intrapartum care, and PNC services, involves evidence-based interventions that reduce maternal and newborn morbidity and mortality (WHO 2016c, 2022d; World Health Organization 2002, 2018). An estimated 74% of maternal deaths could be averted if all women had access to skilled care before, during, and after childbirth to prevent or manage pregnancy and birth-related complications (Wagstaff 2004).

Many countries are behind in their efforts to achieve the 2030 sustainable development goals (SDGs) target of reducing the global maternal mortality ratio (MMR) to less than 70 per 100,000 live births. Sub-Saharan Africa bears the highest burden of maternal mortality, and a significant proportion of maternal and newborn deaths occur in conflict or displacement settings (UNICEF 2022; WHO 2019b). While the MMR in the region has decreased from 878/100,000 live births in 2000 to 542/100,000 live births in 2017, the average yearly reduction rate between 2000 and 2017 was only 2.8% (World Health Statistics 2021).

In Ethiopia, the MMR has decreased by 53%, from 871 to 412 maternal deaths per 100,000 live births, and the neonatal mortality rate has also reduced by 39%, from 49 to 30 neonatal deaths per 1000 live births over 20 years (1996-2016). However, these death rates remain among the highest globally (CSA-Ethiopia 2001; CSA-Ethiopia & I. C. F. I 2016; CSA-Ethiopia 2012; Macro 2006). A study conducted in 32 health facilities in Ethiopia revealed that most did not meet the national maternal and neonatal healthcare (MNH) quality standards (Biadgo et al. 2021).

Improving healthcare delivery requires a deliberate focus on the quality of health services. The World Health Organization (WHO) provides clear guidance concerning the recommended interventions during the antenatal, intrapartum, and postnatal care services (WHO 2014b, 2016c; WHO, UNPF & UNICEF 2015; World Health Organization 2018) (**Tables 6.1-6.3**). In 2019, the United Nations General Assembly adopted a resolution that outlined the urgent need for action for Universal Health Coverage with quality services (WHO QC 2019). To achieve these UN goals, it is first necessary to understand the areas where improvements are most needed and what population subgroups are affected. This requires examining the recommended interventions women receive during pregnancy, birth, and immediately afterward and the associated socio-demographic and maternal care determinants over time that may reveal inequalities between population subgroups.

Only a few studies have analysed national data on Ethiopia's quality maternal and newborn healthcare service indicators. A study conducted by Fekadu et al. (2019) indicated that women who had attended ≥4 ANC visits for their last birth, who had secondary or above level education, were from urban areas,

were from the richest households, and who were employed had higher odds of delivering at health facilities. Mothers who received more ANC interventions, such as nutritional counselling and blood testing during ANC visits, had higher odds of delivering their babies at health facilities or receiving PNC services (Fekadu, Ambaw & Kidanie 2019). Other studies have examined trends in maternal and newborn health outcomes and care coverage. For example, a study by Berhanu et al. (2021) revealed that four years after the launch of the Community-Based Newborn Care programme in 2017 in Ethiopia, the percentage of women reporting at least one ANC visit increased by 15%; ≥4 ANC visits increased by 17%, and institutional delivery increased by 40% (Berhanu et al. 2021). While these studies provide a valuable snapshot of some trends and use of health care, no studies comprehensively examine trends in quality ANC, quality intrapartum care, immediate PNC services, determinants of these trends, and inequalities for receipt of these care services between population subgroups over an extended period in Ethiopia.

A comprehensive assessment of quality ANC, quality intrapartum care, and immediate PNC services trends and their socio-demographic and maternal care determinants over an extended period can help healthcare providers, managers, and policymakers identify effective socio-demographic and maternal care interventions to improve access to maternal healthcare quality and outcomes. Therefore, this study aimed to assess trends in providing quality ANC, quality intrapartum care, immediate PNC services, and their associated socio-demographic and maternal care determinants over the two decades (2001-2019) in Ethiopia.

Methods

Study design, data, and variables

The study analysed data from Ethiopia's demographic and health surveys (EDHSs) from 2005-to 2019. The EDHSs used a stratified two-stage cluster sampling technique selected in two stages using the 1994 Population and Housing Census (PHC) as a sampling frame for the EDHS 2005 survey and the 2007 PHC as a sampling frame for EDHSs 2011, 2016, and 2019 (Central Statistical 2007; International Household Survey Network 1994). Due to the non-proportional allocation of the sample to different regions and their urban and rural areas, a sampling weight was used in all analyses of the EDHSs data to ensure the representativeness of the findings. A total weighted sample of 7307, 7908, 7590, and 3927 mothers with the most recent live birth within the previous five years to the surveys 2005, 2011, 2016, and 2019, respectively, were included in the analysis of quality ANC, quality intrapartum care, and immediate PNC services over 20 years (2001-2019).

Note that across the EDHSs, there were slight variations in the definition of skilled personnel. In the 2005 and 2011 EDHSs, skilled personnel was defined as doctors, nurses, or midwives, while in the 2016 and 2019 EDHSs, skilled personnel was defined as doctors, nurses, midwives, health officers, or health extension workers ([WHO 2018a](#)).

Socio-demographic characteristics

Urban areas include all capitals of administrative regions, zones, and districts. Areas with at least 1000 people primarily engaged in non-agricultural activities were declared as urban areas. Rural areas are all areas that are not urban. Urban centres with a population of 100,000 inhabitants or more and regional capitals (irrespective of their population size) are further classified as major urban centres ([Central Statistical Agency-Ethiopia 2014](#) ; [Croft, Marshall & Allen](#)). Maternal education was defined as the highest level of the mother's formal education during the time of the interview. It was categorised into four levels: no education, primary education (1-8 grades), secondary education (9-12 grades), and higher education (above 12th grade) ([Croft, Marshall & Allen](#)). Maternal age at birth was the biological mother's age at her most recent live birth, and it was classified into three age groups in completed years: teenage (<20), 20-34, and older mothers (35-49) ([Croft, Marshall & Allen](#)).

A wealth quintile is a score given to a household based on the number and kinds of consumer goods it owns, ranging from a television to a bicycle or car, in addition to housing characteristics such as a source of drinking water, toilet facilities, and flooring materials. These scores were derived using the principal component analysis. National wealth quintiles are compiled by assigning the household score to each usual (de jure) household member, ranking each person in the household population by their score, and dividing the distribution into five equal categories, each comprising 20% of the population. The wealth is then sub-divided into five categories, quintiles ([Croft, Marshall & Allen](#)). The poorest and poorer quintiles were considered poor, while the richest and richer quintiles were considered rich.

Maternal care characteristics

The number of months pregnant at the time of the first ANC visit was categorised as being during the first trimester (<4 months), 4-5 months, or six or more months of pregnancy. The number of ANC visits was categorised as no ANC, one ANC contact, 2-3 contacts, or four or more ANC contacts. The healthcare facility where ANC was received was categorised as a hospital (government/private), government health centre, private clinic/NGO health facility, or government health post.

Quality antenatal care during pregnancy for the most recent live birth

Antenatal care, a critical maternal healthcare intervention, provides a platform for important healthcare functions, including health promotion, screening and diagnosis, and disease prevention (WHO 2016c). We applied the WHO's recommendations on antenatal care for a positive pregnancy experience to measure ANC quality (WHO 2016c). Accordingly, a woman who attended ANC at least once during pregnancy for her most recent live birth across the four DHSs (2001-2019) was defined to have received quality ANC if she received all the following five recommended interventions during her ANC visits: blood pressure measurement; blood screening for infection and/or anaemia; urine tests for detecting bacteriuria and/or proteinuria; information about pregnancy-related complications; and iron supplementation.

Table 6.1 1: The recommended interventions during antenatal care, Ethiopia DHS 2005-2019 (WHO 2016c; WHO, UNPF & UNICEF 2015).

Antenatal care
Adequate visits (eight and above) with skilled personnel
Nutritional counselling
Multivitamin supplements (e.g., iron and folic acid supplements)
Blood sample taken
Urine sample taken
Preventive antibiotics
Newborn's protection against neonatal tetanus
Health education to support a healthy pregnancy
Birth preparedness and complication readiness
Recognize and act upon obstetric danger signs

Quality intrapartum care for the most recent live birth

We applied the WHO's recommendations on intrapartum care for a positive childbirth experience to measure the quality of intrapartum care across the four DHSs (2001-2019) (World Health Organization 2018). A mother was categorised as receiving quality intrapartum care if provided with the three recommended interventions during intrapartum care: health facility birth, skilled personnel assisted birth, and newborn put to the breast within one hour of birth.

Table 6.2 1: The recommended interventions during intrapartum care, Ethiopia DHS 2005-2019 (WHO, UNPF & UNICEF 2015; World Health Organization 2018).

Intrapartum care
Respectful care
Clear and compelling communication between the women and health workers
The option of a companion during labour and childbirth
Health facility birth attended by skilled personnel
Appropriate pain relief strategies
Mobility in labour where possible
Choice of birth position
Use of prophylactic uterotonics
Delayed cord clamping (after a minute)
Immediate kangaroo care
Newborn put to the breast immediately
Delayed bathing of the newborn (24 hours)
Care of the mother and her newborn in a health facility for at least 24 hours after birth

Immediate PNC for the most recent uncomplicated live birth

We applied the WHO's recommendations on the PNC of the mother and her newborn to measure the immediate PNC across the four Ethiopia DHSs (2005-2019) (WHO 2022d). Accordingly, a mother and her newborn have received immediate PNC if they received PNC services within 24 hrs of birth at health facilities or home (excluding caesarean deliveries).

Table 6.3 1: The recommended interventions during postnatal care, Ethiopia DHS 2005-2019

([WHO 2014b](); [WHO, UNPF & UNICEF 2015]()).

Postnatal care
Immediate maternal and newborn postnatal care (within 24 hours after birth)
At least three additional postnatal visits within 42 days after birth for the mother and newborn
Home visits in the first week after birth
Exclusive breastfeeding
Cord care
Prophylactic antibiotics for the mother
Health education on maternal and newborn health danger signs

Statistical analyses

Statistical control charts were used to analyse trends in accessing maternal and newborn healthcare quality from 2001-2019 ([ASQ 2022]()). Statistical control charts are used to analyse processes to determine if they are in control (i.e., have points randomly distributed within the control limits), which means that the variation observed occurs only from sources common to the process (called common-cause variation). An out-of-control process (i.e., points falling outside the control limits or non-random patterns of points) is considered a special-cause variation ([Montgomery 2007](); [Nelson 1984]()). Control limits reflect the expected amount of variation when only common causes of variation are present ([Montgomery 2007](), [2020](); [Nelson 1984]()). We specifically used the p- control charts as the p-chart monitors the percentage of maternal and newborn healthcare quality rates over time, allowing for varying sample sizes. Eight Shewhart control chart rules (i.e., tests for special-cause variation) were applied to assist with the interpretation of the changes over time (**Table 6.4**).

Equiplots were used to compare absolute inequality (akin to coverage differences among mothers from wealthy and poor households) between distinct groups over time ([WHO]()). Pro-poor inequalities are present when the coverage of quality ANC, quality intrapartum care, and/or immediate PNC services decreases with increasing household wealth. Pro-rich inequalities are present when the coverage of these services increases as household wealth increases ([Leventhal et al. 2021]()). Equiplots present disaggregated data using circles (to show the level of intervention coverage in each subgroup) and lines (to show the gaps between subgroups), illustrating inequalities ([WHO]()).

Table 6.4 1: Shewhart statistical control chart rules, 2021.

Test	Rule	Problem identified
1.	One point is outside the control limits.	A large shift.
2.	8/9 points on the same side of the center line.	A small sustained shift.
3.	Six consecutive points are steadily increasing or decreasing.	A trend or drift up or down.
4.	Fourteen consecutive points are alternating up and down.	Non-random systematic variation.
5.	Two out of three consecutive points are more than two sigmas from the centerline in the same direction.	A medium shift.
6.	Four out of five consecutive points are more than one sigma from the center line in the same direction.	A small shift.
7.	Fifteen consecutive points are within one sigma of the center line.	Stratification.
8.	Eight consecutive points on either side of the center line with not within one sigma.	A mixture pattern.

Multivariate logistic regression decomposition analysis was employed to inform our understanding of the extent to which each variable independently contributed to the observed change in accessing quality ANC, quality intrapartum care, or immediate PNC services over time. Multivariate decomposition provides a way to analyse differences in the outcome between two points in time. This study used the multivariate decomposition for nonlinear response models (mvdcmp) procedure in Stata, which is comparable to the Oaxaca-Binder method but runs the nonlinear models (Powers, Yoshioka & Yun 2011). The decomposition procedure divides the total change in accessing quality ANC, quality intrapartum care, or immediate PNC services over the two decades into two portions: the portion that can be attributed to the change in the composition, distribution, coverage, or prevalence of the socio-demographic and maternal care characteristics included in the analysis (referred to as the *endowments* portion), and the portion that can be attributed to the change in the effect of these indicators (referred to as the *coefficients* portion) (Powers, Yoshioka & Yun 2011). The coefficients of an explanatory variable are estimates of population parameters that describe the relationship between the explanatory variable and the outcome variable. A positive sign indicates that as the predictor variable increases, the outcome variable also increases. A negative sign indicates that the outcome variable decreases as the predictor variable increases. A significant association is available when the confidence interval doesn't include zero (Powers, Yoshioka & Yun 2011). The percent (pct) entails the magnitude of proportional change that occurred to the outcome variable due to the change in distribution/coverage or effect of an explanatory variable (Powers, Yoshioka & Yun 2011). The decomposition procedure relies on two key pieces of information: the prevalence of all selected indicators at both points in time and

the coefficients derived from multivariate regression models predicting quality ANC, quality intrapartum care, or immediate PNC services run separately at both time-points. The *endowments* column quantifies the amount of change in accessing quality ANC, quality intrapartum care, or immediate PNC services explained by the change in coverage in each selected socio-demographic characteristic or maternal care indicator between the two points in time, assuming that the effect of the socio-demographic characteristic or maternal care indicator was constant across the entire period. The *coefficients* column quantifies the amount of change in accessing quality ANC, quality intrapartum care, or immediate PNC services explained by a change in the size of effects between the two-time points if coverage (the distribution of each variable) had been constant across the entire period. The model assumes the additivity of the components for composition and effect (Powers, Yoshioka & Yun 2011). Using the statistical software Stata/SE 16.1 for the windows version (StataCorp LLC 2022), all decomposition analyses employed sampling weights and were adjusted for sampling design (i.e., clustering and stratification). Statistical significance was set at p<0.05.

Patient and Public Involvement Statement

This study used secondary data from the DHS program, which was not subject to ethical approval because it did not involve data concerning human participants, and the data were de-identified. The risk of an individual being re-identified in the data is extremely rare. The DHS surveys are fully available upon request without restriction.

Results

Changes in the distribution of mothers' socio-demographic and maternal care characteristics across the two decades in Ethiopia (2001-2019).

Over the two decades (2001-2019), there was a 25.6% decrease in the percentage of mothers with no education and a corresponding increase in mothers with primary (18.8%) and secondary or above (6.7%). Mothers residing in urban areas increased by 17.4%. Teenage birth (<20 years) and birth at advanced maternal age (≥35 years) decreased by 1.8% and 2.8%, respectively, while birth at 20-34 years increased by 4.6%. Households with poorer and richer wealth quintiles increased by 2.6% and 0.8%, respectively, while the percentage of middle-income households decreased by 3.4% (**Table 6.5**).

Mothers who received their first ANC visit during the first trimester increased by 15.0%, while those who received their first ANC visit at or after six months of pregnancy decreased by 24.3%. The receipt of four or more ANC visits increased by 14.7%. Mothers who received their ANC at government health centres increased by 22.4%, while those who received their ANC at hospitals decreased by 15.1%.

Mothers who received quality ANC, quality intrapartum care, and immediate PNC increased by 35.9%, 39.4%, and 19.5%, respectively (**Table 6.5**).

Table 6.5 1: Study characteristics and maternal healthcare interventions during ANC, intrapartum care, and PNC services for the last birth over 2001-2019, according to the Ethiopia Demographic and Health Surveys.

Study characteristics and interventions	EDHS 2005 n (%)	EDHS 2005 (95% C.I.)	EDHS 2011 n (%)	EDHS 2011 (95% C.I.)	EDHS 2016 n (%)	EDHS 2016 (95% C.I.)	EDHS 2019 n (%)	EDHS 2019 (95% C.I.)	Difference 2005-2019 (%)
Mother's education level									
no education	8,838 (79.2)	(76.8, 81.3)	8,227 (69.3)	(66.7, 71.8)	7,284 (66.1)	(63.4, 68.7)	2,962 (53.6)	(49.8, 57.3)	-25.6
primary	1,855 (16.6)	(14.6, 18.8)	3,211 (27.1)	(24.8, 29.4)	2,951 (26.8)	(24.6, 29.0)	1,956 (35.4)	(32.5, 38.4)	+18.8
secondary+	470 (4.2)	(3.6, 4.9)	434 (3.7)	(3.1, 4.4)	788 (7.2)	(6.2, 8.3)	609 (11.0)	(9.4, 12.9)	+6.8
Mother's age at birth									
<20	1,715 (15.4)	(14.1, 16.7)	1,541 (13.0)	(11.7, 14.3)	1,301 (11.8)	(10.6, 13.1)	751 (13.6)	(12.1, 15.2)	-1.8
20-34	7,702 (69.0)	(67.5, 70.4)	8,675 (73.1)	(71.6, 74.5)	8,090 (73.4)	(71.8, 74.9)	4,069 (73.6)	(71.4, 75.7)	+4.6
≥35	1,746 (15.6)	(14.5, 16.8)	1,657 (14.0)	(12.9, 15.1)	1,632 (14.8)	(13.5, 16.2)	707 (12.8)	(11.3, 14.5)	-2.8
Area of residence									
rural	10,348 (92.7)	(91.5, 93.7)	10,344 (87.1)	(85.1, 89.0)	9,807 (89.0)	(87.2, 90.5)	4,160 (75.3)	(72.0, 78.3)	-17.4
urban	815 (7.3)	(63.0, 84.5)	1,528 (12.9)	(11.0, 14.9)	1,216 (11.0)	(9.5, 12.8)	1,367 (24.7)	(21.7, 28.0)	+17.4
Wealth (household)									
Poor	4,796 (43.0)	(39.9, 46.1)	5,368 (45.2)	(41.7, 48.8)	5,156 (46.8)	(43.0, 50.6)	2,518 (45.6)	(40.2, 51.1)	+2.6
Middle	2,486 (22.3)	(20.5, 24.2)	2,437 (20.5)	(18.6, 22.6)	2,280 (20.7)	(18.4, 23.1)	1044 (18.9)	(16.2, 21.9)	-3.4
Rich	3,882 (34.8)	(31.9, 37.8)	4,067 (34.3)	(31.1, 37.5)	3,587 (32.5)	(29.3, 36.0)	1,965 (35.6)	(31.3, 40.0)	+0.8
First ANC GA									
<4 mnths	466 (22.7)	(20.4, 25.3)	888 (26.4)	(24.2, 28.6)	1,550 (36.5)	(34.1, 39.0)	1,092 (37.7)	(33.9, 41.7)	+15
4-5 mnths	706 (34.4)	(31.5, 37.4)	1,304 (38.7)	(36.1, 41.4)	1,972 (46.5)	(44.1, 48.9)	1,264 (43.7)	(40.1, 47.3)	+9.3
6+ mnths	879 (42.9)	(39.0, 46.8)	1,176 (34.9)	(32.3, 37.6)	723 (17.0)	(15.1, 19.2)	538 (18.6)	(16.1, 21.4)	-24.3
ANC contacts									
Once	336 (16.4)	(14.2, 18.8)	352 (10.5)	(8.9, 12.3)	335 (7.0)	(5.9, 8.3)	130 (4.5)	(3.5, 5.7)	-11.9
2-3	828 (40.3)	(36.7, 44.1)	1,504 (44.7)	(41.9, 47.6)	2,007 (42.2)	(39.8, 44.6)	1,095 (37.6)	(34.9, 40.4)	-2.7
4+	888 (43.3)	(39.4, 47.3)	1508 (44.8)	(41.8, 47.8)	2,415 (50.8)	(48.2, 53.3)	1,688 (58.0)	(55.1, 60.7)	+14.7
Facility ANC received									
Hospital	535 (27.0)	(22.8, 31.6)	336 (10.1)	(7.7, 13.1)	403 (8.7)	(7.3, 10.3)	342 (11.9)	(9.3, 15.0)	-15.1
Health centre	863 (43.5)	(38.6, 48.5)	2,004 (60.1)	(56.4, 63.8)	3,045 (65.4)	(62.3, 68.4)	1,902 (65.9)	(60.5, 71.0)	+22.4
Prvt clinic/NGO	169 (8.5)	(5.8, 12.4)	180 (5.4)	(3.9, 7.5)	165 (3.5)	(2.7, 4.6)	82 (2.8)	(1.8, 4.5)	-5.7
Health post	417 (21.0)	(17.2, 25.5)	812 (24.4)	(21.3, 27.7)	1,041 (22.4)	(19.7, 25.2)	559 (19.4)	(15.0, 24.6)	-1.6
Blood pressure measured during ANC	1,284 (61.9)	(58.4, 65.4)	2,427 (71.6)	(68.3, 74.6)	3,592 (75.3)	(72.9, 77.5)	2,575 (88.1)	(85.7, 90.2)	+26.2

Blood sample was taken during ANC	543 (26.2)	(23.4, 29.3)	1,831 (54.0)	(50.2, 57.7)	3,461 (72.5)	(69.7, 75.2)	2,305 (78.9)	(74.8, 82.4)	+52.7
Urine sample was taken during ANC	550 (26.6)	(23.6, 29.7)	1,399 (41.3)	(37.5, 45.1)	3,155 (66.1)	(63.2, 68.9)	2,160 (73.9)	(69.5, 77.8)	+47.3
Iron was supplemented during ANC	491 (23.6)	(20.9, 26.6)	1,064 (31.4)	(28.7, 34.2)	2,868 (60.1)	(57.2, 62.9)	2,249 (77.0)	(73.5, 80.1)	+53.4
Informed of pregnancy complications during ANC	653 (31.4)	(28.8, 34.2)	679 (20.0)	(18.1, 22.1)	2,145 (45.0)	(42.3, 47.6)	1,751 (59.9)	(56.1, 63.6)	+28.5
Received all five ANC interventions	77 (3.7)	(2.9, 4.8)	176 (5.2)	(4.3, 6.3)	1,036 (21.7)	(19.7, 23.9)	1,158 (39.6)	(35.6, 43.8)	+35.9
Skilled personnel assisted birth	508 (7.4)	(6.4, 8.5)	932 (12.2)	(10.7, 13.9)	2,524 (38.6)	(35.4, 41.9)	2,120 (61.8)	(56.3, 67.1)	+54.4
Health facility birth	466 (6.8)	(5.8, 7.9)	928 (12.2)	(10.7, 13.8)	2,404 (36.8)	(33.6, 40.0)	2,018 (59.4)	(53.7, 64.8)	+52.6
Newborn put to the breast within 1hr	4,583 (68.7)	(66.2, 71.1)	3,888 (52.3)	(49.4, 55.2)	4,693 (74.5)	(72.2, 76.7)	2,464 (71.9)	(68.9, 74.6)	+3.2
Received all three IPC interventions	265 (3.9)	(3.2, 4.6)	465 (6.1)	(5.2, 7.2)	1,720 (26.3)	(23.8, 29.0)	1,485 (43.3)	(38.6, 48.2)	+39.4
Received immediate PNC	190 (2.6)	(2.2, 3.2)	391 (5.0)	(4.2, 6.0)	590 (8.0)	(6.9, 9.1)	815 (22.1)	(19.1, 25.5)	+19.5

Five ANC interventions: blood pressure measured + blood tested + urine tested + iron supplemented, and informed of pregnancy-related complications during last pregnancy.

Three intrapartum care (IPC) interventions: Given birth at health facility + birth assisted by skilled personnel, and newborn put to the breast within one hour of birth.

Immediate postnatal care: The mother and her newborn received postnatal care within 24 hours of birth.

Quality antenatal care

Among mothers who had at least one ANC visit for the last birth, the percentage of mothers who received all the five recommended interventions during their ANC visits increased from 4.7% in 2001 to 26.3% in 2016 and to 41.8% in 2019 (**Figure 6.1**).
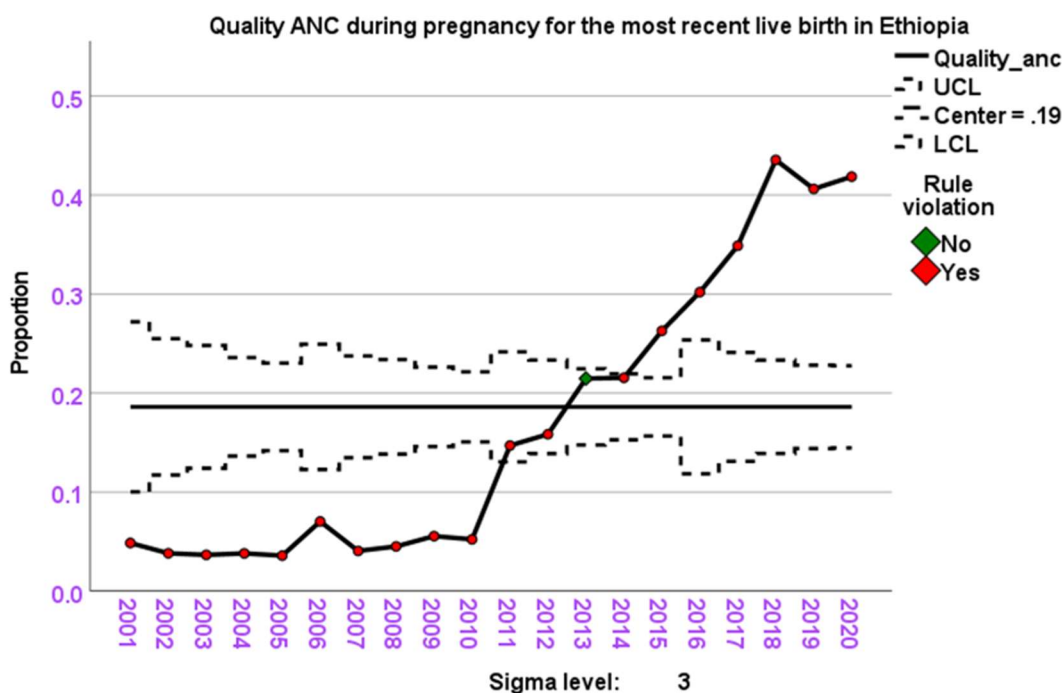
Figure 6.1 1: The percent prevalence of mothers receiving all the five components of ANC during their ANC visits in Ethiopia (2001-19).

Note: UCL: Upper control limit; LCL: Lower control limit
Quality ANC: blood pressure measured + blood tested + urine tested + iron supplemented, and informed of pregnancy-related complications during last pregnancy.
Three Sigma Level: The data are within three standard deviations from the mean.

For all subgroups in maternal education, area of residence, household wealth, mother's age at birth, the number of ANC contacts, the type of health facility where ANC was provided, and the number of months pregnant at the first ANC, the receipt of quality ANC increased over the 20 year period. However, during this period, there was a widening gap in the receipt of quality ANC between: women with no education and those with higher education (by 25.0%); women residing in rural and urban locations (by 7.5%); and women from the poorest and richest wealth quintiles (by 32.1%). There was also a widening gap in the receipt of quality ANC between: teenage mothers and mothers aged 20-34 years (by 1.2%); women who received one ANC visit and ≥4 ANC visits (by 38.6%); women who attended their ANC at government health posts and hospitals (by 33.0%); and women who had their

first ANC at or after eight months of pregnancy and women who had ANC during the first trimester (by 37.1%) (**<u>Figures 6.2 and 6.3)</u>**
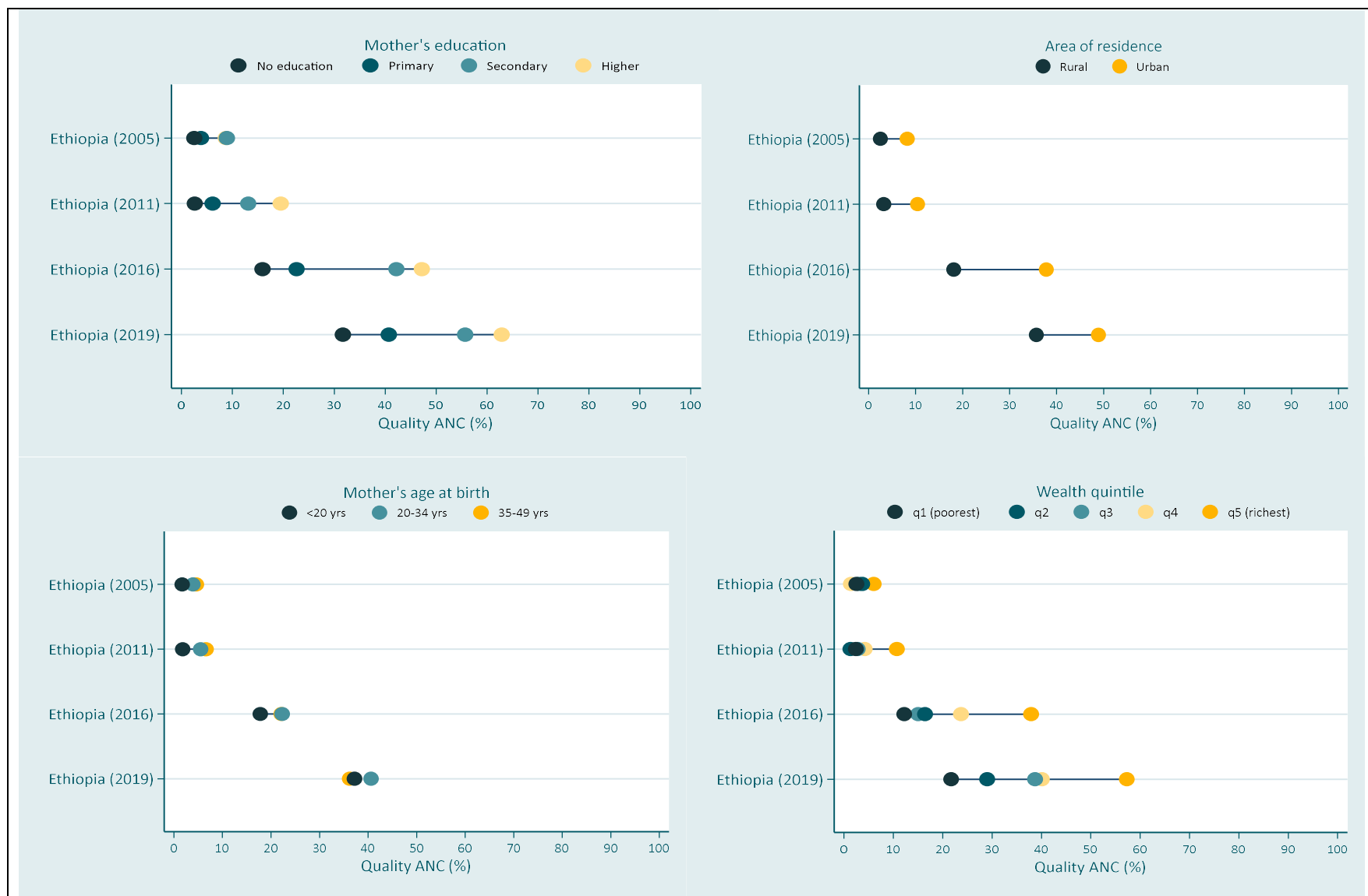
Figure 6.2 1: Inequality in accessing quality ANC by the mother's education, residence, age at birth, and household wealth over 2001-2019, Ethiopia DHSs.
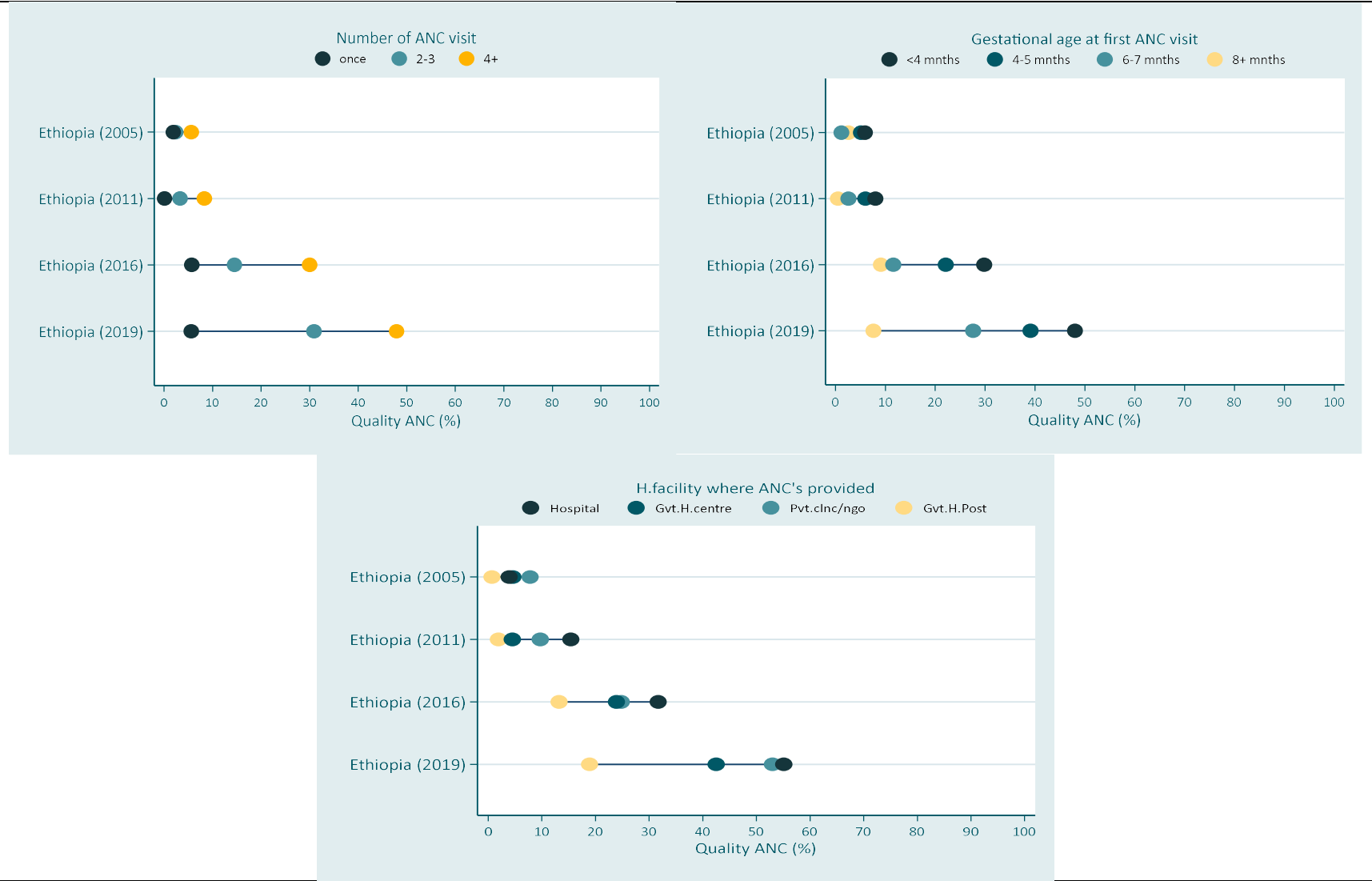
Figure 6.3 1: Inequality in accessing quality ANC by the number of ANC visits, number of months pregnant at the first ANC visit, and type of health facility a mother received ANC over 2001-2019, Ethiopia DHSs.

Quality intrapartum care

Among mothers who received intrapartum care for the last birth, the percentage of mothers who received all three interventions increased from 5.7% in 2001 to 32.6% in 2016 and to 46.1% in 2019 (**Figure 6.4**).
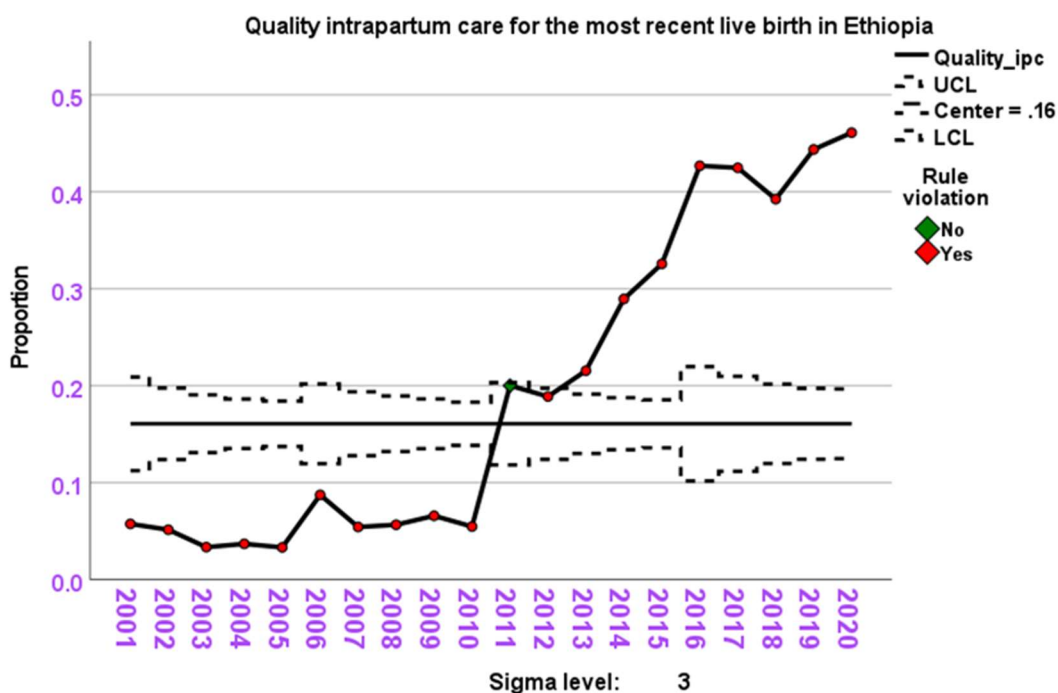
Figure 6.4 1: The percent prevalence of mothers receiving all the three components during intrapartum care in Ethiopia (2001-19).

Note: UCL: Upper control limit; LCL: Lower control limit

Quality intrapartum care: Given birth at health facility + birth assisted by skilled personnel, and newborn put to the breast within one hour of birth.

Three Sigma Level: The data are within three standard deviations from the mean.

For all population subgroups, the number of women who received quality intrapartum care increased over the 20 years. During this period, there was a decreasing gap in the receipt of quality intrapartum care between: mothers who had no education and those with higher education (by 16.3%); and women living in rural and urban areas (by 8.3%). However, the gap in the receipt of quality intrapartum care has widened between: the poorest and richest quintiles (by 30.1%); mothers aged ≥35 years and teenage mothers (by 11.9%); women who had no ANC visit and ≥4 ANC visits (by 28.7%); and women who had their first ANC at or after eight months of pregnancy and during the first trimester (by 6.2%) (**Figures 6.5 and 6.6**).
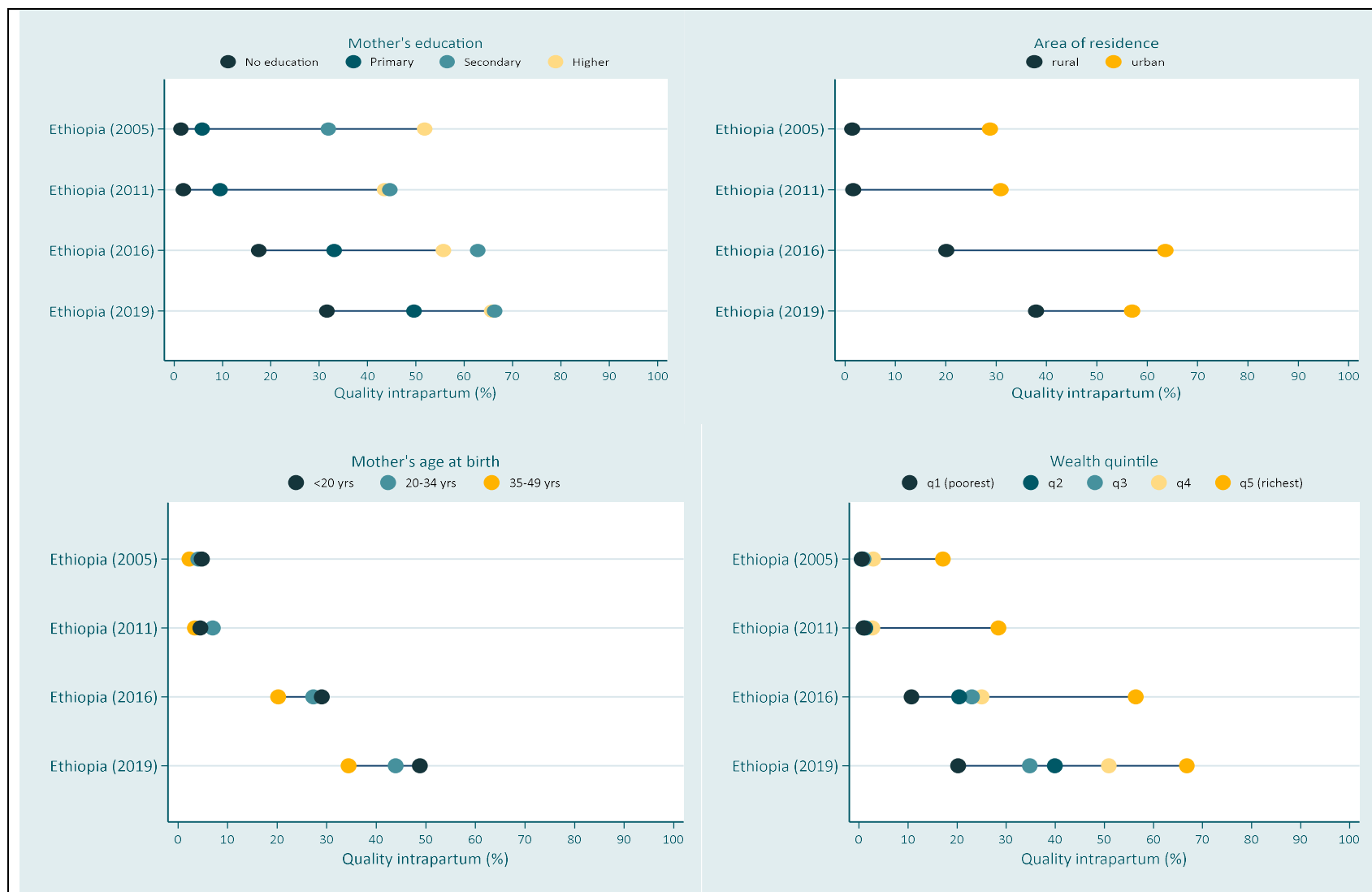
Figure 6.5 1: Inequality in accessing quality intrapartum care by the mother's education level, residence, age at birth, and wealth over 2001-2019, Ethiopia DHSs.
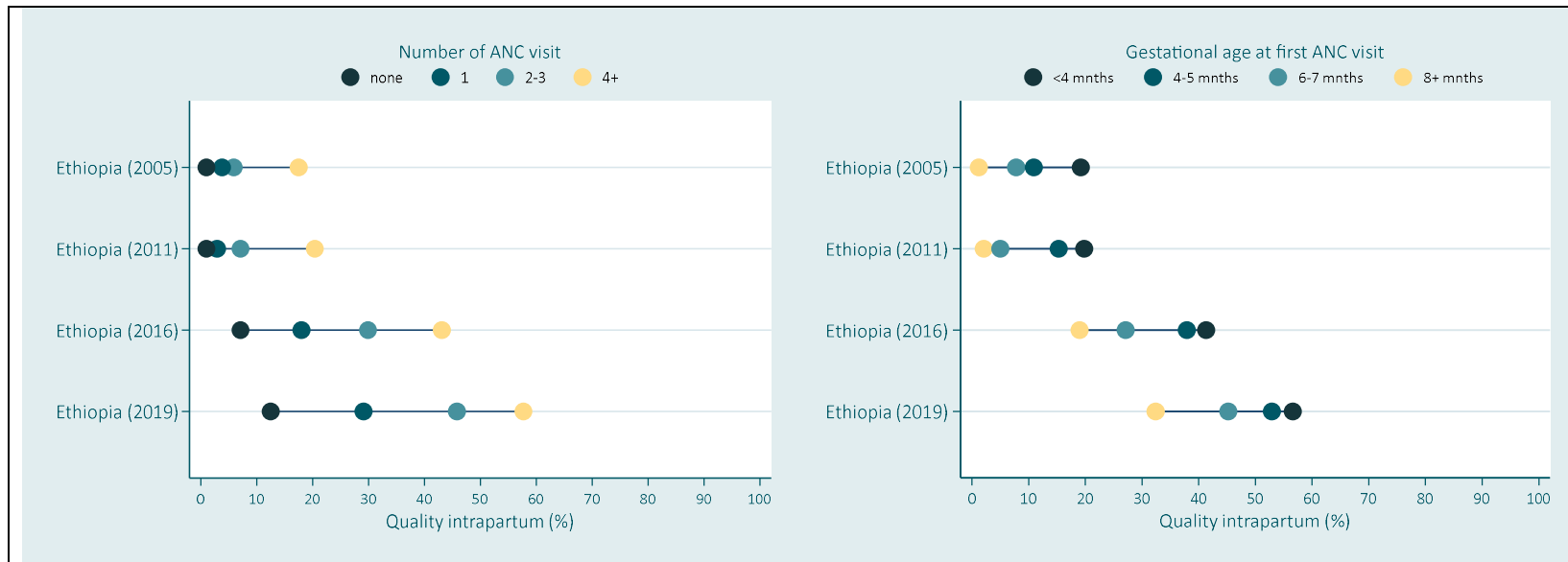
Figure 6.6 1: Inequality in accessing quality intrapartum care by the number of ANC visits during the pregnancy and by the number of months pregnant at the first ANC visit over 2001-2019, Ethiopia DHSs.

Immediate PNC

The percentage of mothers who received immediate PNC for their most recent uncomplicated birth increased from 4.0% in 2001 to 9.3 % in 2016 and then to 41.8% in 2019 (**Figure 6.7**). More women across all subgroups received immediate PNC over the 20 years. However, there was a decline in the rates of mothers with the highest level of education who received immediate PNC.
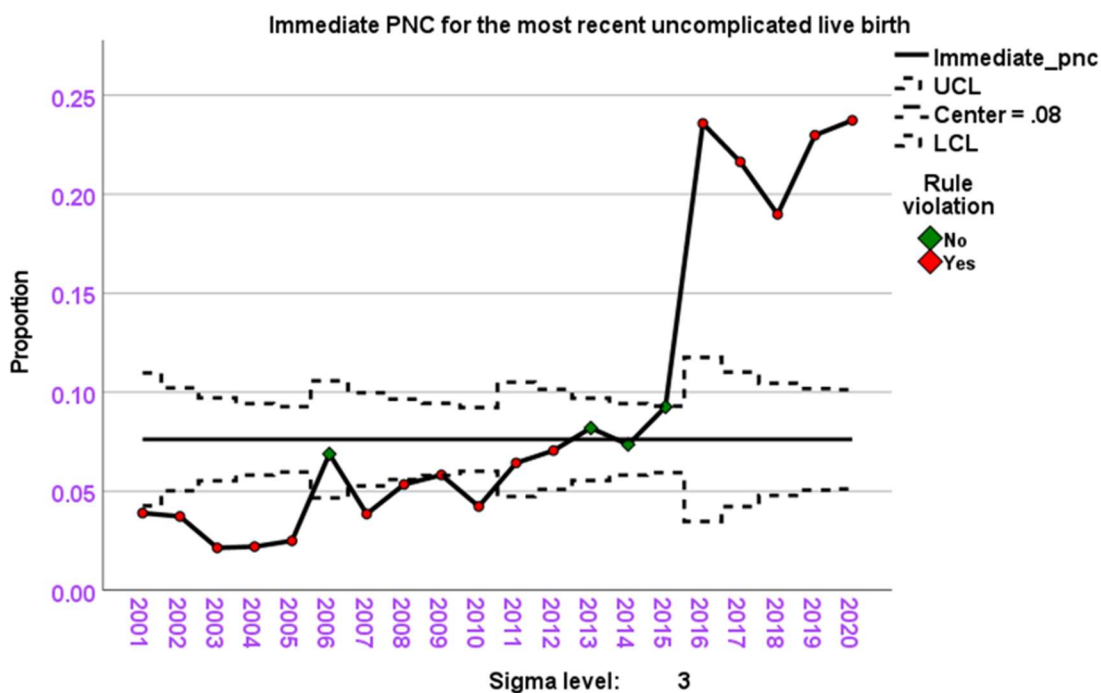
Figure 6.7 1: The percent prevalence of mothers and their newborns receiving immediate PNC (within 24 hrs of birth) at home or health facilities for their most recent uncomplicated live births in Ethiopia (2001-19).

Note: UCL: Upper control limit; LCL: Lower control limit
Immediate postnatal care: The mother and her newborn received postnatal care within 24 hrs of birth.
Three Sigma Level: The data are within three standard deviations from the mean.

During this period, there was a widening gap in the receipt of immediate PNC between: women with no education and those with higher education (by 23.1%); and women living in rural and urban locations (by 7.4%). There was also a widening gap in the receipt of immediate PNC between: the poorest and richest quintiles (by 19.8%); mothers aged ≥35 years and teenage mothers (by 4.0%), women who had no ANC visit and women who had ≥4 ANC visits (by 21.0%), and mothers who had their first ANC at or after eight months of pregnancy and those receiving care during the first trimester (by 18.9%) (**Figures 6.8 and 6.9**).
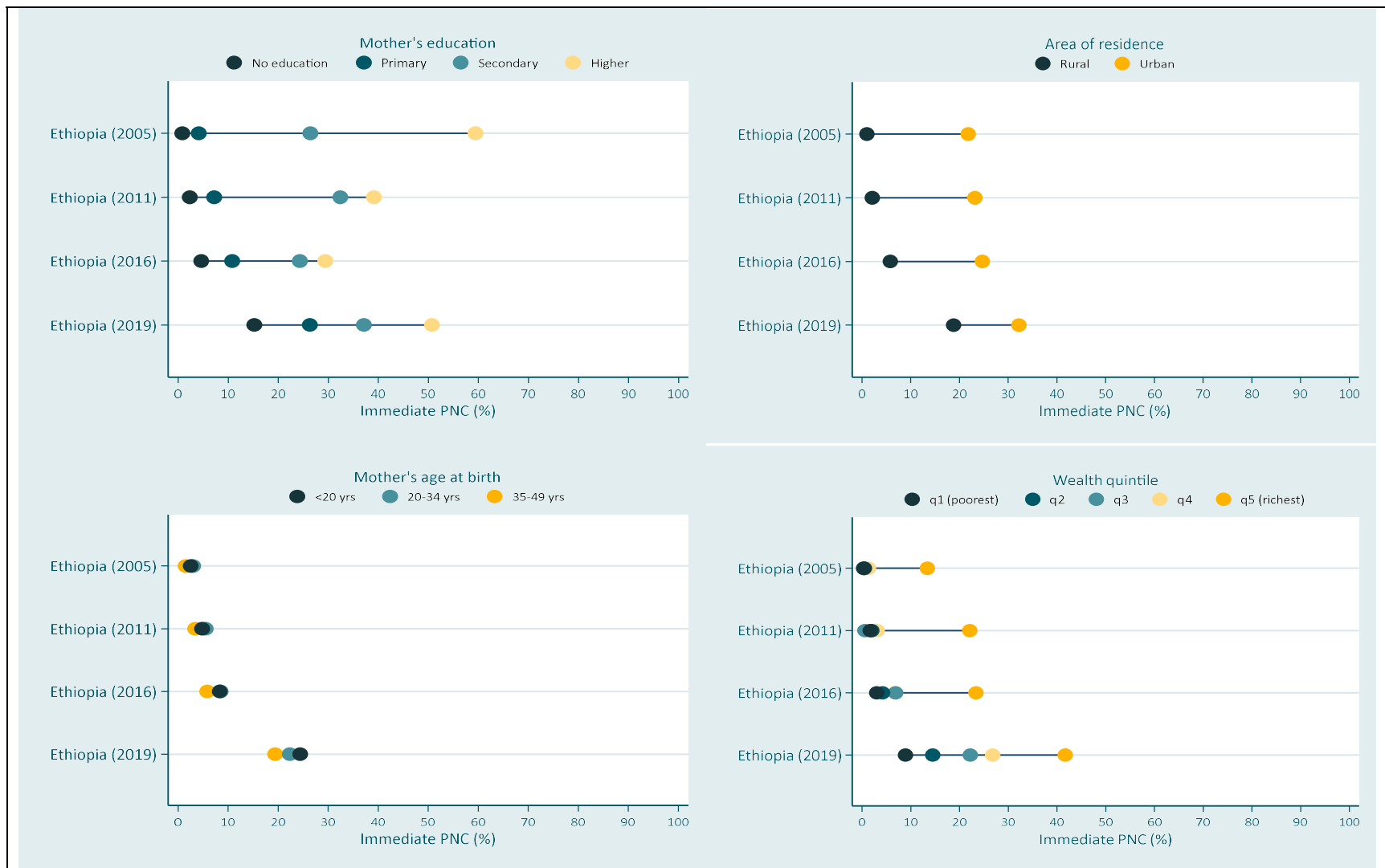
Figure 6.8 1: Inequality in accessing immediate PNC by the mother's education, residence, age at birth, and wealth over 2001-2019, Ethiopia DHSs.
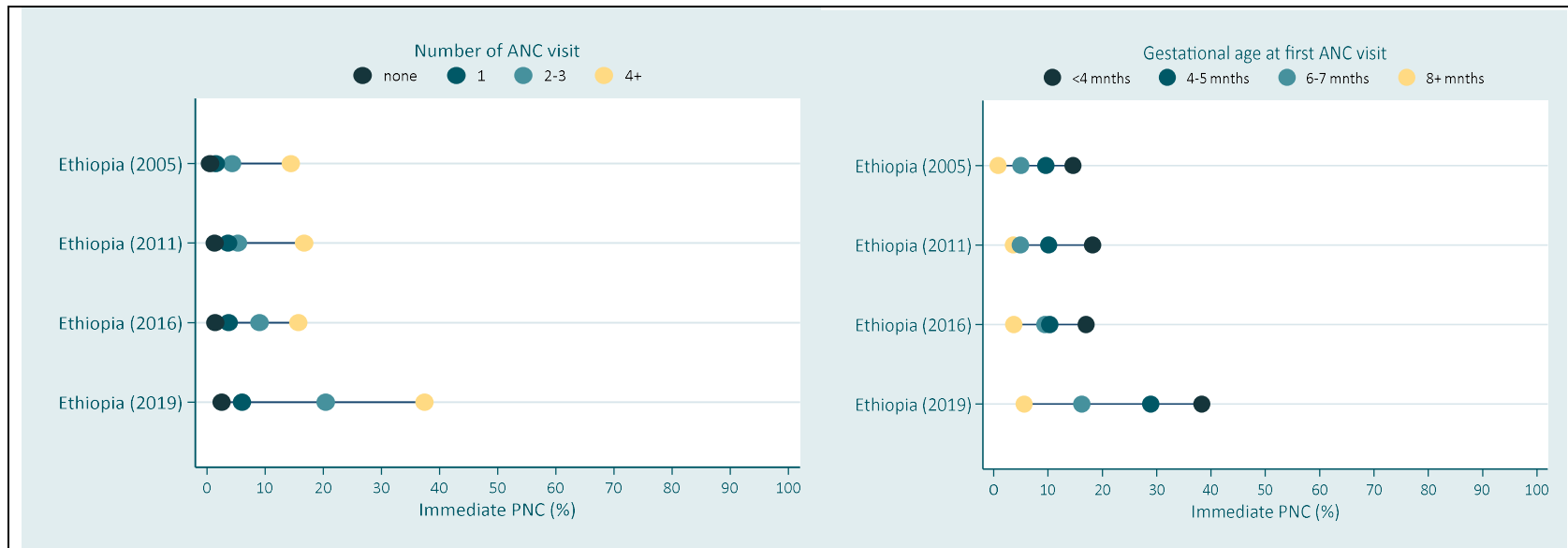
Figure 6.9 1: Inequality in accessing immediate PNC by the number of ANC visits during the pregnancy and by the number of months pregnant at the first ANC over 2001-2019, Ethiopia DHSs.

Factors associated with the changes in accessing quality ANC over 2001-2019 in Ethiopia.

Over the period, 61.2% of the increment in accessing quality ANC was associated with changes in the distribution of mothers' socio-demographic and maternal care characteristics (*endowments*) (p<0.001), while 38.8% of this increment was associated with the changes in the effect of these characteristics (*coefficients*) (p<0.001) (**Table 6.6**).

Table 6.6 1: Determinants of changes in accessing quality ANC services by mothers over two decades (2001-2019) in Ethiopia, attributed to changes in the distribution or coverage, and effects of socio-demographic and maternal care characteristics, multivariate logistic regression decomposition analysis of Ethiopia DHSs 2005 - 2019 data.

Characteristics	Quality ANC by characteristics			Due to changes in distribution or coverage		Due to changes in effects	
	2005 n (%)	2019 n (%)	Differ ence	Coefficient (95% C.I.)	Pct.	Coefficient (95% C.I.)	Pct.
Maternal education							
No education	32 (2.5)	407 (31.7)	+29.2	1.00		1.00	
Primary	18 (3.8)	469 (40.7)	+36.9	0.0038871 (-0.0030632, 0.010837)	1.80	-0.0018736 (-0.0071152, 0.0033679)	-0.87
Secondary+	27 (8.9)	282 (57.9)	+49.0	0.0045164 (0.00079487, 0.008238) *	2.09	-0.00030804 (-0.0017732, 0.0011571)	-0.14
Mother's age at birth							
<20 years	5 (1.7)	145 (37.2)	+35.5	1.00		1.00	
20-34 years	58 (3.9)	893 (40.6)	+36.7	0.00047227 (-0.001901, 0.0028456)	0.22	-0.017919 (-0.044453, 0.0086144)	-8.29
≥35 years	15 (4.6)	121 (36.2)	+31.6	0.000091834 (-0.0018633, 0.002047)	0.04	-0.0073748 (-0.01447, -0.00027921) *	-3.41
Residence							
Rural	41 (2.5)	732 (35.7)	+33.2	1.00		1.00	
Urban	36 (8.2)	426 (48.9)	+40.7	-0.0025596 (-0.011038, 0.0059188)	-1.18	-0.0023792 (-0.005539, 0.00078048)	-1.10
Household Wealth							
Poor	16 (3.2)	257 (26.1)	+22.9	1.00		1.00	
Middle	12 (3.0)	227 (38.7)	+35.7	-0.0020088 (-0.0035622, -0.00045536) *	-0.93	0.0043435 (-0.0045491, 0.013236)	2.01
Rich	49 (4.2)	673 (50.0)	+45.8	0.00065245 (0.00027534, 0.0010296) **	0.30	0.018438 (0.0044661, 0.03241) *	8.53
First ANC							
6+ months	14 (1.5)	132 (24.5)	+23.0	1.00		1.00	
<4 months	27 (5.9)	524 (48.0)	+42.1	0.0078726 (-0.0005391, 0.016284)	3.64	-0.00073811 (-0.0021919, 0.00071568)	-0.34
4-5 months	36 (5.1)	495 (39.1)	+34.0	0.0066498 (-0.0016514, 0.014951)	3.08	-0.0015352 (-0.0036, 0.00052965)	-0.71
ANC visits							
Once	6 (1.9)	7 (5.6)	+3.7	1.00		1.00	
2-3 visits	20 (2.4)	338 (30.9)	+28.5	0.022455 (0.013265, 0.031645) ***	10.38	0.0037019 (-0.00059246, 0.0079964)	1.71
4+ visits	50 (5.6)	808 (47.9)	+42.3	0.05457 (0.038013, 0.071127) ***	25.24	0.0045083 (-2.5342e-08, 0.0090167)	2.08

Place ANC received						
Place ANC received						
Government Health post						
Hospital	3 (0.7)	106 (18.9)	+18.2	1.00		1.00
Health centre	21 (3.9)	189 (55.1)	+51.2	0.0020069 (0.0009906, 0.0030233) ***	0.93	-0.00041416 (-0.0025934, 0.0017651)	-0.19
Private clinic/NGO	39 (4.6)	808 (42.5)	+37.9	0.033749 (0.021038, 0.04646) ***	15.61	-0.0015751 (-0.004819, 0.0016688)	-0.73
	13 (7.8)	43 (53.0)	+45.2	-0.000042288 (-0.000070809, -0.000013767) **	-0.02	-0.0005224 (-0.0012649, 0.00022007)	-0.24
Constant						0.087578 (0.042506, 0.13265) ***	40.50
Total				0.13231 (0.11592, 0.1487) ***	61.19	0.08393 (0.057162, 0.1107) ***	38.81

Note: *p<0.05; **p<0.01; and ***p<0.001.

Coefficients were adjusted for all socio-demographic and maternal care characteristics listed in the table.

Quality ANC: blood pressure measured + blood tested + urine tested + iron supplemented, and informed of pregnancy-related complications during pregnancy for the last birth.

Pct= percent

The increased percentage of secondary or above maternal education over the period significantly increased the receipt of quality ANC by 2.1%, compared to those with no education over the same period (p=0.017). The decreased percentage of middle-income households over the period significantly decreased the receipt of quality ANC by 0.9%, compared to poor households over the same period (p=0.011). The small increase in the percentage of rich households significantly increased the receipt of quality ANC over the same period by 0.3%, compared to poor households over the same period (p<0.001) (**Table 6.6**). The improved effect of the rich household wealth index over the period significantly increased the receipt of quality ANC by 8.5%, compared to the poor household wealth indices (p=0.010). The negative effect of advanced maternal age at birth (≥35 years) on the receipt of quality ANC over the two decades significantly decreased the receipt of quality ANC by 3.4%, compared to the effect of teenage maternal age (<20 years) over the same period (p=0.042) (**Tables 6.6** and **6.7**).

Over the period, the decreased percentage of 2-3 times ANC visits and the increased percentage of ≥4 ANC visits during pregnancy significantly increased the receipt of quality ANC by 10.4% and 25.2%, respectively (p<0.001). Over the period, the decreased percentage of mothers who received ANC at hospitals and the increased percentage of mothers who received ANC at government health centres significantly increased the receipt of quality ANC by 0.9% (p<0.001) and by 15.6% (p<0.001), respectively. However, the decreased percentage of mothers who received ANC at private/NGO health facilities from 2001-2019 significantly decreased the receipt of quality ANC by 0.02% (p=0.004) (**Tables 6.5 and 6.6**).

Table 6.7 1: Changes in the effects of socio-demographic and maternal care characteristics on accessing quality ANC in Ethiopia over 2001-2019 from multivariate logistic regression analysis, according to the Ethiopia DHSs.

Characteristics	EDHS 2005		EDHS 2019	
	*Coefficient (95% C.I.)	P-value	*Coefficient (95% C.I.)	p-value
Maternal education				
No education	1.00			
Primary	0.4802268 (-0.393539, 1.353993)	0.281	0.155335 (-0.1259005, 0.4365706)	0.279
Secondary+	0.7088269 (-0.2155096, 1.633163)	0.133	0.4980268 (0.0963842, 0.8996694)	0.015
Mother's age at birth				
<20	1.00		1.00	
20-34	0.8248715 (-0.14658, 1.796323)	0.096	0.0764911 (-0.3078841, 0.4608664)	0.697
≥35	1.334231 (0.2081876, 2.460275)	0.020	-0.0241178 (-0.5372998, 0..4890642)	0.927
Residence				
Rural	1.00		1.00	
Urban	0.828611 (-0.2291507, 1.886373)	0.125	-0.1102208 (-0.4728466, 0.252405)	0.551
Household Wealth				
Poor	1.00		1.00	
Middle	-0.1170326 (-1.216953, 0.9828874)	0.835	0.4449579 (0.1152967, 0.7746191)	0.008
Rich	-0.9026137 (-1.819782, 0.0145543)	0.054	0.6253329 (0.2935221, 0.9571437)	<0.001
First ANC				
6+ months	1.00		1.00	
<4 months	0.8881423 (-0.047046, 1.823331)	0.063	0.379173 (-0.029053, 0.787399)	0.069
4-5 months	1.001236 (0.1581322, 1.84434)	0.020	0.3014735 (-0.0812657, 0.6842128)	0.123
ANC visits				
Once	1.00		1.00	
2-3 times	-0.0785135 (-1.220967, 1.06394)	0.893	1.360247 (0.6114084, 2.109085)	<0.001
4+ times	0.1800512 (-0.8880708, 1.248173)	0.741	1.812851 (1.049883, 2.57582)	<0.001
Place ANC received				
Govt. H. post	1.00		1.00	
Hospital	1.323626 (0.0601338, 2.587118)	0.040	1.074764 (0.5256727, 1.623856)	<0.001
H. centre	1.536268 (0.2359745, 2.836562)	0.021	0.9489634 (0.5762339, 1.321693)	<0.001
Pvt. clnc/ngo	2.056222 (0.6269961, 3.485447)	0.005	1.060031 (0.3333384, 1.786724)	0.004

| Constant | -6.179831 (-7.739925, -4.619736) | <0.001 | -3.656302 (-4.528807, -2.783797) | <0.001 |

Note: *Coefficients were adjusted for all socio-demographic and maternal care characteristics listed in the table.

Quality ANC: blood pressure measured + blood tested + urine tested + iron supplemented, and informed of pregnancy-related complications during last pregnancy.

Factors associated with the changes in accessing quality intrapartum care over 2001-2019 in Ethiopia.

Over the period, 69.3% of the increment in accessing quality intrapartum care was associated with the changes in the effects of mothers' socio-demographic and maternal care characteristics (*coefficients*) (p<0.001), while 30.7% of this increment was associated with the changes in the distribution of these characteristics (*endowments*) (p<0.001) (**Table 6.8**).

The increased distribution of poor households and the decreased distribution of middle-income households over the period significantly decreased the receipt of quality intrapartum care by 13.0% (p=0.018) and by 4.8% (p=0.004), respectively, over the same period (**Tables 6.5 and 6.8**). The decreased effect of secondary or above maternal education and urban residence over the period significantly decreased receipt of quality intrapartum care by 3% (p=0.039) and by 10% (p<0.001), respectively, over the same period (**Tables 6.8 and 6.9**).

Over the period, the increased percentage of ≥4 ANC visits and quality ANC women received significantly increased the receipt of quality intrapartum care by 30% (p=0.009) and 14% (p=0.039), respectively (**Tables 6.5 and 6.8**).

Table 6.8 1: Determinants of changes in accessing quality intrapartum care services by mothers over two decades (2001-2019) in Ethiopia, attributed to changes in the distribution or coverage, and effects of socio-demographic and maternal care characteristics, multivariate logistic regression decomposition analysis of Ethiopia DHSs 2005 - 2019 data.

Characteristics	Quality intrapartum care by characteristics			Due to changes in distribution or coverage		Due to changes in effects	
	2005 n (%)	2019 n (%)	Difference (%)	Coefficient (95%)	Pct.	Coefficient (95%)	Pct.
Maternal education							
No education	74 (1.4)	521 (31.6)	+30.2	1.00			
Primary	67 (5.8)	638 (49.6)	+43.8	0.032313 (-0.0065372, 0.071164)	7.29	-0.0062808 (-0.024238, 0.011677)	-1.42
Secondary+	124 (34.0)	325 (66.1)	+32.1	0.013545 (-0.00071844, 0.027808)	3.06	-0.012958 (-0.025236, -0.00067952) *	-2.92
Mother's age at birth							
<20	46 (4.8)	244 (48.8)	+44.0	1.00		1.00	
20-34	189 (4.1)	1085 (43.9)	+39.8	-0.042328 (-0.090195, 0.0055403)	-9.55	-0.016899 (-0.069948, 0.036151)	-3.81
≥35	29 (2.3)	156 (34.4)	+32.1	0.004969 (-0.00045565, 0.010394)	1.12	-0.0066513 (-0.024267, 0.010965)	-1.50
Residence							
Rural	85 (1.4)	934 (37.9)	+36.5	1.00		1.00	
Urban	180 (28.8)	551 (57.0)	+28.2	0.0046032 (-0.024906, 0.034112)	1.04	-0.042263 (-0.059346, -0.025179) ***	-9.54
Household Wealth							
Rich	236 (9.4)	844 (59.8)	+50.4	1.00		1.00	
Poor	15 (0.5)	406 (30.3)	+29.8	-0.057548 (-0.10519, -0.0099034) *	-12.99	-0.0038337 (-0.029266, 0.021598)	0.87
Middle	14 (0.9)	235 (34.8)	+33.9	-0.02111 (-0.035446, -0.0067741) **	-4.76	0.0036077 (-0.02303, 0.030246)	0.81
First ANC							
6+ months	52 (6.2)	195 (43.1)	+36.9	1.00		1.00	
<4 months	88 (19.2)	581 (56.6)	+37.4	0.010764 (-0.040553, 0.06208)	2.43	0.0034365 (-0.016298, 0.023171)	0.78
4-5 months	75 (10.9)	606 (52.9)	+42.0	0.017213 (-0.020841, 0.055267)	3.88	0.012188 (-0.014484, 0.038859)	2.75
ANC visits							
Once	12 (3.8)	27 (29.1)	+25.3	1.00		1.00	
2-3 visits	46 (5.9)	433 (45.8)	+39.9	0.017422 (-0.0014419, 0.036286)	3.93	0.024119 (-0.021406, 0.069644)	5.44
4+ visits	153 (17.5)	923 (57.7)	+40.2	0.13297 (0.03362, 0.23232) **	30.01	0.032205 (-0.020033, 0.084443)	7.27

Had received quality ANC							
No	196 (10.2)	734 (47.6)	+37.4	1.00		1.00	
Yes	19 (25.7)	653 (59.1)	+33.4	0.060616 (0.0031947, 0.11804) *	13.68	-0.00076614 (-0.0038295, 0.0022972)	-0.17
Constant						0.32103 (0.1799, 0.46217) ***	72.46
Total				0.13614 (0.10754, 0.16474) ***	30.73	0.30694 (0.2681, 0.34578) ***	69.27

Note: *p<0.05; **p<0.01; and ***p<0.001.

Coefficients were adjusted for all socio-demographic and maternal care characteristics listed in the table.

Quality intrapartum care: Given birth at health facility + birth assisted by skilled personnel, and newborn put to the breast within one hour of birth.

Pct= percent

Table 6.9 1: Changes in the effects of socio-demographic and maternal care characteristics on accessing quality intrapartum care in Ethiopia over 2001-2019 from multivariate logistic regression analysis, according to the Ethiopia DHSs.

Characteristics	EDHS 2005		EDHS 2019	
	*Coefficient (95%)	p-value	*Coefficient (95%)	p-value
Maternal education				
No education	1.00			
Primary	0.463612 (-0.149443, 1.076667)	0.138	0.2261089 (-0.0596712, 0.5118891)	0.121
Secondary+	1.192 (0.5773427, 1.806657)	<0.001	0.4041864 (-0.0024038, 0.8107765)	0.051
Mother's age at birth				
<20	1.00		1.00	
20-34	-0.1504421 (-0.688272, 0.3873879)	0.584	-0.3594209 (-0.7321028, 0.013261)	0.059
≥35	-0.1245864 (-0.9738911, 0.7247184)	0.774	-0.499565 (-1.005441, 0.0063112)	0.053
Residence				
Rural	1.00		1.00	
Urban	1.79305 (1.157361, 2.428739)	<0.001	0.0535459 (-0.2954332, 0.4025251)	0.764
Household Wealth				
Rich	1.00		1.00	
Poor	-0.4685288 (-1.311223, 0.3741656)	0.276	-0.6056643 (-0.9372574, -0.2740713)	<0.001
Middle	-0.9559574 (-2.086988, 0.175073)	0.098	-0.7963607 (-1.151646, -0.4410757)	<0.001
First ANC				
6+ months	1.00		1.00	
<4 months	-0.0527521 (-0.7135459, 0.6080417)	0.876	0.0813251 (-0.3149312, 0.4775813)	0.687
4-5 months	-0.1532143 (-0.7288068, 0.4223781)	0.602	0.161121 (-0.2081575, 0.5303996)	0.392
ANC visits				
Once	1.00		1.00	
2-3 times	0.0172873 (-0.7602062, 0.7947808)	0.965	0.547671 (-0.0955871, 1.190929)	0.095
4+ times	0.1825117 (-0.6648649, 1.029888)	0.673	0.8424692 (0.1798198, 1.505119)	0.013
Had received quality ANC				
No	1.00		1.00	
Yes	0.4163632 (-0.2561702, 1.088897)	0.225	0.2357133 (-0.0236578, 0.4950845)	0.075
Constant	-3.11846 (-4.026576, -2.210344)	<0.001	-0.3045636 (-1.045932, 0.4368046)	0.421

Note: *Coefficients were adjusted for all socio-demographic and maternal care characteristics listed in the table.

Quality intrapartum care: Given birth at health facility + birth assisted by skilled personnel, and newborn put to the breast within one hour of birth.

Factors associated with the changes in accessing immediate PNC services over 2001-2019 in Ethiopia (2001-2019).

Over the period, 75.7% of the increment in accessing immediate PNC services was associated with changes in the distribution of mothers' socio-demographic and maternal care characteristics (*endowments*) (p<0.001), while 24.3% of this increment was associated with changes in the effect of these characteristics (*coefficients*) (p<0.001) (**Table 6.10**).

Over the period, the increased distribution of poor households significantly decreased the access to immediate PNC services by 5.9% (p=0.026) (**Tables 6.5 and 6.10**). The decreased effects of secondary or above maternal education and urban residence significantly decreased the access to immediate PNC services by 2.6% (p=0.029) and by 3.1% (p= 0.043), respectively (**Tables 6.10 and 6.11**).

The increased percentage of ≥4 ANC, ANC during the first trimester, quality ANC, and quality intrapartum care over 2001-2019 significantly increased the access to immediate PNC over the same period by 30.9% (p=0.003), 13.1% (p= 0.008), 19.2% (p= 0.002) and 60.7% (p<0.001), respectively (**Tables 6.5 and 6.10**). Conversely, the decreased effect of the access to quality intrapartum care over the two decades significantly reduced the access to immediate PNC by 2.1% (p= 0.009) over the same period (**Tables 6.10 and 6.11**).

Table 6.10 1: Determinants of changes in accessing immediate PNC services by mothers over two decades (2001-2019) in Ethiopia, attributed to changes in the distribution or coverage, and effects of socio-demographic and maternal care characteristics, multivariate logistic regression decomposition analysis of Ethiopia DHSs 2005 - 2019 data.

Characteristics	Immediate PNC by characteristics			Due to changes in distribution or coverage		Due to changes in effects	
	2005 n (%)	2019 n (%)	Difference (%)	Coefficient (95%)	Pct.	Coefficient (95%)	Pct.
Maternal education							
No education	46 (0.8)	295 (15.2)	+14.4	1.00			
Primary	49 (4.1)	346 (26.3)	+22.2	0.005696 (-0.012361, 0.023753)	2.27	-0.0021416 (-0.0099737, 0.0056904)	-0.85
Secondary+	95 (29.6)	174 (41.2)	+11.6	0.00081542 (-0.0063969, 0.0080277)	0.33	-0.0064459 (-0.012222, -0.00067012) *	-2.57
Mother's age at birth							
<20 years	25 (2.5)	126 (24.4)	+21.9	1.00		1.00	
20-34 years	144 (3.0)	591 (22.3)	+19.3	-0.0053018 (-0.022786, 0.012182)	-2.12	-0.015018 (-0.042475, 0.012438)	-6.00
≥35 years	21 (1.5)	99 (19.4)	+17.9	-0.0010302 (-0.0033616, 0.0013012)	-0.41	0.000031903 (-0.0078756, 0.0079394)	0.01
Residence							
Rural	65 (1.0)	521 (18.8)	+17.8	1.00		1.00	
Urban	125 (21.8)	294 (32.2)	+10.4	-0.00095902 (-0.014763, 0.012845)	-0.38	-0.0078419 (-0.015439, -0.00024464) *	-3.13
Household Wealth							
Rich	170 (6.6)	469 (34.4)	+27.8	1.00		1.00	
Poor	11 (0.4)	185 (11.6)	+11.2	-0.014726 (-0.02767, -0.0017819) *	-5.88	0.00049953 (-0.010235, 0.011234)	0.20
Middle	8 (0.5)	161 (22.2)	+21.7	-0.00078689 (-0.0045404, 0.0029666)	-0.31	0.0074121 (-0.004216, 0.01904)	2.96
First ANC							
6+ months	34 (4.0)	74 (14.6)	+10.6	1.00		1.00	
<4 months	63 (14.6)	368 (38.3)	+23.7	0.032859 (0.0085736, 0.057144) **	13.12	0.0049069 (-0.0041395, 0.013953)	1.96
4-5 months	65 (9.6)	347 (28.9)	+19.3	0.015383 (-0.0013483, 0.032115)	6.14	0.0022992 (-0.01009, 0.014689)	0.92
ANC visits							
Once	5 (1.5)	8 (6.0)	+4.5	1.00		1.00	
2-3 visits	35 (4.3)	206 (20.4)	+16.1	0.0057853 (-0.00032493, 0.011896)	2.31	0.0025423 (-0.022434, 0.027519)	1.01
4+ visits	120 (14.4)	574 (37.4)	+23.0	0.077365 (0.025558, 0.12917) **	30.88	0.0070436 (-0.020471, 0.034558)	2.81

Had received quality ANC							
No	151 (7.8)	374 (22.5)	+14.7	1.00		1.00	0.30
Yes	13 (19.0)	416 (40.7)	+21.7	0.047984 (0.017768, 0.0782) **	19.16	0.00074718 (-0.00048678, 0.0019811)	
Received quality intrapartum care No	82 (1.3)	206 (11.3)	+10.0	1.00		1.00	
Yes	108 (47.0)	608 (44.7)	-2.3	0.15204 (0.11755, 0.18653) ***	60.69	-0.0052104 (-0.0091021, -0.0013186) **	-2.08
Constant						0.072102 (-0.0019742, 0.14618)	28.78
Total				0.18958 (0.16482, 0.21435) ***	75.68	0.060927 (0.032535, 0.089318) ***	24.32

Note: *p<0.05; **p<0.01; and ***p<0.001.

Coefficients were adjusted for all socio-demographic and maternal care characteristics listed in the table.

Immediate postnatal care: The mother and her newborn received postnatal care within 24 hours of birth (excluding caesarean deliveries).

Pct= percent

Table 6.11 1: Changes in the effects of socio-demographic and maternal care characteristics on accessing immediate PNC in Ethiopia over 2001-2019 from multivariate logistic regression analysis, according to the Ethiopia DHSs.

Characteristics	EDHS 2005		EDHS 2019	
	Coefficient (95%)	p-value	Coefficient (95%)	p-value
Maternal education				
No education	1.00			
Primary	0.2969337 (-0.3387809, 0.9326482)	0.360	0.1010013 (-0.2220863, 0.424089)	0.540
Secondary+	0.9959272 (0.3020895, 1.689765)	0.005	0.0514033 (-0.4037823, 0.5065888)	0.825
Mother's age at birth	1.00		1.00	
<20 years	0.3299923 (-0.3824551, 1.04244)	0.364	-0.1293703 (-0.5544894, 0.2957487)	0.551
20-34 years	0.2435267 (-0.7373775, 1.224431)	0.627	0.2480885 (-0.314194, 0.810371)	0.387
≥35 years				
Residence				
Rural	1.00		1.00	
Urban	0.7544288 (0.0903921, 1.418466)	0.026	-0.0266559 (-0.4095876, 0.3562758)	0.891
Household Wealth				
Rich	1.00		1.00	
Poor	-0.4904559 (-1.403942, 0.4230299)	0.293	-0.444794 (-0.8090417, -0.0805462)	0.017
Middle	-0.8884342 (-2.123868, 0.3469996)	0.159	-0.0865062 (-0.4966599, 0.3236475)	0.679
First ANC				
6+ months	1.00		1.00	
<4 months	0.1391939 (-0.5718915, 0.8502793)	0.701	0.604409 (0.1425411, 1.066277)	0.010
4-5 months	0.2408912 (-0.4072698, 0.8890522)	0.466	0.3863908 (-0.0470603, 0.8198419)	0.081
ANC visits				
Once	1.00		1.00	
2-3 visits	0.6171396 (-0.4608949, 1.695174)	0.262	0.7586571 (-0.1029001, 1.620214)	0.084
4+ visits	0.8181657 (-0.2092915, 1.845623)	0.119	1.169624 (0.3051696, 2.034079)	0.008
Had received quality ANC				
No	1.00		1.00	
Yes	0.0101944 (-0.659387, 0.6797758)	0.976	0.4442424 (0.1507282, 0.7377565)	0.003
Received quality intrapartum care				
No	1.00		1.00	
Yes	2.307277 (1.710978, 2.903577)	<0.001	1.253249 (0.9505168, 1.555981)	<0.001

Constant	-4.463939 (-5.726722, -3.201157)	<0.001	-2.897881 (-3.861905, -1.933857)	<0.001

Note: *Coefficients were adjusted for all socio-demographic and maternal care characteristics listed in the table.

Immediate postnatal care: The mother and her newborn received postnatal care within 24 hours of birth.

Discussion

There was an overall increment in the percentage of mothers accessing quality ANC, intrapartum care, and immediate PNC services over two decades (2001-2019) in Ethiopia. However, these gains were not equally distributed and dependent on the mothers' socio-demographic and maternal care characteristics.

Over 2001-2019, the increased distribution of ≥4 ANC visits, ANC at government health centres, and higher maternal education contributed the largest significant increase in accessing quality ANC by 25%, 16%, and 2%, respectively, while the increased distribution of ≥4 ANC and quality ANC services contributed the largest significant increase to accessing quality intrapartum care by 30% and 14%, respectively. Over the period, the increased distribution of ANC in the first trimester, quality ANC, ≥4 ANC, and quality intrapartum care contributed the largest significant increase to accessing immediate PNC services by 13%, 19%, 31%, and 61%, respectively. A study conducted in southwestern Ethiopia by Negero et al. shows mothers with four or more ANC contacts during their last pregnancy were seven times more likely to receive skilled personnel-assisted birth than mothers with no or fewer ANC contacts (Negero et al. 2018). Women who felt their ANC was of poor quality will not return for subsequent care (Berhan & Berhan 2014). Mothers will not come or bring their newborns to healthcare facilities for timely PNC if they are discouraged by staff or treated poorly at prior visits (Sacks & Kinney 2015).

Our study shows widening inequality between rich and poor mothers, between teenage mothers and mothers aged 20-34 years, and their receipt of quality ANC, intrapartum care, and immediate PNC services over the period. This concurs with findings from South Africa, where a comparison of serial national household surveys conducted between 2008 and 2012 indicated that inequalities between socio-economic quartiles for ANC attendance and a doctor's presence at childbirth had worsened over 18 years (Wabiri et al. 2016).

Over 2001-2019, the increased access to quality ANC and immediate PNC services was attributed more to the changes in the distribution of socio-demographic and maternal care characteristics than to the changes in the effect of these characteristics, while the increased access to quality intrapartum care was attributed more to the changes in the effect of socio-demographic and maternal care characteristics than to the changes in the distribution of these characteristics. This reveals that improved women's socio-demographic statuses and access to maternal healthcare over 2001-2019 primarily and significantly increased the access to quality ANC and immediate PNC services, while the increased effects of these socio-demographic and maternal care characteristics over the period significantly

improved access to quality intrapartum care. In Ethiopia, over two decades (1996-2016), school attendance rates have increased significantly for pre-primary, primary, and secondary education. The gender gap in primary school enrolment has been eliminated, and the primary school attendance rate of young teenage girls (aged 10-14 years) exceeded that of their male counterparts (80% and 78%, respectively). The gender gap in secondary school attendance rates has narrowed to a 5% difference (higher for boys). The share of children who attended the right grade for their age nearly doubled from 31% in 2000 to 61% in 2016. Between 2000 and 2016, the incidence of child marriage halved, from 20% to 11%; the incidence of teenage pregnancy declined to 13% (Elezaj et al. 2019). However, the illiteracy rate among adult women in Ethiopia remains persistently high despite increased literacy among teenagers since 2000 (Elezaj et al. 2019).

Between 2000-2016, the coverage of adequate ANC visits increased from 10% to 32%, and skilled personnel assisted birth from 6% to 33% (Elezaj et al. 2019). These improvements could arguably be causally attributed to the introduction of two community-based national health policies, the health extension program (HEP) and the health development army (HDA), launched after 2000. The HEP, launched in 2003, expanded basic health infrastructure and local human resources (two health extension workers per village). In 2010, the government introduced the HDA policy to increase the efficiency of HEWs and the HEP in reaching every household, with one female HDA team leader for every 30 households (Ministry of Health 2017). The HDA is a women-centred community movement inspired by military structures and discipline. Its objective was to improve maternal health outcomes (Ministry of Health 2017) by establishing networks of female neighbours who meet at least once per week. Each network has a leader responsible for referring pregnant women and linking them with health workers.

Despite these improvements, our study shows that increases in the distribution of poor households over the period contributed to the largest significant decrease in accessing quality intrapartum care and immediate PNC services by 13% and 6%, respectively, over the same time period. On the other hand, over the period, the increased effect of the rich households contributed the largest significant increase to the receipt of quality ANC by 9%. This highlights the critical need to improve access to the recommended interventions during ANC, intrapartum care, and PNC services for mothers of low socio-economic status and the need to promote women's economic empowerment. Poverty hinders a mother from seeking the recommended maternal healthcare interventions, including institutional delivery (Leventhal et al. 2021). Socio-economic inequalities in PNC service use have been identified across low-and middle-income countries (Langlois et al. 2015).

In our study, the decreased effect of urban residence and secondary or above maternal education over the period significantly decreased the receipt of quality intrapartum care by 10% and 3% and immediate PNC by 3% and 3%, respectively. This might be due to the rising poverty among urban residents in Ethiopia. Our analysis shows that the poor household distribution in urban areas in Ethiopia increased by nine-fold over the two decades and is likely to be linked to decreased access to quality care. The decreased effect of quality intrapartum care over the period significantly decreased the access to immediate PNC services over the same period by 2%. This might be due to the worsening care experience during labor and delivery services over time.

In our study, the decreased percentage of mothers who received ANC at hospitals and the increased percentage of mothers who received ANC at government health centres across the two decades significantly increased the receipt of quality ANC, indicating the benefits of redirecting uncomplicated maternal healthcare services to lower-level health facilities to avoid crowding of higher-level health facilities and hence low-quality care. In an analysis paper pleading for the healthcare system redesign for maternal and newborn survival in low and middle-income countries, Roder-DeWan et al. argued that all deliveries in these settings need to be shifted to hospitals or other advanced care facilities to bring care in line with global best practices, and there should be investments in boosting the quality of primary care facilities for antenatal, postnatal and newborn care services and mobilizing populations to demand high-quality care (Roder-DeWan et al. 2020).

The negative effect of advanced maternal age (≥ 35 years) over the period contributed the largest significant decrease to accessing quality ANC over the same period by 3%, and this signals the necessity to encourage and make sure older mothers receive the recommended interventions during their ANC visits. The risk of poor utilization of ANC services is higher among older women (≥ 31 years). Access to ANC clinics could be increased by improving transport, actively engaging community members in their promotion, minimizing costs, and extending opening hours (Rurangirwa et al. 2017).

This study has several limitations. The study shares the limitations of a cross-sectional study design, which makes it challenging to demonstrate cause-and-effect relationships. However, we used four consecutive Ethiopian Demographic and Health Surveys data, which are nationally representative and could enhance the findings' generalisability. In addition, statistical control charts can only be used to assess each variable independently/singularly without assessing the effects of other variables, as this may not be intuitive to the reader. Due to the missing data on some essential interventions during care in the Ethiopia DHSs, including an ultrasound scan during the first 24 weeks of gestation, the

experience of care (respectful care), effective communication, a companion of choice during labour and delivery and delayed umbilical cord clamping, the study does not constitute a comprehensive evaluation of the quality of care according to the WHO's recommended interventions during pregnancy, intrapartum or postpartum care services. The multivariate decomposition analysis enabled the identification of factors that positively or negatively contributed to the changes in access to quality ANC, intrapartum care, and immediate PNC services over the two decades in Ethiopia that could help policymakers and health planners in low-income settings design applicable strategies.

Conclusions

From 2001 to 2019, the receipt of quality maternal healthcare improved in Ethiopia despite widening inequality between population subgroups. Changes in distribution and effects of maternal socio-demographic and healthcare indicators over the period significantly affected the receipt of quality maternal healthcare. Over the period, the increased distribution of ≥4 ANC, ANC at the government health centres, and secondary or above maternal education contributed the largest significant increase to the receipt of quality ANC. The rich household's increased effect contributed the largest significant increase in receiving quality ANC over the period. The increased percentage of ≥4 ANC and quality ANC over the period contributed the largest significant increase to accessing quality intrapartum care over the same period. However, the increased distribution of poor households and the decreased distribution of middle-income households, and the decreased effects of secondary or above maternal education and urban residence contributed the largest significant decreases to accessing quality intrapartum care over the period. The increased coverage of ANC during the first trimester, quality ANC, ≥4 ANC, and quality intrapartum care contributed the largest significant increase to accessing immediate PNC services over the period. However, the increased distribution of poor households contributed the largest significant decrease to accessing immediate PNC services over the same period.

The healthcare system in Ethiopia should strive to make accessible all the recommended interventions during ANC, intrapartum, and PNC services to the disadvantaged section of the society: non-educated, poor, teenage (<20 years), older (≥35 years), and rural mothers. Promoting ≥4 ANC visits, ANC during the first trimester, girls' and women's education, and enabling women's economic empowerment is needed. Promoting and putting into practice the policy of the universal coverage of quality maternal and newborn healthcare across the continuum is needed.

6.1 Chapter Summary

The study in chapter six showed that over the period 2001-2019 in Ethiopia, there were increases in women's use of quality ANC, intrapartum care, and immediate PNC services, however, with widening inequalities among women, disproportionately favouring those from advantageous sub-populations. In addition, changes in distribution and effects of women's socio-demographic and maternal healthcare characteristics over the period significantly affected the receipt of quality maternal healthcare services. The next chapter investigates women's use of skilled maternal healthcare services across the continuum throughout pregnancy, childbirth and postnatal, and its key predictors in 28 LLMICs for last birth within two years preceding the DHS.

Chapter 7: Women's use of maternal healthcare services across the continuum in 28 low- and lower-middle-income countries.

This chapter studies the prevalence, determinants, and within and between-country socio-demographic inequalities of women's use of skilled maternal healthcare services across the continuum throughout pregnancy, childbirth, and postpartum for the last birth within two years preceding the latest DHSs across 28 LLMICs. The study is currently under review in the journal: BMJ Open

Negero, M.G., Sibbritt, D. & Dawson, A. Women's use of maternal healthcare services across the continuum in 28 low- and lower-middle-income countries. BMJ Open. bmjopen-2022-067888 (This is under review in the BMJ Open Journal)

Abstract

Objective: This study sought to investigate the prevalence, within and between country socio-demographic inequalities and determinants of accessing maternal healthcare across the continuum in low- and lower-middle-income countries (LLMICs).

Design, outcomes, setting, and analysis: Maternal healthcare across the continuum refers to the continuity of skilled care throughout pregnancy, birth, and after delivery. We used the latest demographic and health surveys data from 28 LLMICs (2016-2021). We employed equiplot, concentration curve, and concentration index to measure within and between country socio-demographic inequalities in accessing the care continuum. We fitted a multilevel mixed-effects logistic regression model to determine predictors of the care continuum.

Results: Five of every eight mothers in LLMICs received maternal healthcare across the continuum, but with substantial attrition along the care continuum. The care continuum was significantly pro-rich, with the degree of pro-rich inequality significantly greater among rural, non-educated, and older (≥35 years) mothers. Commencing antenatal care (ANC) visits during the first trimester, having ≥4 ANC contacts, receiving quality ANC, exposure to mass media, having healthcare insurance, higher maternal education levels and household wealth indices were associated with the higher odds of receiving the care continuum. In addition, having a lower number of births (<5), longer birth intervals (≥4 years), and an intended pregnancy significantly increased the likelihood of receiving the care continuum. In contrast, teenage mothers were less likely to receive the care continuum. Women who had to get permission to seek medical care and reported a lack of companionship and longer distances to healthcare facilities were less likely to receive the care continuum.

Conclusions: We recommend promoting early ANC visits, ≥4 ANC contacts, quality ANC, healthcare insurance, birth spacing, reproductive health services to prevent unintended pregnancies, mother's companionship to health facilities, low parity, women's rights, and maternal healthcare continuum of teenage mothers. Women's education and economic empowerment in LLMICs need to be progressed as per the Sustainable Development Goals.

Introduction

Despite the significant progress made over the last two decades to address maternal mortality, an estimated 295,000 women died globally in 2017 from causes related to or aggravated by pregnancy and childbirth, with a maternal mortality ratio (MMR) of 211 maternal deaths per 100,000 live births. Furthermore, an estimated 2.4 million children died globally within the first 28 days of life (the neonatal period) in 2019, with a neonatal mortality rate of 17 neonatal deaths per 1000 live births. Low-income and lower-middle-income countries accounted for 94% of the global maternal deaths in 2017, with an MMR of 462 and 254 per 100,000 live births, respectively. The highest burden of maternal mortality is in sub-Saharan Africa, followed by Central and Southern Asia. Sub-Saharan Africa and Central and Southern Asia accounted for more than 80% of the global under-five deaths in 2019 (World Health Organization 2021). The mother's receipt of the maternal healthcare continuum significantly reduces the risk of neonatal and infant mortality (Usman, Banerjee & Srivastava 2021). Most maternal and neonatal deaths are preventable with timely management by skilled health personnel working in a supportive environment. This care should be across the care continuum (Negero, Sibbritt & Dawson 2021a; WHO 2022b).

The maternal healthcare continuum refers to the continuity of skilled care throughout pregnancy, birth, and after delivery—that is, the use of antenatal care (ANC), intrapartum care, and postnatal care (PNC) provided by skilled personnel (Wang & Hong 2013b). The maternal healthcare continuum has two dimensions: 1) time dimension referring to the continuity of care from pregnancy to childbirth and postpartum; and 2) place dimension referring to the continuity of care across places' levels of care delivery (e.g., from home to the first-level facility, and the hospital) (Kerber et al. 2007b).

The cumulative effect of receiving the recommended components that make up each care package across the continuum is key to improving the health of mothers and their newborns (Kerber et al. 2007b; Tinker et al. 2005; Wang & Hong 2013b). Several studies based on data from nationally representative surveys have found differences in the receipt of the maternal healthcare continuum. A study by Wang et al. [2013] based on the Cambodia 2010 demographic and health survey (DHS) data showed that three of every five (60%) Cambodian mothers received maternal and newborn healthcare across the continuum. However, after receiving ANC, 11% of mothers had skilled intrapartum care but no PNC, 8% had PNC but no SBA, and 13% received neither. The quality of ANC that mothers received also affected their subsequent use of SPAB and PNC (Wang & Hong 2013b). A study by Sserwanja et al. [2022] based on Uganda 2016 DHS data defined the maternal healthcare continuum as a mother having had four or more ANC visits, delivery in a health facility, and at least one PNC check-up within six

weeks of birth for the last birth. The authors reported that the proportion of the maternal healthcare continuum was 10.7%, with 59.9% of women having had four or more ANC visits, 76.6% of women delivered in a health facility, and 22.5% received at least one PNC visit within six weeks of the last birth. Predictors of the maternal healthcare continuum were early initiation of ANC (in the first trimester) and secondary or above maternal education (Sserwanja, Mukunya, et al. 2022).

A study from India by Kothavale & Meher [2021] based on secondary analysis of the National Family Health Survey (NFHS-4) data conducted during 2015/16 showed that about 39% of mothers in India had received maternal, newborn, and child healthcare continuum by receiving all four types of services (ANC, institutional delivery, PNC, and full child immunization). The highest number of dropouts in the continuum of care was observed at the first stage (low utilization of ANC services), with a loss of nearly 38%. Education, wealth, and health insurance coverage were significant predictors of receiving the continuum of care (Kothavale & Meher 2021).

There are few studies investigating the maternal healthcare continuum across multiple countries. The findings of research based on a secondary analysis of DHS data from nine South Asia and sub-Saharan African countries described the maternal healthcare continuum based on four key elements of the continuum of care - at least one ANC visit, four or more ANC visits, skilled intrapartum care and PNC for the mother within the first 24 hours since birth. A major dropout (more than 50%) occurred early on in the continuum of care between the first ANC visit and four or more ANC visits. Few women (less than 5%) who did not receive ANC have a skilled delivery or PNC. Women who received some or all the elements of the continuum of care were found to have greater autonomy, were richer, and were more educated than women who received none of the elements of care across the continuum (Singh, Story & Moran 2016).

There is little research examining the uptake of the maternal healthcare continuum, its socio-demographic inequalities, and its determinants across the LLMICs. We undertook a study using the latest nationally representative DHSs data from 28 LLMICs collected during the first six years of the Sustainable Development Goals (SDGs) implementation era (2016-2021) to measure the prevalence of the maternal healthcare continuum received, the socio-demographic inequalities, and its predictors to provide evidence for policymakers, healthcare providers and researchers in LLMICs to assess implementation fidelity, plan services, allocate resources and execute to improve maternal and newborn health outcomes.

Methods

Data source and study design

We undertook a secondary analysis of data from the most recent DHSs, conducted between 2016 and 2021, in 28 countries from LLMICs. According to the World Bank Country and Lending Groups' Classification 2019–2020 (World Bank 2019), eight DHSs were conducted in low-income countries, and twenty DHSs were conducted in lower-middle-income countries. The data for the study were extracted from the children's recode file (K.R. file) of the individual countries upon permission from the DHS program website. The DHSs of the 28 countries were chosen because they contain the necessary indicators to calculate the outcome variable and its potential explanatory variables. The respective DHS data were collected during the first six years of implementation of the SDGs era (2016-2021), thus allowing us to evaluate progress over time in the maternal healthcare continuum.

The DHS is a nationally representative cross-sectional survey undertaken in more than 85 low- and middle-income countries since 1984. The DHS contains information on household characteristics, reproductive health, women's and children's health, nutrition, and mortality, whose data are publicly available with no identifying information (Corsi et al. 2012). The DHS uses a multi-stage cluster sampling technique to select women of reproductive age (15–49 years) and children younger than five years for inclusion (Corsi et al. 2012).

Patient and public involvement

There was no direct patient or public involvement in this study. This study used secondary data from the DHS program, which was not subject to ethical approval because it did not involve data concerning human participants, and the data were de-identified.

Variables

Outcome variable

The outcome variable in our study was the maternal healthcare continuum. A mother who received at least one skilled ANC visit, skilled intrapartum care, and maternal and/or newborn PNC within two days of birth for the most recent live birth within two years preceding the latest DHS was considered to have received the maternal healthcare continuum.

At least one skilled ANC visit is defined as the maternal healthcare services or interventions a mother receives during pregnancy, during one or more rounds of visits from skilled personnel for a positive pregnancy experience. Skilled intrapartum care is defined as the provision of care during labour and

delivery by competent health professionals (Croft et al. 2018; WHO 2018a). A mother and/or her newborn whose health was checked postpartum by a healthcare provider at a health facility or at home before or after discharge from a health facility or after home delivery within two days of birth is considered to have received the maternal and/or newborn PNC.

Explanatory variables

The explanatory variables included in this study were selected based on their significant associations with the maternal healthcare continuum based on the literature (Chukwuma et al. 2017; Emiru, Alene & Debelew 2020; Iqbal et al. 2017; Sakuma et al. 2019; Singh, Story & Moran 2016; Wang & Hong 2013b) and their availability in the DHS dataset. Our study included 14 explanatory variables. These variables were categorized into individual women (level-one) variables, level-two clusters, and level-three clusters. Our study included 197,958 individual women who gave birth within two years preceding each survey (**Figure 7.1**). The individual women (level-one) variables included ANC attendance during the first trimester, access to four or more ANC visits, and access to quality ANC. Quality ANC was defined as having: blood pressure measurement, urine and blood tests, iron supplementation, newborn protection against neonatal tetanus, and provision of deworming medication during the ANC visits for the last birth. Level one variables also included the number of children, mother's age at birth, duration of preceding birth interval, mother's level of education, health insurance coverage, household wealth index, and reading newspapers, watching television, or listening to the radio at least once a week. Also included in the individual women (level-one) variables were whether the pregnancy was wanted, whether permission was required to go to a health facility, and whether lack of a companion to health facility and distance to health facility were major problems to accessing care. The level-two clusters selected were areas of residence (urban-rural areas of residence), of which there were 692 clusters (**Figure 7.1**). The level-three clusters employed were the administrative states of residence in a country, of which there were 356 level-three clusters (**Figure 7.1**).
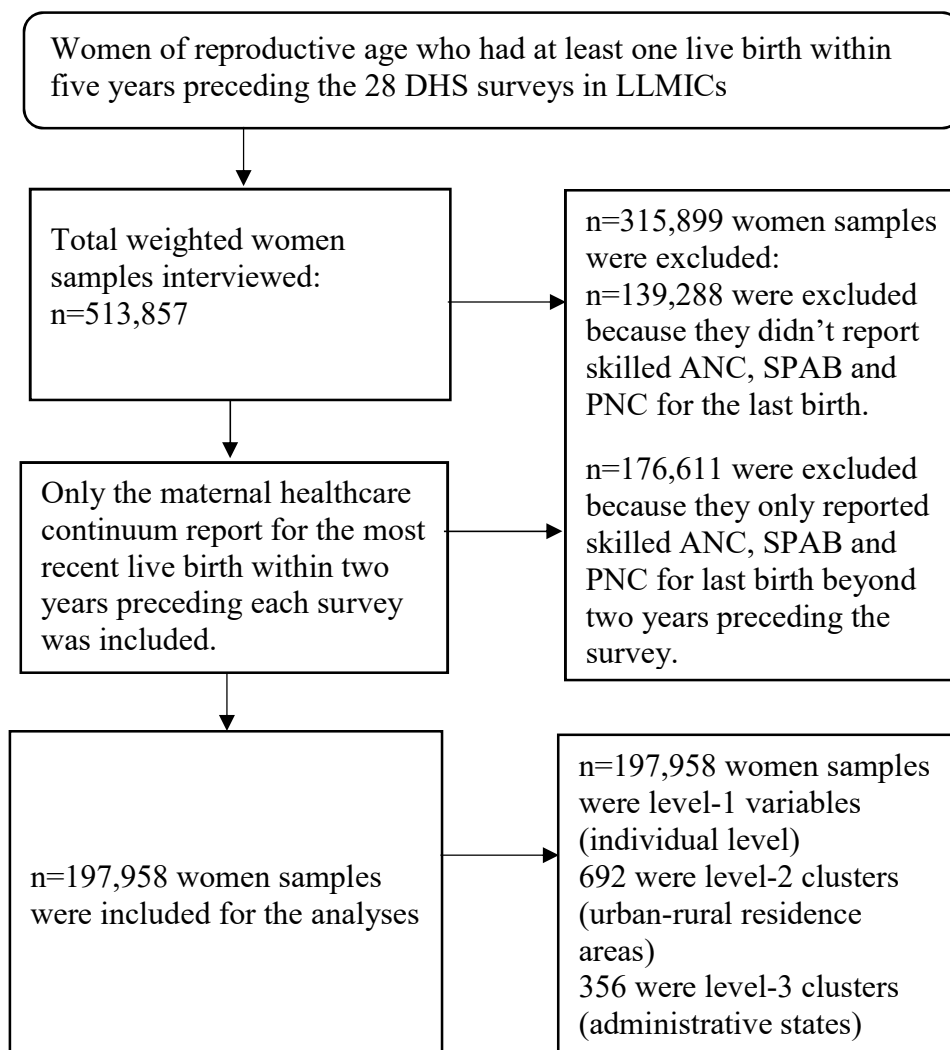
```
┌─────────────────────────────────────────────────────────────────┐
│ Women of reproductive age who had at least one live birth within │
│ five years preceding the 28 DHS surveys in LLMICs                │
└─────────────────────────────────────────────────────────────────┘
                              │
                              ▼
┌──────────────────────────┐        ┌──────────────────────────────┐
│ Total weighted women     │        │ n=315,899 women samples      │
│ samples interviewed:     │───────▶│ were excluded:               │
│ n=513,857                │        │ n=139,288 were excluded      │
│                          │        │ because they didn't report   │
│                          │        │ skilled ANC, SPAB and        │
│                          │        │ PNC for the last birth.      │
└──────────────────────────┘        │                              │
                              │      │ n=176,611 were excluded      │
                              │      │ because they only reported   │
┌──────────────────────────┐ │─────▶│ skilled ANC, SPAB and        │
│ Only the maternal health-│        │ PNC for last birth beyond    │
│ care continuum report for│        │ two years preceding the      │
│ the most recent live     │        │ survey.                      │
│ birth within two years   │        └──────────────────────────────┘
│ preceding each survey    │
│ was included.            │
└──────────────────────────┘
                              │
                              ▼
┌──────────────────────────┐        ┌──────────────────────────────┐
│                          │        │ n=197,958 women samples      │
│                          │        │ were level-1 variables       │
│                          │        │ (individual level)           │
│ n=197,958 women samples  │───────▶│ 692 were level-2 clusters    │
│ were included for the    │        │ (urban-rural residence       │
│ analyses                 │        │ areas)                       │
│                          │        │ 356 were level-3 clusters    │
│                          │        │ (administrative states)      │
└──────────────────────────┘        └──────────────────────────────┘
```

Figure 7.1 1: Schematic presentation showing included samples for the maternal healthcare continuum analyses across the 28 LLMICs' DHSs, 2016-2021.

Statistical Analyses

The distribution of the maternal healthcare continuum across the explanatory variables was examined using cross-tabulations. Excel bar graphs were used to summarise the prevalence of the maternal healthcare continuum across all study countries. Two summary measures of within and between-country wealth-related inequalities were also employed: absolute inequalities (akin to coverage differences among mothers from wealthy and poor households) using the equiplot index of inequality and relative inequalities (akin to the ratio of coverage levels for wealthy and poor mothers) using the concentration index (CIX). Pro-poor inequalities are present when the coverage of the maternal healthcare continuum decreases with increasing household wealth, and pro-rich inequalities are present when coverage of the maternal healthcare continuum increases as household wealth increases (Leventhal et al. 2021). We used equiplots to compare absolute inequality between distinct groups over

time ([WHO 2022a](#)). Equiplots present disaggregated data using circles (to show the level of intervention coverage in each subgroup) and lines (to show the gaps between subgroups), providing an illustration of inequalities ([WHO 2022a](#)).

The concentration curve and the concentration indices (CCI) were used to estimate wealth-related, between-country inequalities in the maternal healthcare continuum. If all mothers had an equal proportion of the maternal healthcare continuum irrespective of their socioeconomic status, the curve would coincide with the 45° line, indicating perfect equality in the maternal healthcare continuum ([O'Donnell et al. 2016](#); [Wagstaff et al. 2007](#)). If the concentration curve falls below the 45° line of equality, it indicates that the maternal healthcare continuum is more concentrated among the rich. The opposite is true if the curve falls above the line of equality ([O'Donnell et al. 2016](#); [Wagstaff et al. 2007](#)). The CCI ranges between −1 and +1; an index of 0 indicates equality in receiving the maternal healthcare continuum ([O'Donnell et al. 2016](#); [Wagstaff et al. 2007](#)). Positive values of CCI indicate the pro-rich distribution of the maternal healthcare continuum. In contrast, a negative index implies an uneven concentration of the maternal healthcare continuum among the poor ([O'Donnell et al. 2016](#); [Wagstaff et al. 2007](#)).

We then employed multilevel mixed-effects logistic regression analyses adjusted for administrative states across countries, urban-rural areas of residence, and sampling weights to determine the association of explanatory variables with the maternal healthcare continuum across the 28 LLMICs. A three-level model to examine predictors of the maternal healthcare continuum across the 28 LLMICs was specified: level 1 included the individual women and household factors (197,958 women samples); level 2 included the clustering (692 urban-rural residence areas); and level 3 included the administrative state in each country (356 were administrative states). Using the statistical software Stata/SE 16.1 program, all analyses employed sampling weights and were adjusted for sampling design (i.e., clustering and stratification). Results were presented with Adjusted Odds Ratio (AOR), and statistical significance was set at $p < 0.05$.

Results

Across the 28 LLMICs, 62.5% of mothers received the maternal healthcare continuum for their last birth, with mothers from Tajikistan having the highest proportion (87.1%) and mothers from Ethiopia having the lowest proportion (16.9%). Across the LLMICs, 86% of mothers received at least one skilled ANC visit, with women from Burundi and Ethiopia having the highest (99.2%) and the lowest (64.3%) proportions, respectively. Overall, 79% of mothers received skilled intrapartum care, with women from Tajikistan and Ethiopia having the highest (95.6%) and lowest (37.2%) proportions, respectively. Overall, 73.2% of mothers received maternal and/or newborn PNC services within two days of birth, with women from Tajikistan and Ethiopia having the highest (93.8%) and lowest (19.6%) proportions, respectively (**Figures 7.2-7.5**). Across the 28 LLMICs, after receiving at least one skilled ANC visit, there was a greater dropout rate in the care continuum between childbirth and postpartum 19,792 (10%) than the dropout rate between pregnancy and childbirth 18,284 (9.24%) (**Table 7.1**).
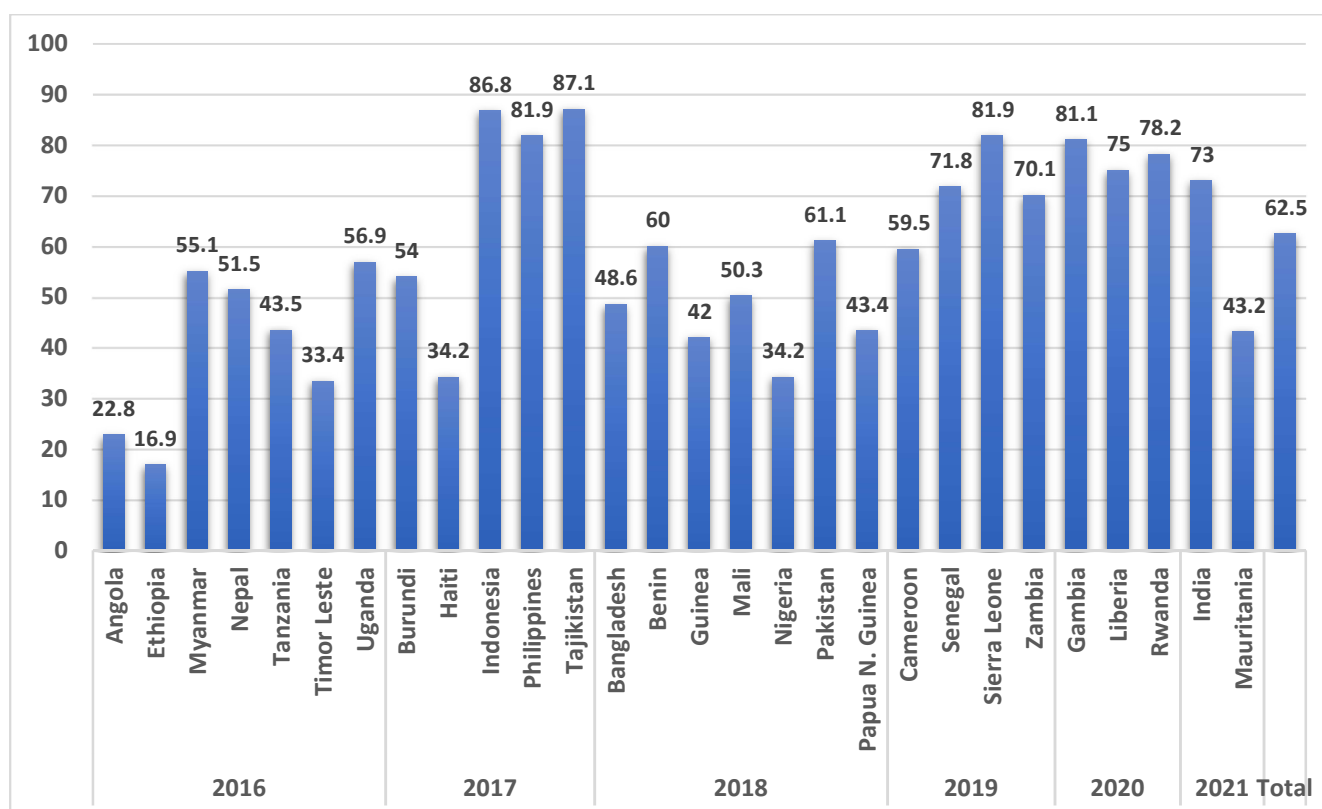

Figure 7.2 1: The percentage of women receiving maternal healthcare across the continuum for the last birth within two years preceding the latest DHS across the 28 LLMICs (2016-21).
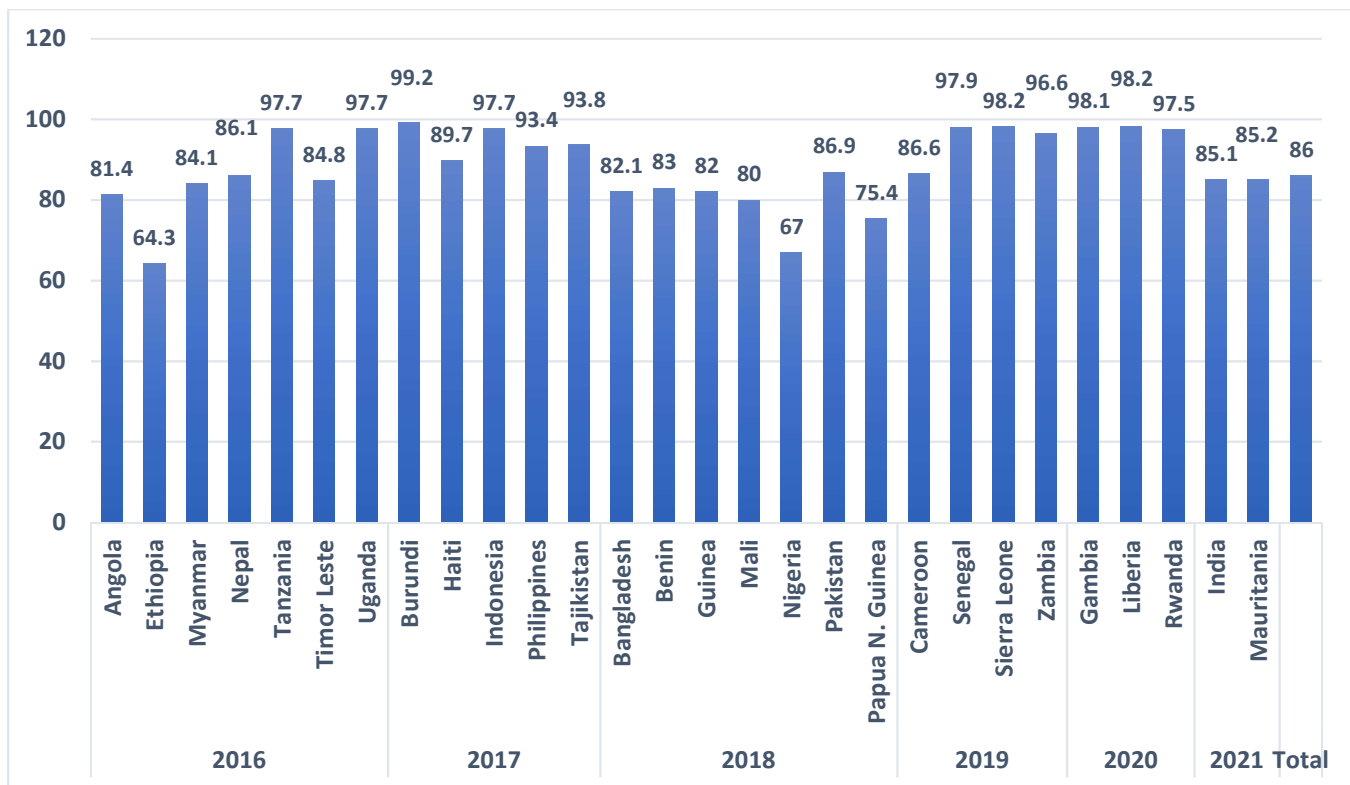
Figure 7.3 1: The proportion of women receiving at least one skilled ANC visit for the last birth within two years preceding the latest DHS across the 28 LLMICs (2016-21).
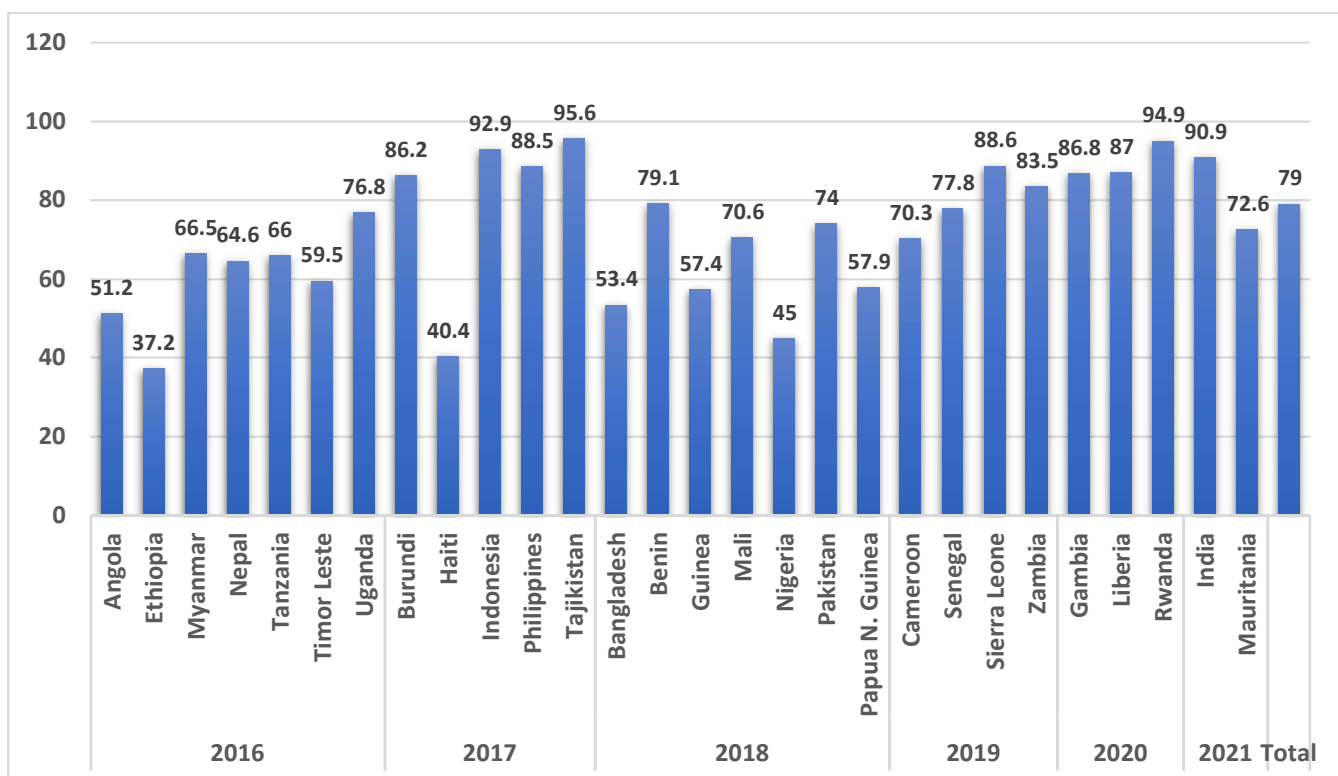

Figure 7.4 1: The proportion of women receiving skilled intrapartum care for the last birth within two years preceding the latest DHS across the 28 LLMICs (2016-21).
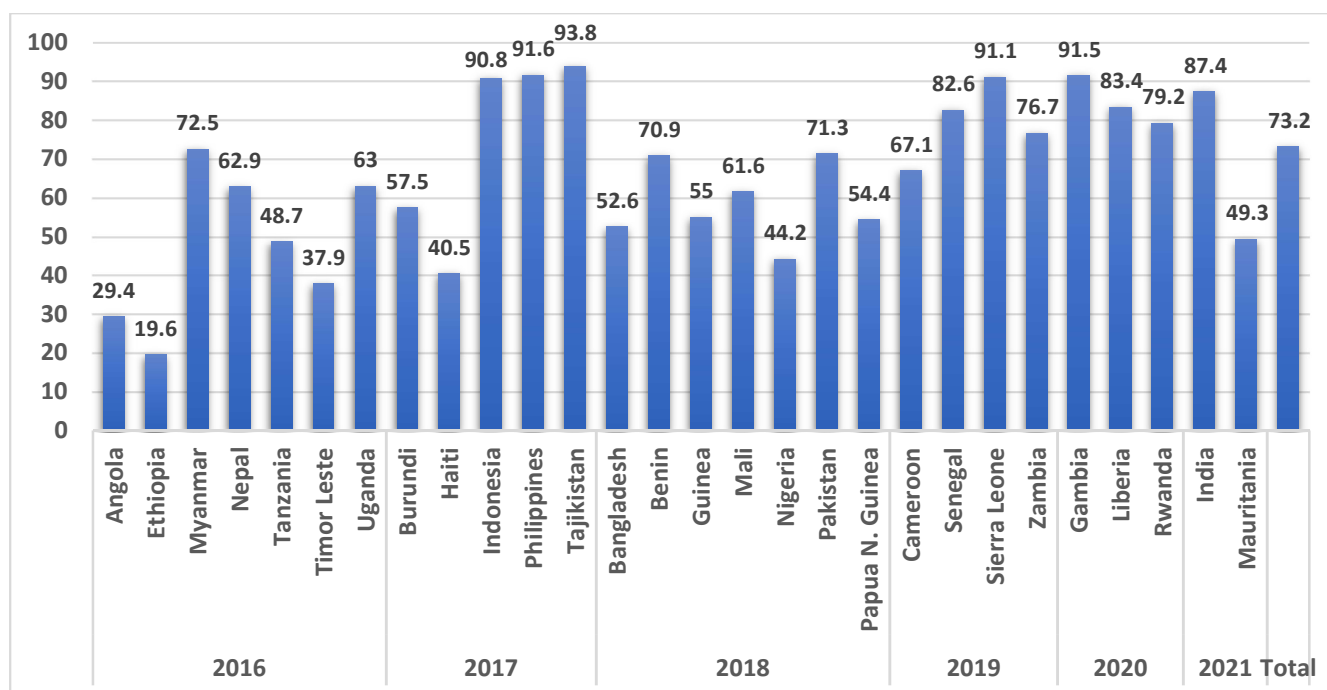
Figure 7.5 1: The proportion of women receiving maternal and/or newborn PNC within two days of the last birth within two years preceding the latest DHS across the 28 LLMICs (2016-21).

Table 7.1 1: Percent distribution of women by maternal healthcare services received during pregnancy, childbirth, and postnatal period for the last birth within two years preceding survey, LLMICs, 2016-2021 (n=197,958).

Received at least one skilled ANC visit	Received skilled intrapartum care	Received maternal and/or newborn PNC within two days of birth	Number (%)
-	-	-	12,008 (6.07)
+	-	-	18,284 (9.24)
+	+	-	19,792 (10.00)
+	+	+	123,743 (62.51)
+	-	+	8,253 (4.17)
-	+	-	3,040 (1.54)
-	-	+	2,981 (1.51)
-	+	+	9,809 (4.96)
Total			197,958 (100.00)

Among the mothers who received ANC during the first trimester, 75% received the maternal healthcare continuum, while among those who had not had ANC visits during the first trimester, only 47% received the maternal healthcare continuum. Among mothers who had received ≥4 ANC visits, 75% received the maternal healthcare continuum, while only 46% of women who had received <4 or no ANC visits received the maternal healthcare continuum. Among mothers who had received the six recommended interventions during their ANC visits, 77% received the maternal healthcare continuum, while only 65% of those who had not received all the six recommended interventions during their

ANC visits received the maternal healthcare continuum. Of the mothers from the LLMICs who had to get permission to seek medical care, only 50% received the care across the continuum. In comparison, 65% of those who did not need permission to seek medical care received care across the continuum. Only 50% of mothers who had issues accessing healthcare due to distance received the maternal healthcare continuum. In comparison, 68% of those who had no problems accessing healthcare due to distance received care across the continuum (Supplementary Table A9).
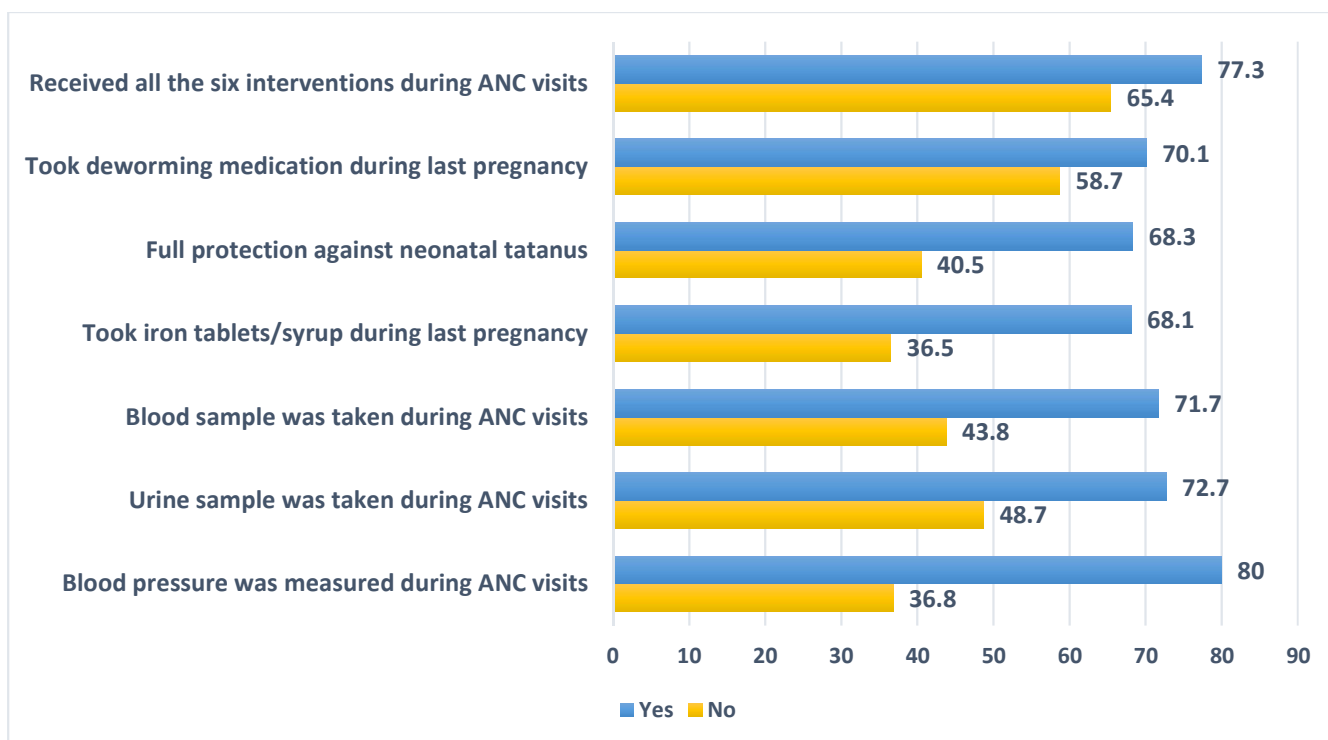
Figure 7.6 1: The proportion of women receiving the maternal healthcare continuum by the recommended interventions during pregnancy for the last birth across the 28 LLMICs (2016-2021).

Between and within all the 28 LLMICs, the inequality gaps between the maternal healthcare continuum received by mothers of different backgrounds were considerably wide, favouring mothers with secondary or above education levels, who lived in urban areas, and who were from the richest households (**Figures 7.7-7.9**). Among the LLMICs, women in Indonesia and Liberia had the highest and lowest inequality gaps between the maternal healthcare continuum received among those with no education and secondary or above level maternal education by 56.9 percentage points (pp) and 7.2 pp, respectively. In contrast, Ethiopia and Tajikistan had the highest and lowest inequality gaps between the maternal healthcare continuum received by mothers living in rural and urban areas by 37.6 pp and by 5.5 pp, respectively. Among the 28 LLMICs, Nigeria and Rwanda had the highest and lowest inequality gaps between the maternal healthcare continuum received by mothers from the poorest and richest households by 65 pp and by 13.3 pp, respectively.
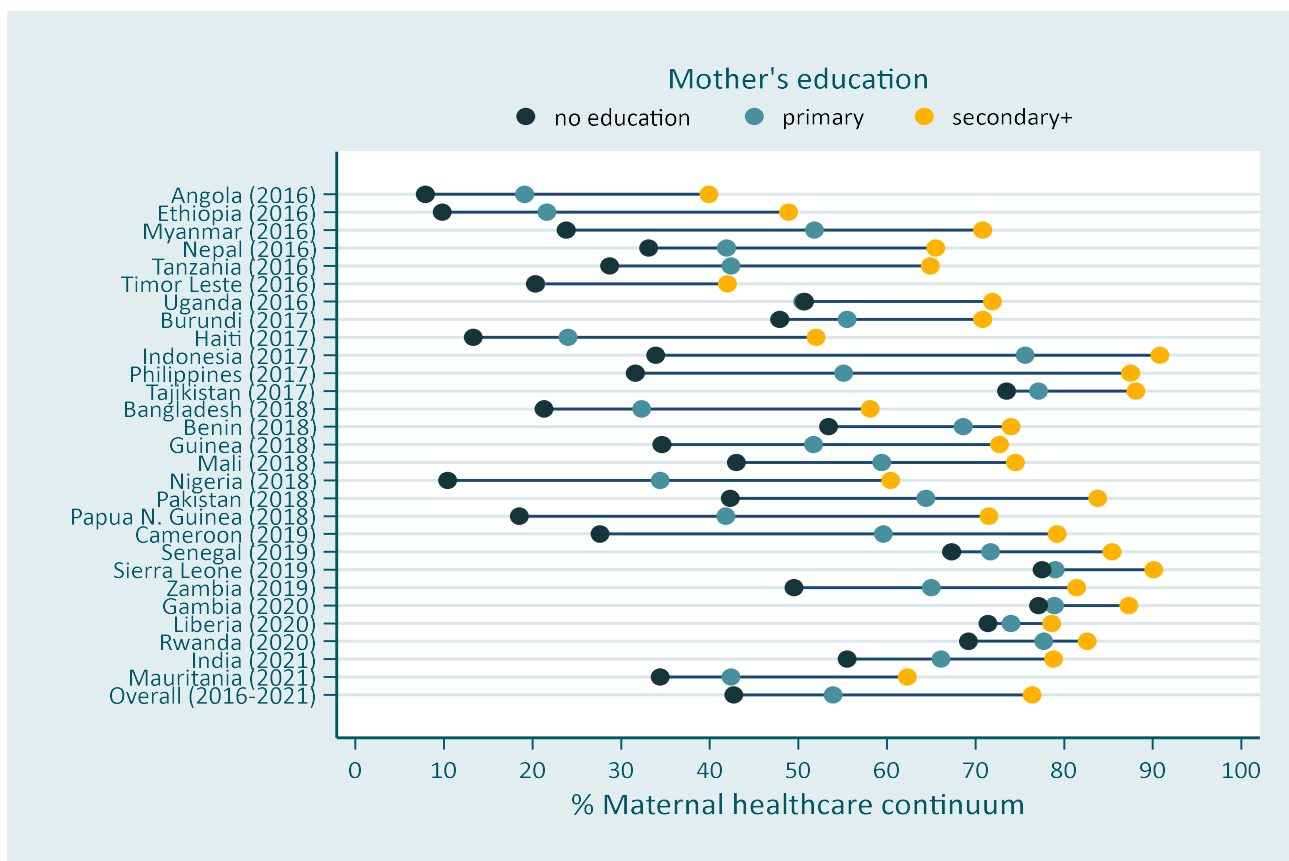

Figure 7.7 1: Equiplot-Inequality in receiving the maternal healthcare continuum by the mother's education level across the 28 LLMICS (2016-2021).
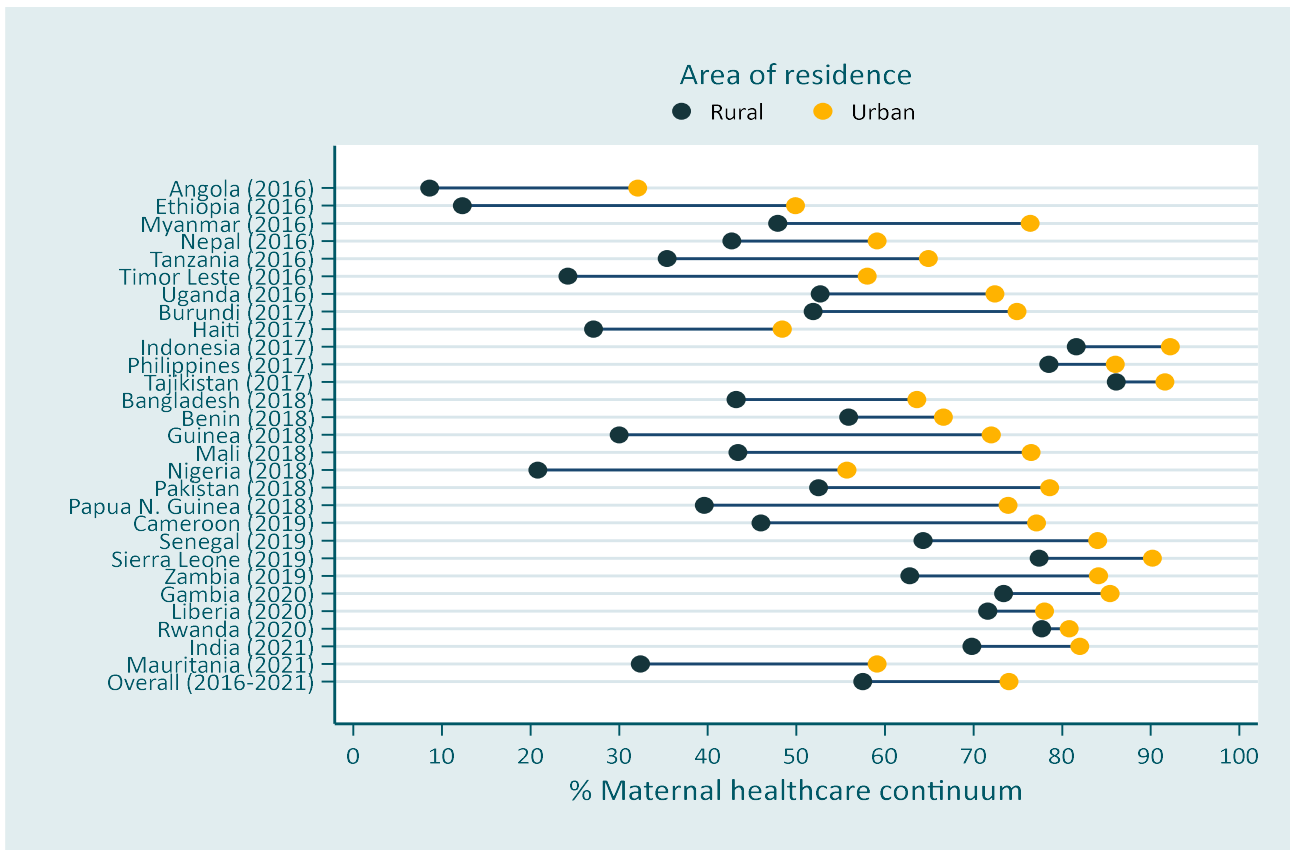
Figure 7.8 1: Equiplot-Inequality in receiving the maternal healthcare continuum by the mother's area of residence across the 28 LLMICS (2016-2021).
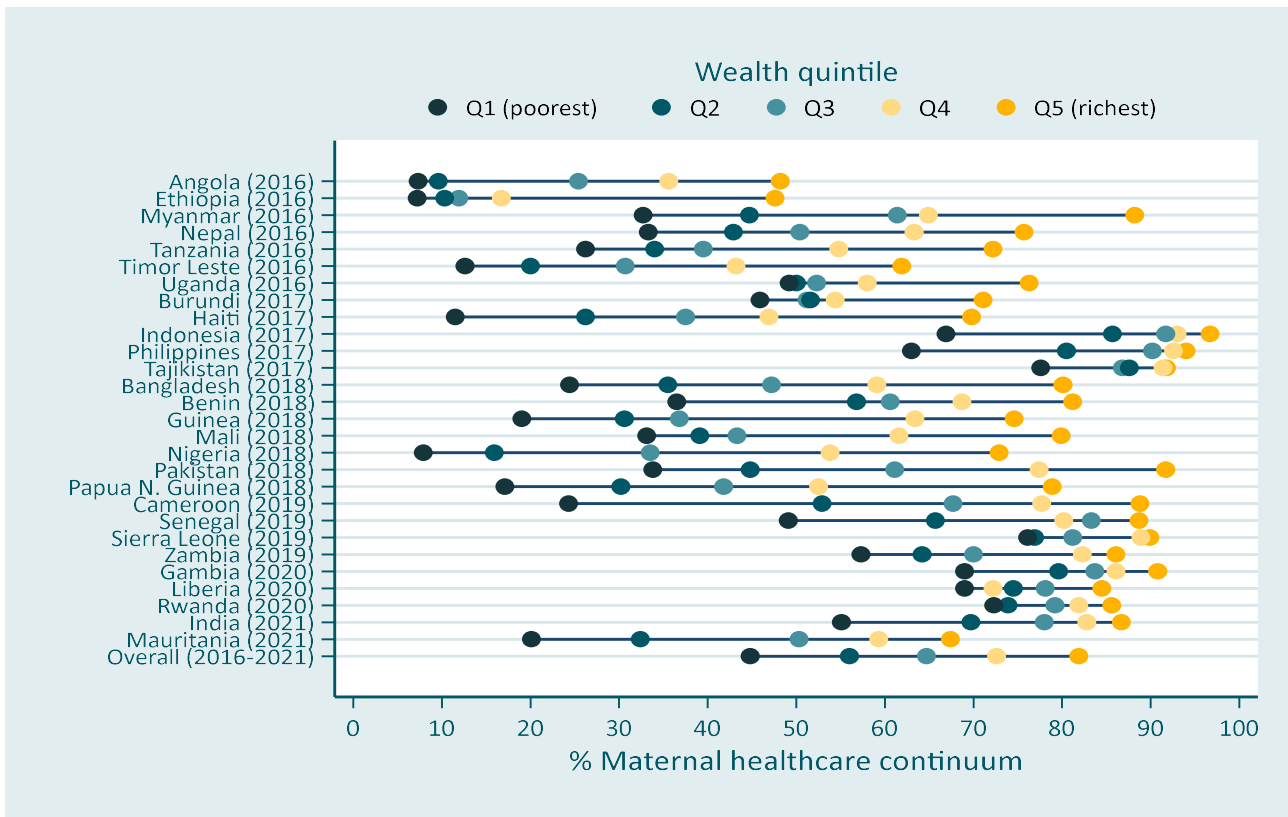
Figure 7.9 1: Equiplot-Inequality in receiving the maternal healthcare continuum by wealth quintile across the 28 LLMICS (2016-2021).

Across the 28 study countries, overall, there was a statistically significant concentration of the receipt of the maternal healthcare continuum towards mothers from the richer households with a concentration index value of 28.9 (p<0.001) (**Figure 7.10**).
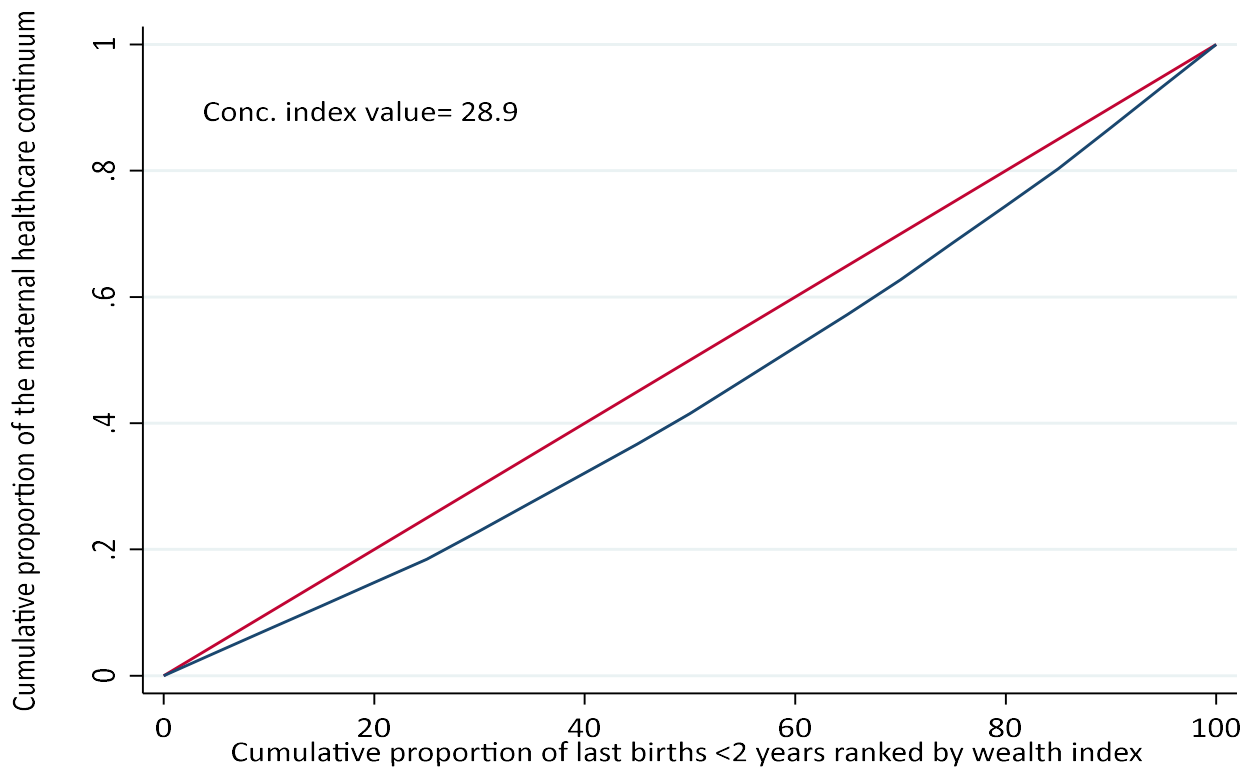
Figure 7.10 1: Concentration index and concentration curve for receiving the maternal healthcare continuum against wealth index rank, LLMICs (DHS, 2016-2021).

There was also a statistically significant concentration of the maternal healthcare continuum among the richer households across all the urban-rural areas of residence, maternal education levels, and maternal age ranges ($p<0.001$). The point estimates suggest that the degree of the pro-rich inequality is greatest in rural areas, among non-educated mothers, and among older mothers ($\geq$35 years) than those living in urban areas, mothers with a primary or above level of education, and mothers aged <35 years (**Table 7.2**).

Table 7.2 1: Concentration indices by background characteristics for receiving the maternal healthcare continuum against wealth index rank, LLMICs (DHS, 2016-2021).

Overall	Index:	No. of obs.	Index value	Robust std. error	p-value
	Erreygers norm. CI	199,335	0.28877213	0.00431608	<0.001
Area of residence: Rural	Erreygers norm. CI	144,782	0.24365678	0.00495543	<0.001
Urban	Erreygers norm. CI	54,553	0.19050827	0.00787656	<0.001
Mother's education level: No education	Erreygers norm. CI	53,924	0.19487458	0.00777563	<0.001
Primary	Erreygers norm. CI	44,102	0.16785711	.00789395	<0.001
Secondary+	Erreygers norm. CI	101,308	0.15097808	0.00447577	<0.001
Mother's age at birth: <20 yrs	Erreygers norm. CI	24,642	0.2020229	0.00955877	<0.001
20-34 yrs	Erreygers norm. CI	153,606	0.28947071	0.0044341	<0.001
35-49 yrs	Erreygers norm. CI	21,087	0.34563528	0.01018091	<0.001

Factors associated with the receipt of the maternal healthcare continuum across the 28 LLMICs

Table 7.3 presents the statistically significant factors that predict the receipt of the maternal healthcare continuum across the study countries. In terms of ANC visits, there was a greater likelihood of the receipt of the maternal healthcare continuum for mothers who: commenced their ANC visits during the first trimester (AOR=1.15; 95% CI= 1.12, 1.19); received four or more ANC visits (AOR=1.58; 95% CI= 1.53, 1.63); and received all the six recommended interventions during their ANC visits (AOR=1.48; 95% CI= 1.43, 1.54).

For the birth characteristics, the likelihood of the receipt of the maternal healthcare continuum was also greater for mothers who: gave birth to four or fewer children (AOR=1.18; 95% CI= 1.14, 1.23); whose last birth was at least four years after the preceding birth (AOR= 1.13; 95% CI= 1.08, 1.18); whose last birth was when they were between 35-49 years (AOR= 1.28; 95% CI= 1.17, 1.39), or between 20-34 years (AOR= 1.16; 95% CI= 1.08, 1.25); and whose last birth was resulted from a wanted pregnancy (AOR= 1.08; 95% CI= 1.04, 1.11).

In terms of access, there was a decreased likelihood of the receipt of the maternal healthcare continuum for mothers who: had to get permission to seek medical care (AOR= 0.88; 95% CI= 0.85, 0.92); reported that a lack of companionship to travel to healthcare facilities affected their access to care

(AOR= 0.95; 95% CI= 0.92, 0.99); and reported that a long distance to a health facility affected their access to care (AOR= 0.86; 95% CI= 0.83, 0.89).

For demographic characteristics, the likelihood of the receipt of the maternal healthcare continuum was also greater with: increasing levels of mother's education (primary education: AOR= 1.17; 95% CI= 1.12, 1.22, secondary and above education: AOR= 1.57; 95% CI= 1.51, 1.64); increasing household wealth indices (the poorer fifth: AOR= 1.37; 95%CI= 1.32, 1.42, the middle: AOR= 1.67; 95%CI= 1.60, 1.74, the richer: AOR= 2.07; 95%CI= 1.97, 2.17, and wealthiest fifth quintile: AOR= 3.03; 95%CI= 2.84, 3.22); exposure to mass media at least once a week (AOR= 1.15; 95% CI= 1.03, 1.29); and healthcare insurance (AOR= 1.19; 95% CI= 1.13, 1.25).

Table 7.3 1: Determinants of the receipt of the maternal healthcare continuum by mothers for the most recent live births within two years preceding the survey during the SDG's era (2016-2021) in 28 LLMICs (n =197,958).

Study variables	Total number of women (%)	Maternal healthcare continuum (%)	Unadjusted Odds Ratio (95% C.I.)	p-value	*Adjusted Odds Ratio (95%CI)	p-value
First trimester ANC						
No	89,808 (45.4)	42,502 (47.3)	1.00		1.00	
Yes	108,150 (54.6)	81,241 (75.1)	3.36 (3.30, 3.42)	<0.001	1.15 (1.12, 1.19)	<0.001
4+ANC visits						
No	82,422 (41.6)	37,529 (45.5)	1.00		1.00	
Yes	115,536 (58.4)	86,215 (74.6)	3.52 (3.45. 3.59)	<0.001	1.58 (1.53, 1.63)	<0.001
Received quality ANC						
No	136,508 (75.4)	89,251 (65.4)	1.00		1.00	
Yes	44,613 (24.6)	34,492 (77.3)	1.80 (1.76, 1.85)	<0.001	1.48 (1.43, 1.54)	<0.001
Parity						
≥5	32,028 (16.4)	13,474 (42.1)	1.00		1.00	
1-4	163,392 (83.6)	108,592 (66.5)	2.73 (2.66, 2.80)	<0.001	1.18 (1.14, 1.23)	<0.001
Preceding birth interval						
<2 years	27,951 (20.5)	15,671 (56.1)	1.00		1.00	
Two years	41,523 (30.5)	22,051 (53.1)	0.89 (0.86, 0.91)	<0.001	0.98 (0.94, 1.01)	0.217
Three years	26,619 (19.5)	15,075 (56.6)	1.02 (0.99, 1.06)	0.184	1.01 (0.97, 1.06)	0.658
4+ years	40,248 (29.5)	26,330 (65.4)	1.48 (1.44, 1.53)	<0.001	1.13 (1.08, 1.18)	<0.001
Mother's age at birth (full years) <20	25,095 (12.7)	14,592 (58.2)	1.00		1.00	
20-34	152,752 (77.2)	98,150 (64.3)	1.29 (1.26, 1.33)	<0.001	1.16 (1.08, 1.25)	<0.001
35-49	20,111 (10.2)	11,002 (54.7)	0.87 (0.84, 0.90)	<0.001	1.28 (1.17, 1.39)	<0.001
The pregnancy was an intended No	37,859 (19.1)	20,959 (55.4)	1.00		1.00	
Yes	160,033 (80.9)	102,767 (64.2)	1.45 (1.41, 1.48)	<0.001	1.08 (1.04, 1.11)	<0.001
Mother had to get permission to go to a healthcare facility No	163,314 (82.5)	106,578 (65.3)	1.00		1.00	
Yes	34,582 (17.5)	17,141 (49.6)	0.52 (0.51, 0.54)	<0.001	0.88 (0.85, 0.92)	<0.001

Lack of companion to a healthcare facility is the problem to access care						
No	151,043 (76.3)	99,678 (66.0)	1.00		1.00	
Yes	46,847 (23.7)	24,042 (51.3)	0.54 (0.53, 0.55)	<0.001	0.95 (0.92, 0.99)	0.019
Distance to a healthcare facility is a problem in accessing care No	134,312 (67.9)	91,736 (68.3)	1.00		1.00	
Yes	63,580 (32.1)	31,982 (50.3)	0.47 (0.46, 0.48)	<0.001	0.86 (0.83, 0.89)	<0.001
Mother reads newspapers, watches T.V., or listens to the radio at least once a week						
No	193,673 (97.8)	120,514 (62.2)	1.00		1.00	
Yes	4,285 (2.2)	3,230 (75.4)	1.86 (1.73, 1.99)	<0.001	1.15 (1.03, 1.29)	0.013
Mother has healthcare insurance No	168,394 (85.1)	100,350 (59.6)	1.00		1.00	
Yes	29,565 (14.9)	23,393 (79.1)	2.57 (2.50, 2.65)	<0.001	1.19 (1.13, 1.25)	<0.001
Mother's education						
No education	52,643 (26.6)	22,465 (42.7)	1.00		1.00	
Primary (1-8)	43,239 (21.8)	23,292 (53.9)	1.57 (1.53, 1.61)	<0.001	1.17 (1.12, 1.22)	<0.001
Secondary+	102,074 (51.6)	77,986 (76.4)	4.35 (4.25, 4.45)	<0.001	1.57 (1.51, 1.64)	<0.001
Household's wealth index						
Poorest	45,696 (23.1)	20,464 (44.8)	1.00		1.00	
Poorer	42,775 (21.6)	23,941 (56.0)	1.57 (1.53, 1.61)	<0.001	1.37 (1.32, 1.42)	<0.001
Middle	39,847 (20.1)	25,765 (64.7)	2.26 (2.19, 2.32)	<0.001	1.67 (1.60, 1.74)	<0.001
Richer	37,211 (18.8)	27,011 (72.6)	3.27 (3.17, 3.36)	<0.001	2.07 (1.97, 2.17)	<0.001
Richest	32,429 (16.4)	26,562 (81.9)	5.58 (5.40, 5.77)	<0.001	3.03 (2.84, 3.22)	<0.001

* Odds ratio adjusted for all study variables listed in the table.

Discussion

Five of every eight mothers across the 28 LLMICs received maternal healthcare across the continuum, with substantial attrition along the care continuum from ANC to skilled intrapartum care and maternal and/or newborn PNC services. This is higher than the pooled estimates of a previous study (six years ago) conducted in sub-Saharan Africa (14%) and South Asia (25%) (Singh, Story & Moran 2016), and the pooled estimates of a recent study conducted in sub-Saharan Africa (25%) (Alem, Shitu & Alamneh 2022). Our findings are in line with a study conducted based on Cambodia DHS 2010 data in 2013 (60%) (Wang & Hong 2013b). The distribution of the receipt of maternal healthcare across the continuum among the study countries greatly varies. Between and within all the 28 LLMICs, the inequality gaps between the maternal healthcare continuum received by mothers: with no education and secondary or above education levels, who were living in urban areas and those who were living in rural areas, and who were from the poorest households and those from the richest households were considerably wide, favouring mothers with secondary or above education levels, who lived in urban areas, and who were from the richest households. Across the 28 LLMICs, the degree of the pro-richer households inequality in receiving maternal care across the continuum was greatest in rural areas, among the non-educated mothers, and among older mothers (≥35 years) than those living in urban areas, mothers with a primary or above levels of education, and mothers aged <35. Mother's socio-demographic characteristics and prenatal care indicators are significantly associated with receiving maternal care across the continuum across the 28 study countries.

Our study revealed that commencing ANC early (during the first trimester) and having four or more ANC visits significantly improved the likelihood of receiving the maternal healthcare continuum across the 28 study countries. The early and more frequently a mother seeks care during pregnancy, the more she receives the recommended interventions during pregnancy intended to improve maternal and newborn health outcomes, and the better her healthcare-seeking behaviour during the whole pregnancy, delivery, and postpartum will be. This is also likely to increase the demand for subsequent care along the maternal care continuum. A multi-country analysis of the latest DHS data from 32 sub-Saharan African countries showed that women who commenced ANC visits after twelve weeks of gestation had lower odds of receiving the maternal healthcare continuum than those who initiated ANC visits during the first trimester. In addition, a study based on the latest DHS data from nine sub-Saharan Africa and South Asia countries revealed that four or more ANC visits play a pivotal role in mothers' receiving maternal healthcare across the continuum (Alem, Shitu & Alamneh 2022; Singh, Story & Moran 2016). In our study, receiving all the six recommended interventions during ANC visits was significantly associated with higher retention in the maternal healthcare continuum across the 28

LLMICs. This might be because receiving quality care during ANC visits increases healthcare-seeking behaviour and encourages an increased demand for subsequent care along the continuum. A study based on the Cambodia 2010 DHS data by Wang et al. [2013] showed that the receipt by mothers of quality ANC affected their subsequent use of skilled intrapartum care and PNC (Wang & Hong 2013b). A study based on DHS data from 28 African countries conducted by Chukwuma et al. [2017] also showed that the odds of retention in SBA were higher among ANC clients that had their blood pressure checked, received information about pregnancy complications, had blood tests conducted, received at least one tetanus injection, and had urine tests conducted (Chukwuma et al. 2017).

We found that mothers whose last births had less than five birth orders, had a longer preceding birth interval (≥4 years), and resulted from an intended pregnancy were associated with higher odds of receiving maternal healthcare across the continuum. In comparison, teenage mothers were less likely to receive maternal healthcare across the continuum. Having fewer children (lower birth orders), and longer birth intervals before the last birth might have enabled mothers to have sufficient resources to seek care along the maternal care continuum. A study from Gambia based on DHS 2013 data indicated that having a child with birth order of less than five had a significant and positive association with receiving maternal healthcare across the continuum (Oh et al. 2020). Another study from India also revealed that the receipt of maternal healthcare across the continuum was observed more among parity-one women (James, Mishra & Pallikadavath 2022). Unintended pregnancy might negatively affect the woman's decision to seek timely care along the maternal care continuum. The lower odds of receiving the maternal healthcare continuum among teenage mothers might be due to the providers' lack of knowledge about vulnerable groups of women and their associated judgmental attitudes, particularly towards unmarried teenagers. A teenage mother's emotional or intellectual immaturity, low education, or inexperience could also hinder seeking optimal care along the maternal care continuum. Therefore, it is necessary to provide teenage-friendly care services to teenage mothers along the continuum from pregnancy to delivery and postpartum. A study based on the latest DHSs data from 32 sub-Saharan African showed that mothers aged 24-49 years at the last birth and the birth being as a result of wanted pregnancy were associated with higher odds of receiving maternal healthcare across the continuum than mothers aged 15-24 years at the last birth and the birth as a result of unintended pregnancy (Alem, Shitu & Alamneh 2022). However, risks of maternal and foetal complications are more likely among teenage mothers than in other age groups, and lower utilization by teenagers of care across the continuum is particularly problematic (Azevedo et al. 2015; Cavazos-Rehg et al. 2015).

The abuse and discriminatory treatment of women and the lack of social and economic empowerment negatively affect the health of mothers and their newborns. In agreement with previous studies (Alem,

Shitu & Alamneh 2022; Singh, Story & Moran 2016), our study revealed that women who lack autonomy in deciding to seek healthcare had lower odds of receiving maternal healthcare across the continuum. Women need emotional, psychological, and practical support from a companion of their choice when seeking care at health facilities. In our study, women who lack companionship to health facilities when seeking care were less likely to receive maternal healthcare across the continuum. Companions of their choice can help mothers navigate potential verbal or physical abuse, non-consented medical procedures, or poor communication while seeking care at health facilities (Balde et al. 2020). Consistent with other studies, we found that women who considered the long distance required to travel to a health facility as a problem in accessing healthcare were less likely to receive maternal healthcare across the continuum (Alem, Shitu & Alamneh 2022; Negero et al. 2018). Physical access to healthcare within a reasonable distance is a universal human right (WHO 2017).

Exposure to media can be a powerful tool to reach all women of varying socioeconomic statuses in disseminating organized and deliberate messages about the importance of receiving essential maternal healthcare services and interventions. In our study, women exposed to mass media (reading newspapers, watching television, or listening to the radio) at least once a week had higher odds of receiving maternal healthcare across the continuum than those not exposed to mass media. A study based on recent DHSs data from 32 sub-Saharan African countries showed that having mass media exposure had a significant and positive association with the completion of the maternal healthcare continuum (Alem, Shitu & Alamneh 2022). We also observed that women with healthcare insurance were more likely to receive maternal healthcare across the continuum than those without insurance. Consistent with our findings, a previous study in thirty low- and middle-income countries based on the latest DHS data showed that health care insurance has contributed to the significantly increased use of maternal health care services (Wang, Temsah & Mallick 2014), while a recent study in India also revealed that the health care insurance is the most significant contributor to the better utilization of full ANC services and institutional delivery at the national level and hindrances in accessing them (Ali et al. 2020).

Education empowers women and girls and reduces gender inequality(Solar & Irwin 2010). Quality education and gender equity are key Sustainable Development Goals (UN SDGs 2022). In our study, improvements in receiving maternal healthcare across the continuum were in line with the increase in the level of the mother's education. Education creates increased awareness and knowledge about maternal health services that can improve the receipt of quality healthcare and women's desire to use health services (Kea et al. 2018; Say & Raine 2007). A recent study based on 32 DHS data from sub-Saharan African countries has also indicated that the increments in the odds of completing the maternal healthcare continuum were consistent with the increase in the level of the mother's education (Alem,

Shitu & Alamneh 2022). In alignment with the findings of other studies, we also found that increases in the receipt of maternal healthcare along the continuum were consistent with the increases in the mother's household wealth index level (Bobo et al. 2021; Singh, Story & Moran 2016).

The strengths of our study include the use of large sample sizes involving multiple nationally representative population-based surveys collected across 28 low-and lower-middle-income countries. Our study comprehensively analyzed the distribution, within- and between countries socio-demographic inequalities in, and determinants of the receipt of the maternal healthcare continuum across the 28 study countries. To decrease the risk of recall bias, we also restricted our study to mothers who gave their last birth within two years preceding the survey. However, the study also has several limitations. The study shares the limitations of a cross-sectional study design, which makes it difficult to demonstrate cause-and-effect relationships. The mother reported the responses to the survey questionnaire with regard to her most recent live birth within two years preceding the survey, with potential recall bias and lack of ability to identify between the different care providers (e.g., doctors, nurses). We used the most recent data available from the DHSs, which dates back to 2016 for some countries, and there may be differences in the current rates for some countries.

Conclusions

Five of every eight mothers across the 28 LLMICs received care across the maternal healthcare continuum, with substantial attrition along the care continuum from ANC to skilled intrapartum care and PNC services. Across the 28 study countries, we found significant pro-rich inequalities in receiving the maternal healthcare continuum. Mothers with higher education levels who lived in urban areas and were from richer households were more likely to receive care across the continuum. Women living in rural areas, non-educated mothers, and older mothers ($\geq$35 years) than those living in urban areas, with a primary or above education level, and those aged <35 years were less likely to receive care across the continuum. Interventions are required to improve maternal care for vulnerable population subgroups (less educated, poor, rural residing, and teenage and older mothers).

Commencing ANC during the first trimester, having $\geq$4 ANC visits, receiving quality ANC during the pregnancy, exposure to mass media at least once a week, having healthcare insurance, higher level of maternal education, and higher household wealth index were associated with the higher odds of receiving care across the continuum in the 28 study countries. In addition, lower birth orders (<5), longer preceding birth intervals ($\geq$4 years), and an intended pregnancy significantly improved the likelihood of receiving the maternal healthcare continuum. In contrast, teenage mothers were less likely to receive care across the continuum. Women who needed permission to seek medical care and

reported a lack of companionship and longer distances to healthcare facilities as barriers to accessing care were less likely to receive healthcare across the continuum. We recommend promoting early and ≥4 ANC contacts, quality ANC services, healthcare insurance, birth spacing, reproductive health services to prevent unintended pregnancy, low parity, women's rights, and emotional support to mothers through companionship to health facilities. Additional focus should be placed on the maternal healthcare continuum of teenage mothers. Women's education and economic empowerment in LLMICs need to be progressed as per the Sustainable Development Goals.

7.1 Chapter Summary

Chapter seven revealed that the percent prevalence of maternal healthcare services across the continuum across the 28 LLMICs was 63%, but with substantial attrition along the care continuum from ANC to intrapartum care and PNC services and disproportionately wider inequality among women and countries, favouring those from advantageous sub-populations. In addition, early and ≥4 ANC visits, healthcare insurance, mass media access, quality ANC, lower parity, birth spacing, and planned pregnancy were positive predictors of women's use of maternal healthcare services across the continuum. In contrast, teenage mothers, women who had no autonomy in deciding on their own's healthcare and needed permission, and those who reported a lack of companionship and reported longer distances as barriers to receiving care were less likely to use the care continuum. The study also had several limitations. The cross-sectional study design makes it difficult to demonstrate causal associations. It might also be difficult for mothers to identify between the different care providers (e.g., doctors and nurses). In the next chapter, we present a study of women's use of quality maternal healthcare services across the continuum throughout pregnancy, childbirth and postnatal, and its key predictors in 19 LLMICs for last birth within five years preceding the latest DHSs.

Chapter 8: Women's use of quality maternal healthcare services across the continuum in 19 low and lower-middle-income countries: A multilevel analysis.

This chapter investigates the percent prevalence, determinants, and between-country socio-demographic inequalities of the receipt by women of the eighteen WHO-recommended maternal healthcare interventions across the care continuum throughout pregnancy, childbirth, and postpartum for the last birth within five years preceding the latest DHSs across 19 LLMICs. The study is currently under review in the journal Health Policy and Planning.

Negero, M.G., Sibbritt, D. & Dawson, A. Women's use of quality maternal healthcare services across the continuum in 19 low and lower-middle-income countries: A multilevel analysis. HEAPOL-2022-Jun-0370.

Abstract

Background

To reduce maternal and neonatal morbidity and mortality substantially, and move towards the elimination of the preventable causes of maternal and neonatal death, increased coverage of maternal healthcare services should be accompanied by improved quality throughout the continuum of care. In the Sustainable Development Goals era, the World Health Organization envisions a world where every pregnant woman and her newborn receives quality care throughout the pregnancy, childbirth, and postnatal period. This study examined the prevalence, between-country socio-demographic inequalities, and predictors of receiving quality maternal healthcare across the continuum in low- and lower-middle-income countries (LLMICs).

Methods

We used the latest demographic and health survey data from 19 LLMICs (2016-2021). We employed equiplot, concentration curve, concentration index, and slope index of inequality to measure the between-country socio-demographic inequalities in receiving maternal healthcare quality across the continuum. We fitted a multilevel mixed-effects logistic regression model to determine predictors of the receipt of maternal healthcare quality across the continuum. The analyses employed sampling weights and were adjusted for sampling design.

Results

Only one of every twelve mothers and/or their newborns (8.2%) received all the recommended interventions across the care continuum. Between the 19 LLMICs, there were considerably wide gaps in receiving maternal healthcare quality across the continuum between population subgroups, favouring mothers with higher education levels, who lived in urban areas, those aged 20-34 years at birth, and those from richer households. There was a statistically significant concentration of the receipt of maternal healthcare quality across the continuum towards mothers from richer households. Along the quality of care continuum, dropouts occurred more between pregnancy and childbirth than between childbirth and postpartum.

Commencing ANC during the first trimester, exposure to mass media at least once a week, having healthcare insurance, a higher maternal education level, and a higher household wealth index were associated with higher odds of receiving maternal healthcare quality across the continuum. In addition, lower birth orders (<5), longer preceding birth intervals (≥2 years), and an intended pregnancy significantly improved the likelihood of receiving maternal healthcare quality across the continuum.

In contrast, women who had to get permission to seek medical care and reported a lack of companionship to healthcare facilities as barriers to accessing care were less likely to receive quality maternal healthcare across the continuum.

Conclusions

We recommend promoting early ANC contacts, provision of recommended interventions during childbirth, early initiation of breastfeeding, healthcare insurance, birth spacing, reproductive health services to prevent unintended pregnancy, low parity, women's rights, and emotional support to mothers through companionship to health facilities. Women's education and economic empowerment in LLMICs should progress as per the Sustainable Development Goals.

Background

The global efforts over the past two decades to reduce the adverse outcomes of pregnancy and childbirth have been directed at increasing skilled birth attendance (Campbell, Graham & Lancet Maternal Survival Series steering 2006; Ki-Moon 2010). This has resulted in higher rates of skilled birth attendance and health facility birth in all the World Health Organization (WHO) regions (World Health Statistics 2021). Globally, based on data from 2014-2020, 83% of births were assisted by skilled personnel, including medical doctors, nurses, and midwives: an increase of about 30% compared to 2000-2006 (World Health Statistics 2021). With the increasing utilisation of health services, a higher proportion of avoidable maternal and perinatal morbidity and mortality have moved to health facilities. In low-income countries, the 2030 Sustainable Development Goals (SDG) targets to decrease the maternal mortality ratio to less than 70 per 100,000 live births and the neonatal mortality rate to less than 12 per 1000 live births, which requires a rapid improvement in maternal healthcare quality. Avoidable maternal and perinatal morbidity and mortality are attributed mainly to the poor quality of care received during pregnancy, childbirth, and the postnatal period at health facilities (Tunçalp et al. 2015b). To reduce maternal and neonatal mortality substantially and move towards the elimination of the preventable causes of maternal and newborn death, increased coverage of maternal healthcare services should be accompanied by improved quality throughout the continuum of care (Campbell, Graham & Lancet Maternal Survival Series steering 2006). Evidence-based practices and care have consistently proved the increment in the demand for care and better outcome (Asefa & Bekele 2015a; Owili et al. 2017; Spector et al. 2012). In the SDGs era, the WHO envisions a world where every pregnant woman and newborn receives quality care throughout the pregnancy, childbirth, and postnatal period (Tunçalp et al. 2015b; WHO 2014a, 2015b, 2016c, 2022d; World Health Organization 2018). To end preventable maternal and newborn morbidity and mortality, every pregnant woman and newborn needs skilled care during pregnancy, childbirth, and postnatal period birth with evidence-based interventions delivered across the continuum in a humane, supportive environment (Tunçalp et al. 2015b).

Maternal healthcare quality across the continuum is an integrated and continuous care package with evidence-based interventions delivered over the pregnancy, birth, and postnatal periods (Kerber et al. 2007b).

During pregnancy, quality antenatal care (ANC) involves nutritional counselling, multivitamin and mineral supplementation, adequate visits with skilled personnel, blood and urine tests, preventive antibiotics, tetanus toxoid injections, an ultrasound scan, and health education on pregnancy and birth danger signs, and common physiological symptoms (WHO 2016c).

Quality intrapartum care (IPC) involves: respectful care, clear and compelling communication between the mother and health workers, the option of a companion during labour and childbirth, routine assessment of fetal well-being on labour admission (auscultation), digital vaginal examination, health facility birth attended by skilled personnel, appropriate pain relief strategies, mobility in labour where possible, and choice of birth position, the use of uterotonics and delayed cord clamping (after a minute), immediate kangaroo care and breastfeeding, delayed bathing of the newborn (24 h), uterine tonus assessment, and the care of mother and newborn in a health facility for at least 24 h after birth (World Health Organization 2018).

Quality postnatal care (PNC) includes immediate PNC within 24 hours of birth for the mother and newborn and at least three additional postnatal contacts are recommended for healthy women and newborns, between 48 and 72 hours, between 7 and 14 days, and during week six after birth, physiological assessment of the woman, local cooling for perineal pain relief, appropriate pain relief strategies and postpartum breast engorgement, prevention of postpartum constipation, screening for and prevention of postpartum depression and anxiety, postpartum contraception, assessment of the newborn for danger signs and abnormalities, sleeping position for the prevention of sudden infant death syndrome, newborn immunization, exclusive breastfeeding, home visits during the first week after birth by skilled personnel (WHO 2022d). We could not find previous studies investigating maternal healthcare quality across the continuum across multiple countries. Analyses of Kenya's Service Provision Assessment (SPA) data showed that healthcare facility characteristics had significant associations with the quality of initial assessment during delivery and postpartum care, while the provider's characteristics became more critical in providing quality delivery care services. Furthermore, the quality of the initial assessment during delivery was positively associated with the quality of delivery care and that of newborn and immediate postnatal care services (Owili et al. 2017). The analyses of DHSs data from 28 African countries revealed a statistically significant and positive association between receiving all the recommended interventions/services during ANC and the retention in skilled personnel-assisted birth (Chukwuma et al. 2017).

We undertook a study using the latest nationally representative DHSs data from 19 LLMICs collected during the first six years of the Sustainable Development Goals (SDGs) implementation era (2016-2021) to measure the prevalence of quality maternal healthcare across the continuum received and its predictors to provide evidence for policymakers, healthcare providers and researchers in LLMICs to assess implementation fidelity, plan services, allocate resources and execute to improve maternal and newborn health outcomes.

Methods

Data source and study design

We undertook a secondary analysis of data from the most recent DHSs, conducted between 2016 and 2021, in 19 countries from LLMICs. According to the World Bank Country and Lending Groups' Classification 2019–2020 (World Bank 2019). The data for the study were extracted from the children's recode file (K.R. file) of the individual countries upon permission from the DHS program website. The DHSs of the 19 countries were chosen because they contain the necessary indicators to calculate the outcome variable and its potential explanatory variables. The respective DHS data were collected during the first six years of implementation of the SDGs era (2016-2021), thus allowing us to evaluate progress over time in maternal healthcare quality across the continuum. The DHS is a nationally representative cross-sectional survey undertaken in more than 85 low- and middle-income countries since 1984. The DHS contains information on household characteristics, reproductive health, women's and children's health, nutrition, and mortality, whose data are publicly available with no identifying information (Corsi et al. 2012). The DHS uses a multi-stage cluster sampling technique to select women of reproductive age (15–49 years) and children younger than five years for inclusion (Corsi et al. 2012).

Variables

Outcome variable

The outcome variable in this study was quality maternal healthcare across the continuum. A mother who received the eighteen recommended interventions during pregnancy, childbirth, and the postnatal period for the last birth within five years preceding the survey: at least one skilled ANC visit, four or more ANC visits, blood pressure measurement, urine and blood tests, iron supplementation, and newborn protection against neonatal tetanus during pregnancy (WHO 2016c); health facility birth, skilled intrapartum care, newborn weighed at birth, newborn's put to the breast within one hour of birth, and child's put on mother's bare skin immediately after birth during childbirth (World Health Organization 2018); and maternal and/or newborn PNC within two days of birth, maternal PNC within 24 hrs of birth, newborn PNC within 24 hrs of birth, stayed in a health facility for at least 24 hours, health provider counselled mother on newborn's health danger signs and health provider counselled mother on breastfeeding during the postnatal period (WHO 2022d), was considered to have received maternal healthcare quality across the continuum (**Figure 8.1**).
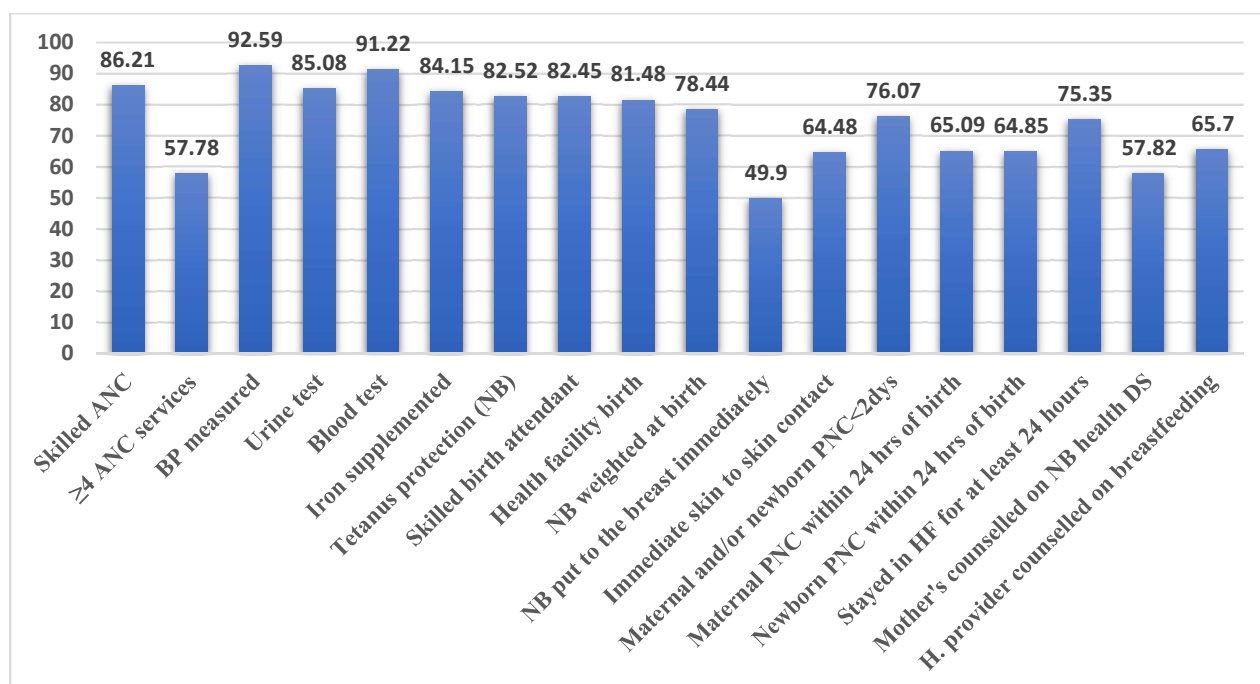
Figure 8.1 1: The percentage of women receiving the recommended interventions during ANC care, intrapartum care and postnatal care services for their last birth within five years preceding the survey across the 19 LLMICs (2016-21).

At least one skilled ANC visit is defined as the maternal healthcare services or interventions a mother receives during pregnancy, during one or more rounds of visits from skilled personnel for a positive pregnancy experience. Skilled intrapartum care is defined as the provision of care during labour and delivery by competent health professionals (Croft et al. 2018; WHO 2018a). A mother and/or her newborn whose health was checked postpartum by a healthcare provider at a health facility or at home before or after discharge from a health facility or after home delivery within two days of birth is considered to have received the maternal and/or newborn PNC.

Explanatory variables

The explanatory variables included in this study were selected based on their significant associations with maternal healthcare quality across the continuum based on the literature (Singh, Story & Moran 2016; Tunçalp et al. 2015b; Wang & Hong 2013b) and their availability in the DHS dataset.

This study included ten explanatory variables. These variables were classified into individual women (level-one) variables, level-two clusters, and level-three clusters. The study included 296,581 individual women who gave their last birth within five years preceding each survey (**Figure 8.2**). The individual women (level-one) variables included ANC attendance during the first trimester, the number of children, duration of preceding birth interval, mother's level of education, health insurance coverage, household wealth index, and reading newspapers, watching television, or listening to the radio at least

once a week. Also included in the individual women (level-one) variables were whether the pregnancy was wanted, whether permission was required to go to a health facility, and whether lack of a companion to a health facility were a major problem to accessing care. The level-two clusters selected were areas of residence (urban-rural areas), of which there were 38 clusters (**Figure 8.2**). The level-three clusters employed were the countries, of which there were 19 level-three clusters (**Figure 8.2**).

```
┌────────────────────────────────────────────────────────────┐
│ Women of reproductive age who had at least one live birth   │
│ within five years preceding the 19 DHS surveys in LLMICs.   │
└────────────────────────────────────────────────────────────┘
```

```
┌──────────────────────────┐         ┌──────────────────────────┐
│ Total weighted women     │         │ n=110,447 women samples  │
│ samples interviewed:     │ ──────► │ were excluded because    │
│ n=407,028.               │         │ they didn't report the   │
└──────────────────────────┘         │ recommended              │
                                      │ interventions during ANC,│
┌──────────────────────────┐         │ intrapartum care and PNC │
│ Only the maternal        │         │ services for the last    │
│ healthcare quality across│ ──────► │ birth.                   │
│ the continuum report for │         └──────────────────────────┘
│ the most recent live     │
│ birth within five years  │
│ preceding the survey was │
│ included.                │
└──────────────────────────┘

┌──────────────────────────┐         ┌──────────────────────────┐
│                          │         │ n=296,581 women samples  │
│                          │         │ were level-1 variables   │
│                          │         │ (individual level);      │
│ n=296,581 women samples  │ ──────► │ 38 were level-2 clusters │
│ were included for the    │         │ (urban-rural area of     │
│ analyses.                │         │ residence);              │
│                          │         │ and 19 were level-3      │
│                          │         │ clusters (country)       │
└──────────────────────────┘         └──────────────────────────┘
```

Figure 8.2 1: Schematic presentation showing the included samples for the women's use of quality maternal healthcare services across the continuum analyses across the 19 LLMICs' DHSs, 2016-2021.

Statistical Analyses

The distribution of maternal healthcare quality across the continuum across the explanatory variables was examined using cross-tabulations. Excel bar graphs were used to summarise the prevalence of maternal healthcare quality across the continuum across all study countries. A summary measure of between-country wealth-related inequalities were also employed: relative inequalities (akin to the ratio of coverage levels for wealthy and poor mothers) using the concentration index (CIX). Pro-poor inequalities are present when the coverage of maternal healthcare quality across the continuum decreases with increasing household wealth, and pro-rich inequalities are present when coverage of the maternal healthcare continuum increases as household wealth increases (Leventhal et al. 2021). The concentration curve and concentration index (CCI) were used to estimate wealth-related, between-country inequalities in maternal healthcare quality across the continuum. If all mothers had an equal proportion of maternal healthcare quality across the continuum irrespective of their socioeconomic status, the curve would coincide with the 45° line, indicating perfect equality in the maternal healthcare continuum (O'Donnell et al. 2016; Wagstaff et al. 2007). If the concentration curve falls below the 45° line of equality, it indicates that maternal healthcare quality across the continuum is more concentrated among the rich. The opposite is true if the curve falls above the line of equality (O'Donnell et al. 2016; Wagstaff et al. 2007). The CCI ranges between −1 and +1; an index of 0 indicates equality in receiving maternal healthcare quality across the continuum (O'Donnell et al. 2016; Wagstaff et al. 2007). Positive values of CCI indicate the pro-rich distribution of maternal healthcare quality across the continuum. In contrast, a negative index implies an uneven concentration of maternal healthcare quality across the continuum among the poor (O'Donnell et al. 2016; Wagstaff et al. 2007).

We then employed multilevel mixed-effects logistic regression analyses adjusted for countries, urban-rural areas of residence, and sampling weights to determine the association of explanatory variables with maternal healthcare quality across the continuum across the 19 LLMICs. A three-level model to examine predictors of maternal healthcare quality across the continuum across the 19 LLMICs was specified: level 1 included the individual women and household factors (296,581 women samples); level 2 included the clustering (38 urban-rural residence areas); and level 3 included the countries (19 countries). Using the statistical software Stata/SE 16.1 program, all analyses employed sampling weights and were adjusted for sampling design (i.e., clustering and stratification). Results were presented with Adjusted Odds Ratio (AOR), and statistical significance was set at p<0.05.

Results

Across the 19 study countries, only 24,207 (8.2%) mothers received all the recommended 18 interventions during pregnancy, childbirth, and postnatal for their last birth, with mothers from India having the highest proportion: 20,745 (11.9%) and mothers from Burundi having the lowest proportion: 5 (0.05%) (**Figure 8.3**). Across these LLMICs, 117,991 (39.8%) women received all the seven recommended interventions during pregnancy, with women from Liberia and Burundi having the highest 2,652 (65.9%) and the lowest 505 (5.7%) proportions, respectively (**Figure 8.4**). Overall, 82,504 (27.8%) women received the five recommended interventions during childbirth for their last birth, with women from Rwanda and Ethiopia having the highest: 4,211 (66.8%) and lowest: 604 (8.0%) proportions, respectively (**Figure 8.5**). Across the 19 study countries, 95,356 (32.2%) mothers received the six recommended interventions during the postnatal for their last birth within five years preceding the survey, with women from India and Ethiopia having the highest: 79,741 (45.6%) and lowest: 86 (1.1%) proportions, respectively (**Figure 8.6**).
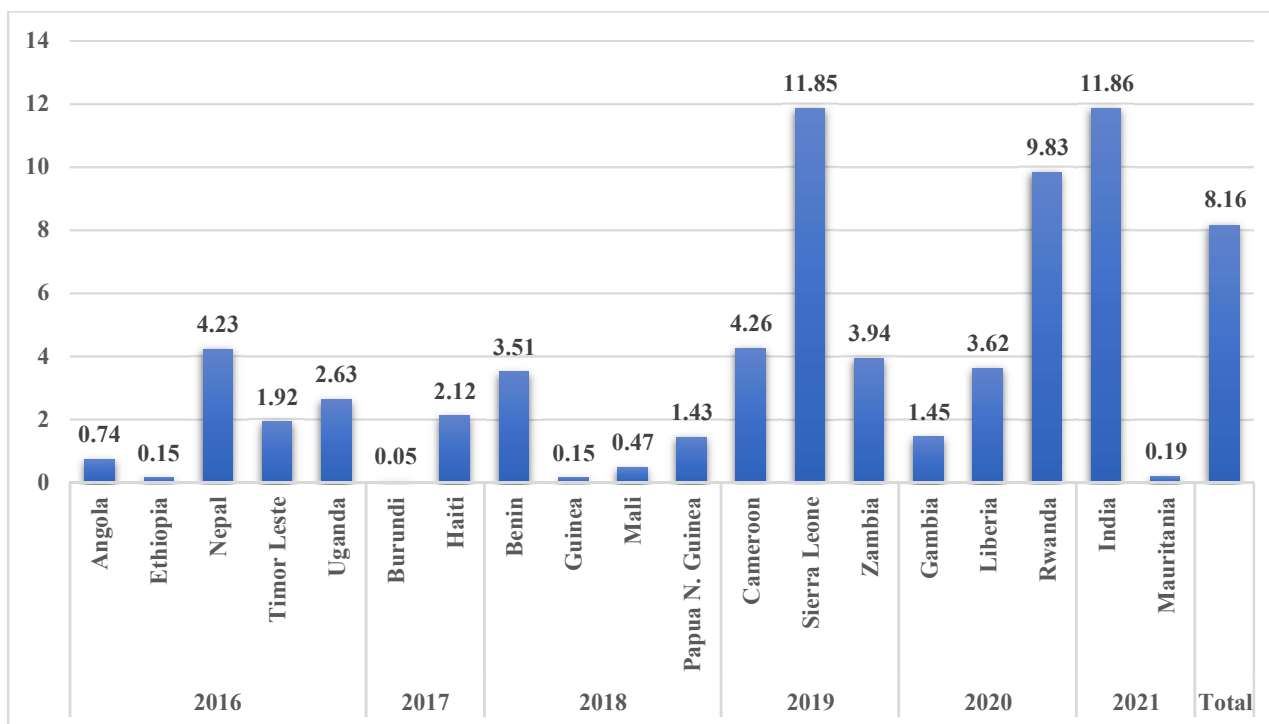
Figure 8.3 1: The percentage of women receiving maternal healthcare quality across the continuum for their last birth within five years preceding the survey across the 19 LLMICs (2016-21).
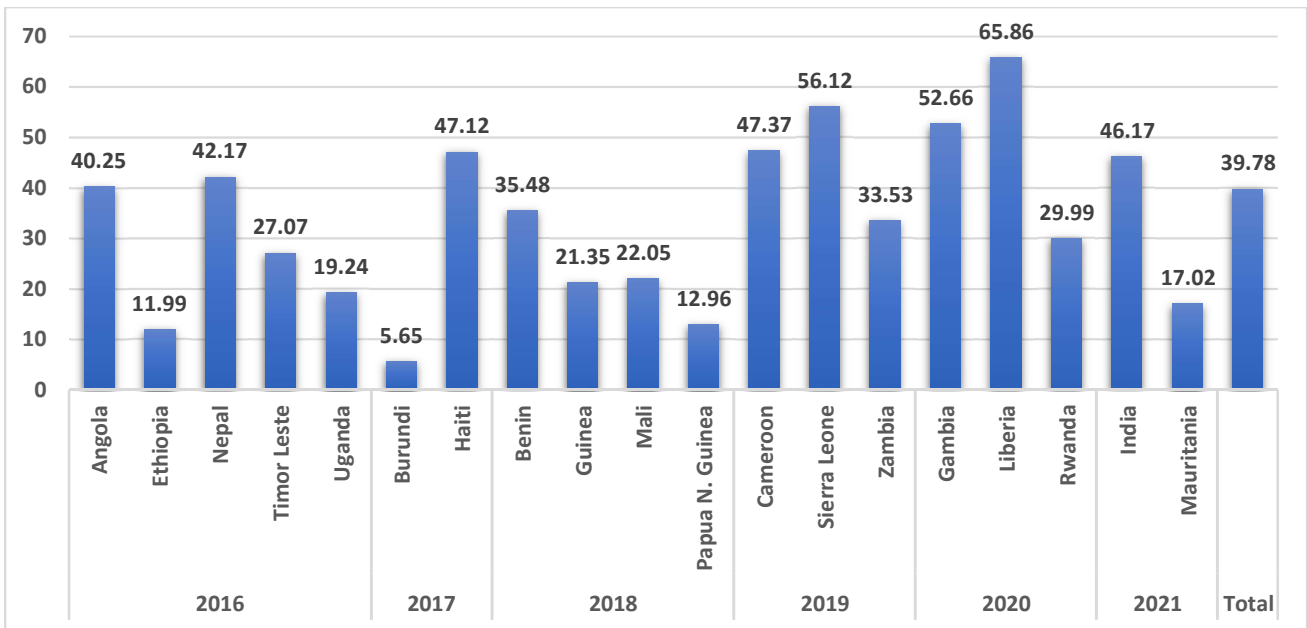
Figure 8.4 1: The percentage of women receiving the seven recommended interventions during ANC for their last birth within five years preceding the survey across the 19 LLMICs (2016-21).
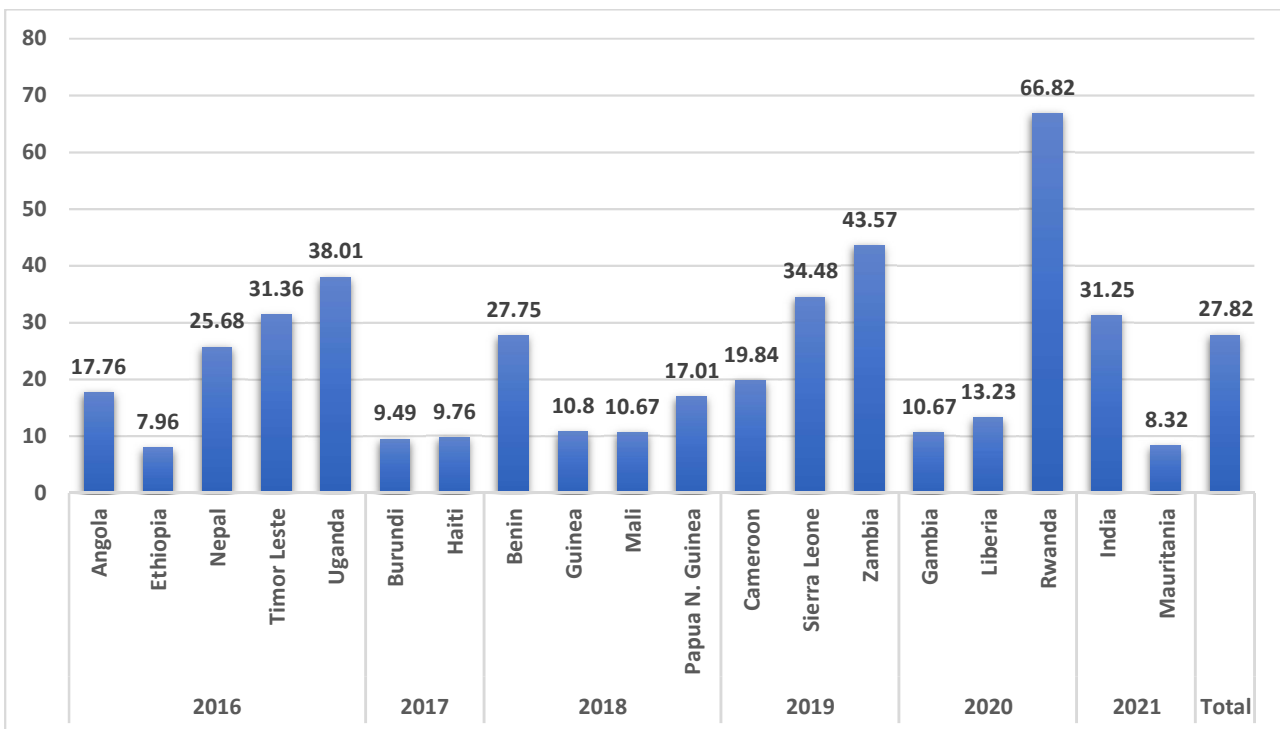
Figure 8.5 1: The percentage of women receiving the five recommended interventions during intrapartum care for their last birth within five years preceding the survey across the 19 LLMICs (2016-21).
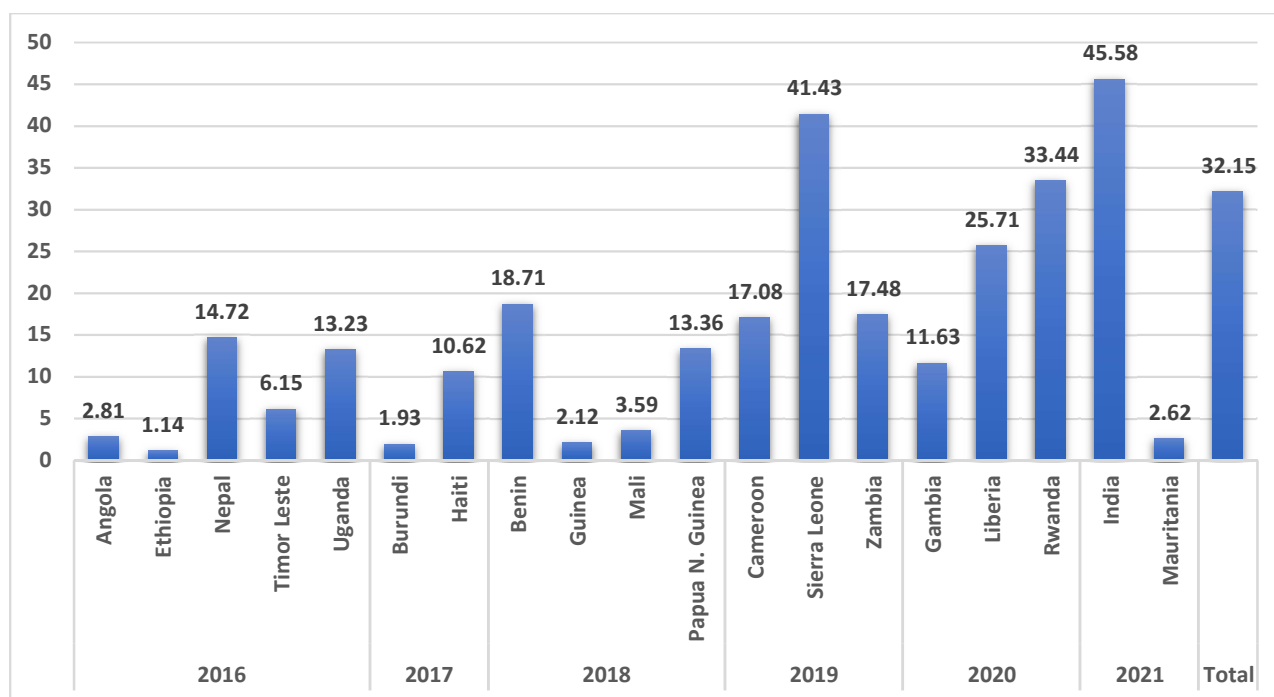
Figure 8.6 1: The percentage of women receiving the six recommended interventions during postnatal care for their last birth within five years preceding the survey across the 19 LLMICs (2016-21).

Across the 19 study countries, 43,877 (14.8%) women received all the recommended interventions during pregnancy but not during childbirth or postpartum, while 18,714 (6.3%) women received all the recommended interventions during pregnancy and childbirth but not during postpartum (Supplementary Table A10 and **Table 8.1**). Overall, 31,194 (10.5%) women received all the recommended interventions during pregnancy and postpartum, but not during childbirth; 14,751 (5.0%) women received all the recommended interventions during childbirth and postpartum, but not during pregnancy; 24,832 (8.4%) women received all the recommended interventions during childbirth, but not during pregnancy or postpartum; 25,204 (8.5%) women received all the recommended interventions during postpartum, but not during pregnancy or childbirth, and113,803 (38.4%) women received none of all the recommended interventions during pregnancy, childbirth or postpartum (Supplementary Table A10 and **Table 8.1**). Except for women in Rwanda and Zambia, in all other countries, along the care continuum from pregnancy to postpartum for receiving all the recommended interventions, the dropout between pregnancy and childbirth is more than the dropout between childbirth and postpartum, while the dropouts for women in Rwanda and Zambia in receiving all the recommended interventions across the continuum is more between childbirth and postpartum than between pregnancy and childbirth (Supplementary Table A10).

Across the 19 study countries, while 117,992 (40%) women received all the recommended interventions during pregnancy, 75,071 (26%) did not continue on the pathway to receive all the

recommended interventions during childbirth. In other words, 42,921 (14%) women who received all the recommended interventions during pregnancy also received all the recommended interventions during childbirth. After delivery, another 43,546 (15%) women did not go on to receive all the recommended interventions during postnatal (Supplementary Table A10 **and Table 8.1**).

Table 8.1 1: Percentage of women by the recommended interventions received during pregnancy, childbirth, and postnatal period for the most recent birth within five years preceding the survey, LLMICs 2016-2021.

Received all the seven recommended interventions during ANC	Received all the five recommended interventions during the intrapartum care	Received all the six recommended interventions during PNC	Number (%)
-	-	-	113,803 (38.37)
+	-	-	43,877 (14.79)
+	+	-	18,714 (6.31)
+	+	+	24,207 (8.16)
+	-	+	31,194 (10.52)
-	+	-	24,832 (8.37)
-	-	+	25,204 (8.50)
-	+	+	14,751 (4.97)
Total			296,581 (100)

Note: + Received the service; - Did not receive the service.

Across the 19 study countries, the receipt by mothers and/or their newborns of all the recommended interventions across the continuum varies between population subgroups. There was a common pattern of higher coverage among advantaged groups (educated, urban, and richer women), except for the early initiation of breastfeeding (within one hour of birth), where women with lower or no education and living in rural areas had higher coverages than women with higher education or living in urban areas (**Figures 8.7-8.10**). In addition, teenage mothers and mothers of advanced age (≥35 years) had lower coverage of the recommended interventions during pregnancy, childbirth, postpartum, or all the recommended interventions across the continuum (Figures 10). Health facility birth had the highest significant pro-rich inequality. In contrast, early initiation of breastfeeding (within one hour of birth) had the lowest significant pro-rich inequality ($p<0.001$) (**Figure 8.10**).
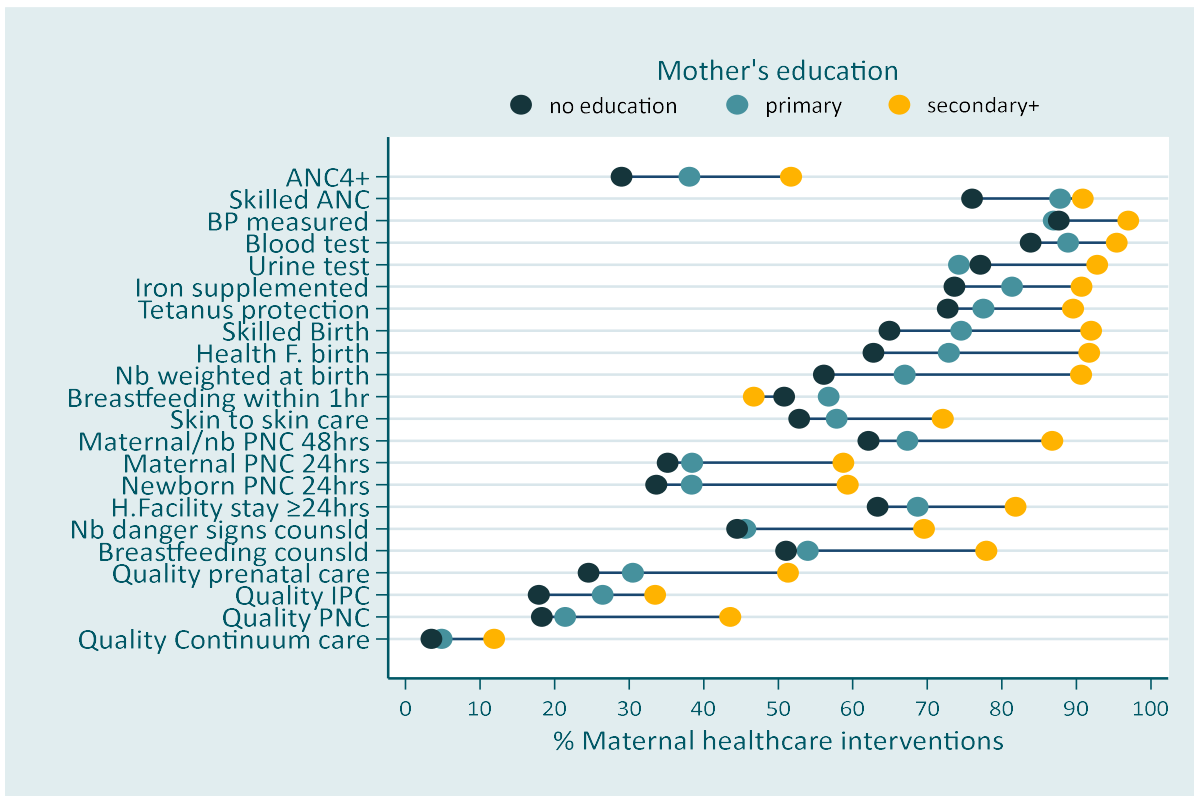
Figure 8.7 1: Equiplot-Inequality in receiving maternal healthcare interventions across the continuum by the mother's education level across the 19 LLMICS (2016-2021).
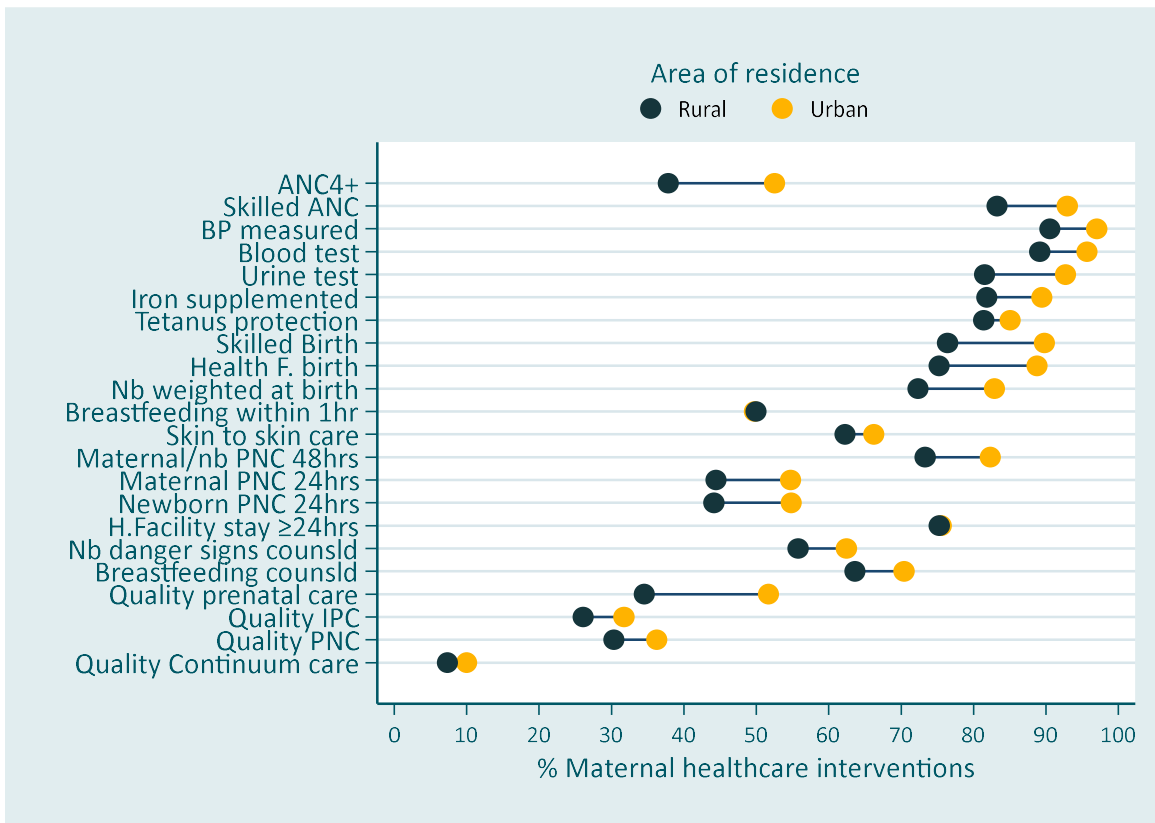
Figure 8.8 1: Equiplot-Inequality in receiving maternal healthcare interventions across the continuum by the mother's area of residence across the 19 LLMICS (2016-2021).
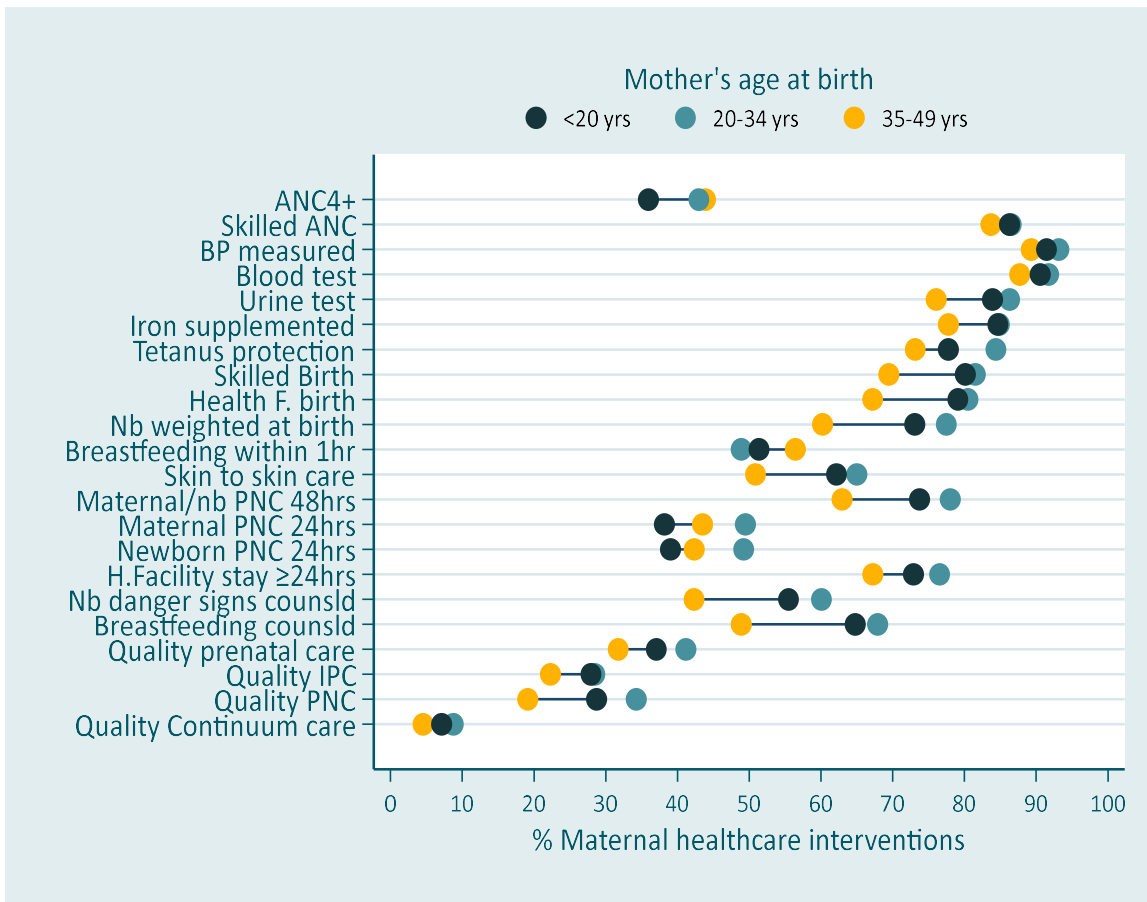
Figure 8.9 1: Equiplot-Inequality in receiving maternal healthcare interventions across the continuum by the mother's age at birth across the 19 LLMICS (2016-2021).

Figure 8.10 1: Equiplot-Inequality in receiving maternal healthcare interventions across the continuum by wealth quintile across the 19 LLMICS (2016-2021).

Overall, across the 19 study countries, there was a statistically significant concentration of the receipt of quality maternal healthcare across the continuum towards mothers from the richer households with a concentration index value of 17.3 (p<0.001) (**Figure 8.11**).

Figure 8.11 1: Concentration index and concentration curve for receiving the maternal healthcare quality across the continuum against wealth index rank, LLMICs (DHS, 2016-2021).

Table 8.2 shows the receipt of quality maternal healthcare across the continuum using characteristics for selected variables in the 19 LLMICs. Of mothers who commenced ANC during the first trimester, 20,011 (11.5%) received quality maternal healthcare across the continuum, while only 4,196 (3.4%) of those who did not commence ANC during the first trimester received quality maternal healthcare across the continuum.

Among mothers with lower birth orders (≤4 children), 22,962 (9.2%) received maternal healthcare quality across the continuum for the last birth, while among those with higher birth orders (≥5 children), only 1,244 (2.7%) received quality maternal healthcare across the continuum. Among mothers with longer preceding birth intervals (≥2 years), 12,125 (7.4%) received quality maternal healthcare across the continuum, while among those with shorter preceding birth intervals (<2 years), only 3,023 (6.8%) received quality maternal healthcare across the continuum. Among mothers whose last birth was due to a wanted pregnancy, 22,149 (9.1%) received quality maternal healthcare across

the continuum, while among those with the last birth due to unintended pregnancy, only 2,058 (3.9%) received quality maternal healthcare across the continuum.

Among women who had to get permission to seek medical care, only 2,517 (4.8%) received quality maternal healthcare across the continuum, while 21,690 (8.9%) of those who did not need permission to seek medical care received quality maternal healthcare across the continuum. Among mothers who reported the lack of companionship to healthcare facilities as a barrier to accessing care, 3,353 (5.2%) received quality maternal healthcare across the continuum, while among those who did not consider lack of companionship as a barrier to accessing care, 20,854 (9.0%) received quality maternal healthcare across the continuum.

Among women exposed to mass media at least once a week, 23,565 (8.1%) received quality maternal healthcare across the continuum. In contrast, among those who were not exposed to mass media at least once a week, only 641 (10.3%) received quality maternal healthcare across the continuum. Among women with healthcare insurance, 6,488 (12.5%) received quality maternal healthcare across the continuum, while among those without healthcare insurance, 17,719 (7.2%) received quality maternal healthcare across the continuum. Among women with no formal education, only 2,766 (3.5%) received quality maternal healthcare across the continuum. In contrast, among those with secondary or above education levels, 18,455 (11.9%) received quality maternal healthcare across the continuum. Among women from the poorest households, only 2,998 (4.6%) received quality maternal healthcare across the continuum. In contrast, among those from the richest households, 5,960 (11.4%) received quality maternal healthcare across the continuum.

Differentials in receiving maternal healthcare quality across the continuum in the 19 LLMICs

Table 8.2 presents the statistically significant factors that predict the receipt of maternal healthcare quality across the continuum for the 19 study countries. Regarding ANC visits, there was a greater likelihood of receiving maternal healthcare quality across the continuum for mothers who commenced their ANC visits during the first trimester (AOR=2.37; 95% CI= 2.27, 2.48).

For the birth characteristics, the likelihood of receiving quality maternal healthcare across the continuum was also greater for mothers who: gave birth to four or fewer children (AOR=1.22; 95% CI= 1.15, 1.31); whose last birth was at least two years after the preceding birth (AOR= 1.10; 95% CI= 1.06, 1.15); and whose last birth was resulted from a wanted pregnancy (AOR= 1.32; 95% CI= 1.25, 1.40).

In terms of access, there was a decreased likelihood of the receipt of quality maternal healthcare across the continuum for mothers who: had to get permission to seek medical care (AOR= 0.69; 95% CI= 0.65, 0.73); and reported that a lack of companionship to travel to healthcare facilities affected their access to care (AOR= 0.89; 95% CI= 0.85, 0.94).

For demographic characteristics, the likelihood of the receipt of quality maternal healthcare across the continuum was also greater with: increasing levels of mother's education (primary education: AOR= 1.35; 95% CI= 1.27, 1.44, secondary and above education: AOR= 1.65; 95% CI= 1.56, 1.74); increasing household wealth indices (the poorer fifth: AOR= 1.28; 95%CI= 1.20, 1.36, the middle: AOR= 1.68; 95%CI= 1.59, 1.79, the richer: AOR= 1.87; 95%CI= 1.76, 2.00, and wealthiest fifth quintile: AOR= 1.85; 95%CI= 1.72, 1.98); exposure to mass media at least once a week (AOR= 1.39; 95% CI= 1.24, 1.56); and healthcare insurance (AOR= 1.25; 95% CI= 1.20, 1.31).

Table 8.2 1: Determinants of receiving quality maternal healthcare across the continuum by mothers for their most recent live births within five years preceding the survey during the SDG's era (2016-2021) in 19 LLMICs (n = 296,581).

Study variables		Total number of women (%)	Maternal healthcare quality across the continuum (%)	Unadjusted Odds Ratio (95% C.I.)	p-value	*Adjusted Odds Ratio (95%CI)	p-value
First trimester ANC	No	121,921 (41.11)	4,196 (3.44)	1.00		1.00	
	Yes	174,660 (58.89)	20,011 (11.5)	3.63 (3.51, 3.76)	<0.001	2.37 (2.27, 2.48)	<0.001
Parity	≥5	46,792 (15.78)	1,244 (2.66)	1.00		1.00	
	1-4	249,789 (84.22)	22,962 (9.19)	3.71 (3.50, 3.93)	<0.001	1.22 (1.15, 1.31)	<0.001
Preceding birth interval	<2 years	44,730 (21.38)	3,023 (6.76)	1.00		1.00	
	≥2 years	164,449 (78.62)	12,125 (7.37)	1.10 (1.05, 1.14)	<0.001	1.10 (1.06, 1.15)	<0.001
The birth was a result of an intended pregnancy	No	53,045 (17.89)	2,058 (3.88)	1.00		1.00	
	Yes	243,457 (82.11)	22,149 (9.10)	2.48 (2.37, 2.60)	<0.001	1.32 (1.25, 1.40)	<0.001
Mother had to get permission to go to a healthcare facility	No	243,744 (82.21)	21,690 (8.90)	1.00		1.00	
	Yes	52,755 (17.79)	2,517 (4.77)	0 .51 (0.49, 0.54)	<0.001	0.69 (0.65, 0.73)	<0.001
Lack of companion to a healthcare facility is a problem in accessing care	No	232,348 (78.36)	20,854 (8.98)	1.00		1.00	
	Yes	64,147 (21.64)	3,353 (5.23)	0.56 (0.54, 0.58)	<0.001	0.89 (0.85, 0.94)	<0.001
Mother exposed to mass media at least once a week	No	290,344 (97.90)	23,565 (8.12)	1.00		1.00	
	Yes	6,237 (2.10)	641 (10.28)	1.30 (1.19, 1.41)	<0.001	1.39 (1.24, 1.56)	<0.001
Mother has healthcare insurance	No	244,718 (82.51)	17,719 (7.24)	1.00		1.00	
	Yes	51,863 (17.49)	6,488 (12.51)	1.83 (1.78, 1.89)	<0.001	1.25 (1.20, 1.31)	<0.001

Mother's education						
No education	79,930 (26.95)	2,766 (3.46)	1.00		1.00	
Primary (1-8)	61,557 (20.76)	2,986 (4.85)	1.42 (1.35, 1.50)	<0.001	1.35 (1.27, 1.44)	<0.001
Secondary+	155,094 (52.29)	18,455 (11.90)	3.77 (3.62, 3.93)	<0.001	1.65 (1.56, 1.74)	<0.001
Household's wealth index						
Poorest	65,734 (22.16)	2,998 (4.56)	1.00		1.00	
Poorer	62,235 (20.98)	4,083 (6.56)	1.47 (1.40, 1.54)	<0.001	1.28 (1.20, 1.36)	<0.001
Middle	58,798 (19.83)	5,214 (8.87)	2.04 (1.94, 2.13)	<0.001	1.68 (1.59, 1.79)	<0.001
Richer	57,624 (19.43)	5,952 (10.33)	2.41 (2.30, 2.52)	<0.001	1.87 (1.76, 2.00)	<0.001
Richest	52,190 (17.60)	5,960 (11.42)	2.70 (2.58, 2.82)	<0.001	1.85 (1.72, 1.98)	<0.001

* Odds ratio adjusted for all study variables listed in the table.

Discussion

Enhancing maternal healthcare across the continuum has become a key strategy of intervention programs to improve mothers' and newborns' health and well-being around the globe. This strategy calls for a service delivery system connecting the three components of maternal healthcare—antenatal, delivery, and postnatal care services, and quality services at each of these levels. To facilitate designing and implementing such a system in LLMICs, it is necessary to understand the uptake of quality maternal healthcare across the continuum in LLMICs. This requires including what services women receive along the pathway and what should be the focus of efforts to improve quality care across the continuum.

The research presented in this study shows that the quality care mothers and/or their newborns received across the continuum from pregnancy to the postpartum period in LLMICs was low. Only one of every twelve mothers and/or their newborns (8.2%) received all the recommended interventions across the care continuum from pregnancy to childbirth and postpartum in LLMICs. In addition, between the 19 LLMICs, there were wide gaps between population subgroups who received quality maternal healthcare across the continuum, favouring mothers with higher education levels, who lived in urban areas, those aged 20-34 years at birth, and those from richer households. An eight percent coverage rate of care across the continuum is less than the reproductive, maternal, newborn, and child health (RMNCH) composite coverage index report by the WHO. The WHO coverage rate is measured as a weighted average of eight indicators in four stages of the care continuum: reproductive health (demand for family planning satisfied); maternal health (ANC coverage – at least four visits –, and birth attended by skilled health personnel); child immunization (Bacillus Calmette–Guérin (BCG), measles and diphtheria, tetanus and pertussis (third dose) (DTP3) immunization coverage); and management of childhood illnesses (oral rehydration therapy for diarrhoea and care-seeking for suspected childhood pneumonia symptoms). The WHO RMNCH composite coverage index indicator differs from the one used in this research as it uses limited interventions along the continuum from pre-pregnancy to child health. The WHO measure of coverage of RNMCH interventions, as in this study varies substantially across 71 countries, with the composite coverage index ranging from 28% in Chad to 90% in Cuba (with a global median of 69%). Within countries, coverage also varies between population subgroups. Coverages increase with economic status and education levels and are higher in urban areas than rural areas ([World Health Statistics 2021](#)).

The findings of the research reported in this paper indicate that after receiving all the recommended interventions during pregnancy, many women "dropped out" from the pathway of continued maternal healthcare quality and did not receive all the recommended interventions during childbirth or

postpartum. Along the care continuum, more dropouts occurred between pregnancy and childbirth than between childbirth and postpartum. The dropout rate between pregnancy and delivery for receiving all the recommended interventions was 15%, while it was 6% between childbirth and postpartum. Moreover, among women who received all the recommended interventions during childbirth, 47% received all the recommended interventions during postnatal, while only 26% of women who didn't receive all the recommended interventions during childbirth received all the recommended interventions during postnatal. This reveals the urgent need to focus on improving the quality of care delivered during childbirth. The maternal healthcare continuum study conducted by International Classification of Functioning (ICF) International in 2013 based on Cambodia DHS data showed that after receiving ANC, many women did not continue to receive care and did not have skilled personnel assisted birth or PNC. More care "dropouts" occurred between pregnancy and delivery than between delivery and the postnatal period (Wang & Hong 2013a).

The study found that commencing ANC visits during the first trimester significantly improved the odds of receiving all the recommended interventions across the continuum. The early a mother seeks care during pregnancy, the more she receives the recommended interventions intended to improve maternal and newborn health outcomes, and the better her healthcare-seeking behaviour during the whole pregnancy, delivery, and postpartum will be. This is also likely to increase the demand for subsequent care interventions along the maternal care continuum. A multi-country analysis of the latest DHS data from 32 sub-Saharan African countries showed that women who commenced ANC visits after twelve weeks of gestation had lower odds of receiving the maternal healthcare continuum than those who initiated ANC visits during the first trimester (Singh, Story & Moran 2016).

We found that women who had fewer than five births had higher odds of receiving quality maternal healthcare across the continuum at their last birth. We also found that women who had fewer than five births (para 4), had a longer preceding birth interval (≥2 years), and an intended pregnancy had higher odds of receiving quality maternal healthcare across the continuum. Having fewer children and longer birth intervals before the last birth might have enabled mothers to obtain sufficient resources to seek the recommended care along the maternal care continuum. A study from Gambia based on DHS 2013 data showed that women who had less than five births were more likely to receive maternal healthcare across the continuum (Oh et al. 2020). Another study from India also showed that women's use of maternal healthcare services across the continuum was observed more among those who had one birth (para 1) (James, Mishra & Pallikadavath 2022). An unintended pregnancy might negatively affect the woman's decision to seek timely and recommended care interventions along the maternal care continuum.

The poor treatment of women and lack of their social and economic empowerment in LLMICs can negatively affect the health of mothers and their newborns. In agreement with previous studies (Alem, Shitu & Alamneh 2022; Singh, Story & Moran 2016), our study revealed that women who lacked autonomy in deciding to seek healthcare had lower odds of receiving quality maternal healthcare across the continuum. Women need emotional, psychological, and practical support from a companion of their choice when seeking care at health facilities. In this study, women who lacked companionship to travel to health facilities were less likely to receive maternal healthcare quality across the continuum. Having companions of their choice can help mothers navigate potential verbal or physical abuse, non-consented medical procedures, or poor communication while seeking care at health facilities (Balde et al. 2020).

Education empowers women and girls and reduces gender inequality (Solar & Irwin 2010). Quality education and gender equity are key Sustainable Development Goals (UN SDGs 2022). In our study, improvements in receiving maternal healthcare quality across the continuum were in line with the increase in the level of the mother's education. Education creates increased awareness and knowledge about maternal health interventions that can improve the receipt of quality healthcare and women's desire to use health services (Kea et al. 2018; Say & Raine 2007). A recent study based on 32 DHS data from sub-Saharan African countries indicated that the odds of completing the maternal healthcare continuum were consistent with the increase in the level of the mother's education (Alem, Shitu & Alamneh 2022). In alignment with the findings of other studies, we also found that increases in the receipt of maternal healthcare quality along the continuum were consistent with the increases in the mother's household wealth index level (Bobo et al. 2021; Singh, Story & Moran 2016).

Exposure to media can be a powerful tool to reach all women of varying socioeconomic statuses in disseminating deliberate messages about the importance of receiving essential maternal healthcare services and interventions. In our study, women exposed to mass media (reading newspapers, watching television, or listening to the radio) at least once a week had higher odds of receiving maternal healthcare quality across the continuum than those not exposed to mass media. A study based on recent DHSs data from 32 sub-Saharan African countries showed that having mass media exposure had a significant and positive association with the completion of the maternal healthcare continuum (Alem, Shitu & Alamneh 2022). We also found that women with healthcare insurance were more likely to receive maternal healthcare quality across the continuum than those without insurance. Consistent with our findings, a previous study in thirty low- and middle-income countries based on the latest DHS data showed that health care insurance has contributed to the significantly increased use of maternal health care services (Wang, Temsah & Mallick 2014), while a recent study in India also revealed that the

health care insurance is the most significant contributor to the better utilization of full ANC services and institutional delivery at the national level and hindrances in accessing them (Ali et al. 2020).

The strengths of our study include the use of large sample sizes involving multiple nationally representative population-based surveys collected across 19 low-and lower-middle-income countries. Our study comprehensively analyzed the distribution, between country socio-demographic inequalities and determinants of the receipt of maternal healthcare quality across the continuum across the 19 study countries. However, the study also has several limitations. The study shares the limitations of a cross-sectional study design, which makes it difficult to demonstrate cause-and-effect relationships. The mother reported the responses to the survey questionnaire with regard to her most recent live birth within five years preceding the survey, with potential recall bias and lack of ability to identify between the different care providers (e.g., doctors, nurses). We used the most recent data available from the DHSs, which dates back to 2016 for some countries, and there may be differences in the current rates for some countries. The analyses were limited to women of the reproductive age group (15–49 years) who gave their last birth within five years preceding the survey. In addition, due to the missing data on some other essential interventions during care in the DHSs, including an ultrasound scan during the first 24 weeks of gestation, the experience of care (respectful care), effective communication, a companion of choice during labour and delivery and delayed umbilical cord clamping, the study doesn't constitute a comprehensive evaluation of the quality of care according to the WHO's recommended interventions during pregnancy, intrapartum or postnatal care services.

Conclusions

A low number of mothers and/or their newborns received all of the recommended interventions across the care continuum from pregnancy to postpartum in LLMICs. Only one of every twelve mothers and/or their newborns received all the recommended interventions across the care continuum. There were considerable gaps in receiving quality maternal healthcare across the continuum between population subgroups, favouring mothers with higher education levels, those who lived in urban areas, those aged 20-34 years at birth, and those from richer households. Across the 19 study countries, there was a statistically significant concentration of the receipt of maternal healthcare quality across the continuum towards mothers from the richer households with a concentration index value of 17.3. Along the care continuum, more women did not continue to receive care or "dropped out" of receiving care between pregnancy and childbirth than between childbirth and postpartum. The distribution of early initiation of breastfeeding was higher among rural and less or non-educated women.

Commencing ANC during the first trimester, exposure to mass media at least once a week, having healthcare insurance, a higher maternal education level, and a higher household wealth index were associated with higher odds of receiving maternal healthcare quality across the continuum across the 19 study countries. In addition, lower birth orders (<5), longer preceding birth intervals (≥2 years), and an intended pregnancy significantly improved the likelihood of receiving maternal healthcare quality across the continuum. In contrast, women who had to get permission to seek medical care and reported a lack of companionship to healthcare facilities as barriers to accessing care were less likely to receive maternal healthcare quality across the continuum. We recommend promoting early ANC contacts, provision of recommended interventions during childbirth, healthcare insurance, birth spacing, reproductive health services to prevent unintended pregnancy, low parity, women's rights, and emotional support to mothers through companionship to health facilities. Women's education and economic empowerment in LLMICs need to be progressed as per the Sustainable Development Goals.

8.1 Chapter Summary

Chapter eight showed that only one of every twelve women across the 19 LLMICs received the eighteen WHO-recommended maternal healthcare interventions across the care continuum from pregnancy to childbirth and postpartum, with disproportionately wider inequalities among women and countries, favouring those from advantageous sub-populations. There was also substantial attrition in women's use of quality maternal healthcare services along the care continuum. The next chapter discusses the key recommendations of the studies and the practical strategies to implement them to improve quality maternal healthcare services across the continuum and maternal and newborn health outcomes, especially among disadvantaged population subgroups in Ethiopia and other LLMICs.

Chapter 9. Discussion

This doctoral research aimed to identify the level, determinants, and inequalities of the women's use of quality maternal healthcare services across the continuum and the role that HRH can play in improving maternal and newborn health in LLMICs, with a focus on Ethiopia.

In the review of studies across LLMICs, we found that significant improvement in quality SRMNH across the continuum was obtained through several HRH initiatives, including maternal and perinatal death audits in health facilities, results-based financing of health workers, local administration of health worker allowances and incentives, skills-based and technology-assisted in-service training of skilled birth attendants, and integration of CHWs into the healthcare system. However, DHS data analyses across LLMICs identified widening inequalities in accessing the maternal healthcare continuum and quality maternal healthcare across the continuum, favouring those countries and women with advantageous socio-demographic characteristics. Further, the analyses identified several factors associated with an increased likelihood of receiving both the care continuum and quality care across the continuum, including commencing ANC during the first trimester, exposure to mass media, having healthcare insurance, and higher maternal education level and household wealth indices. In addition, having a lower number of births (<5), longer birth intervals (≥4 years), and an intended pregnancy significantly increased the likelihood of receiving both the care continuum and quality care across the continuum. In contrast, adolescent mothers were less likely to receive the care continuum. Women who had to gain permission to seek medical care and reported a lack of companionship and longer distances to healthcare were less likely to receive both the care continuum and quality care across the continuum.

This chapter summarises the important insights for quality maternal healthcare services, maternal healthcare across the continuum, and quality maternal healthcare services across the continuum identified in the research, and offers recommendations to improve maternal healthcare in Ethiopia and other LLMICs.

9.1 Human resources for health interventions to expand access to quality maternal healthcare

Improving maternal health requires ensuring access to and receipt of quality maternal healthcare services across the continuum for all women and girls everywhere, through universal coverage of quality maternal healthcare services, including for the most vulnerable women (e.g., women who: have a low or no formal education, are poor, living in rural areas, or are teenage mothers and mothers of advanced age (≥35 years)) (Koblinsky et al. 2016; Tunçalp et al. 2015a). The availability, composition,

165

deployment, retention, and productivity of skilled HRH are crucial in ensuring the expansion of quality sexual, reproductive, maternal, and newborn healthcare services to disadvantaged population subgroups in LLMICs (Campbell 2013; Negero, Sibbritt & Dawson 2021a).

Figure 9.1 compares the ratios of practising midwives, auxiliary midwives, nurse midwives, and obstetricians and gynaecologists to the number of pregnancies in African countries. It shows that countries with the largest numbers of births (e.g., the Democratic Republic of the Congo, Tanzania, Kenya, and Ethiopia) have some of the lowest densities of midwives and obstetricians (<2 per 1000 pregnancies) (United Nations Population 2014). To address the complex and multifaceted health workforce challenges that hinder the provision of quality maternal healthcare services across the continuum, an integrated approach is required to better balance health workforce needs, demand, and supply, as well as to provide health workers with an enabling work environment. Education, policy, finance, management, partnership, and leadership-related HRH interventions to improve access to and receipt of quality maternal healthcare services across the continuum in LLMICs are mentioned in the following sections as per the WHO's HRH action framework (WHO-HRH action framework 2012).
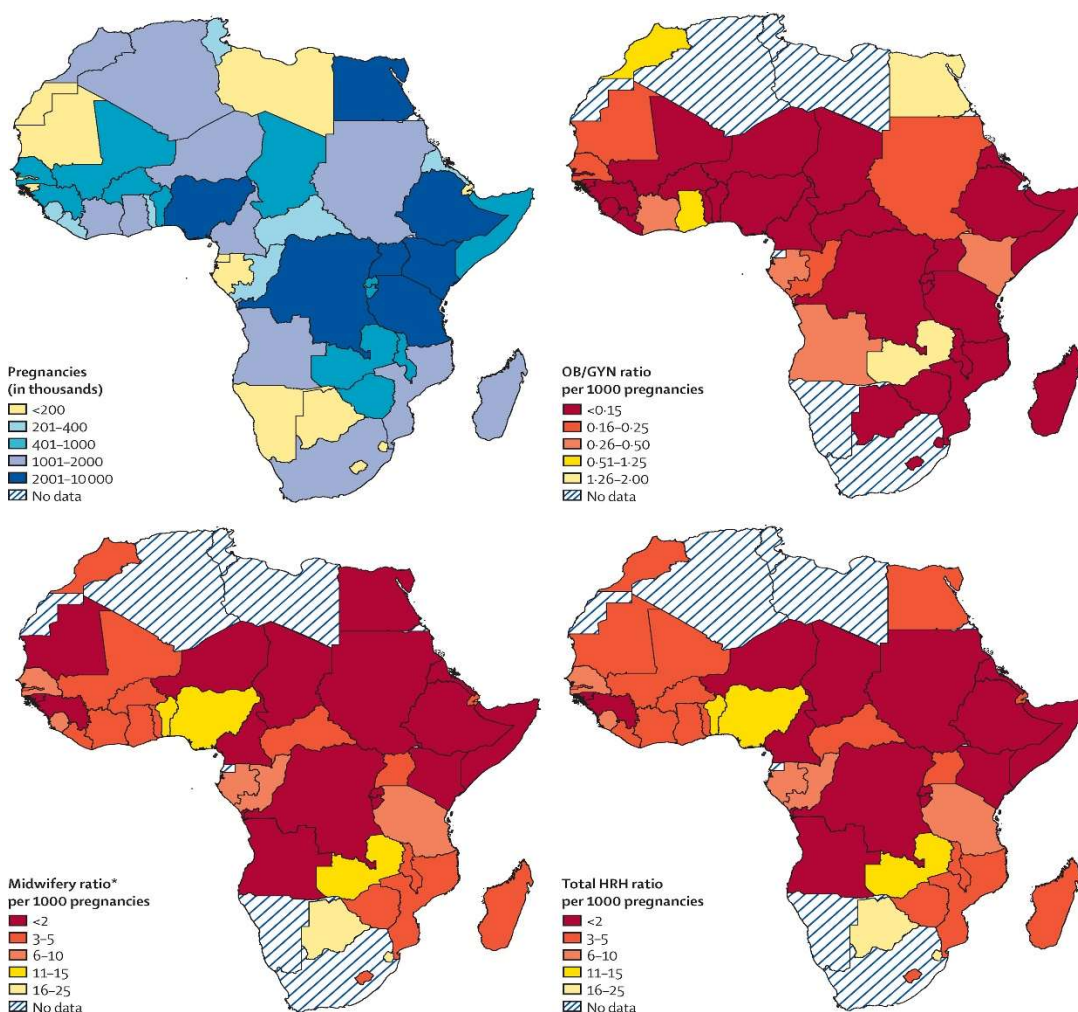
OB/GYN=obstetricians and gynaecologists. HRH=human resources for health. *Midwifery workforce, including midwives, auxiliary midwives, and nurse midwives.

Figure 9.1 1: Human resources for health ratios per 1000 pregnancies in Africa 2012

9.1.1 Scaling-up competency-based skilled health personnel education

Public and private sector investments in skilled personnel education in LLMICs should be linked with population needs and the health system demands. Education strategies should focus on investment in trainers, for which there is good evidence of a high social rate of return. The existing severe shortage of skilled personnel among the disadvantaged population subgroups in LLMICs can be relieved by strengthening pre-service education to ensure a quantitative scale-up through an adequate and gender-balanced pipeline of qualified trainees from rural and remote areas (Koblinsky et al. 2016; WHO 2016a). The curricula should be oriented to balance the pressure to train for international markets and to produce professionals capable of meeting local needs, promoting technical, vocational education, and social accountability approaches that improve the geographic distribution of skilled personnel (McPake et al. 2015; WHO 2016a).

The curricula should also be reviewed to equip health workers with skills to manage mothers and/or their newborns with comorbidities and work collaboratively in inter-professional teams. Such teams should possess the knowledge to intervene effectively on social determinants of access to and receipt of quality of maternal healthcare services across the continuum; with the mission to nurture health workers with public service ethics, professional values and social accountability attitudes required to deliver respectful care that responds to the needs of individual mothers and their newborns, and to population expectations. The teams should have a particular focus on the needs of vulnerable population subgroups, including adolescent mothers and mothers of advanced age; mothers with disabilities, from ethnic or linguistic minorities, with financial constraints and with limited education (Frenk et al. 2010; Koblinsky et al. 2016).

Simulation-based, multidisciplinary in-service team training of skilled personnel combined with adherence to high-quality clinical practice guidelines can improve providers' knowledge, clinical skills, attitudes, team performance, and women-centred approaches (Merién et al. 2010; Renfrew et al. 2014; Tunçalp et al. 2015a). A study conducted by Yeneabat et al. (2022) showed that the availability of ANC guidelines at every health facility and regular in-service refresher training of healthcare providers in Ethiopia significantly improve the quality of ANC counselling (Yeneabat et al. 2022). A Cochrane review based on 31 studies from Africa, Asia, and Latin America also revealed that the lack of sufficient training during their pre-service education or after they had begun clinical work negatively

affected the skilled birth attendant's provision of quality intrapartum and postnatal care services ([Munabi-Babigumira et al. 2017](#)).

In addition, the capacity and quality of health training institutions and their faculty in LLMICs should be strengthened through the development of standards for teaching institutions, accreditation of training schools, and certification of diplomas awarded to health workers. This focus should also ensure an adequate and gender-balanced pool of eligible high-school graduates, reflective of the population's underlying demographic characteristics and distribution, to enter health training programmes to improve health workforce distribution and enhance woman-centred care. Health training institutions represent a priority investment area in terms of adequate numbers and about building and updating their competency to teach using updated curricula and training methodologies and to lead research activities independently ([WHO 2016a](#)).

9.1.2 Policies for optimizing HRH motivation, satisfaction, retention, distribution, and performance

Critical HRH policies that can improve HRH's performance and equitable distribution to improve access to and receipt of quality maternal healthcare services across the continuum for mothers from disadvantaged population subgroups entail gender-sensitive workforce attraction and retention policies and strategies. Such HRH policies include job security, a manageable workload, supportive supervision and organizational management, continuing education and professional development opportunities, enhanced career development pathways (including rotation schemes where appropriate), family and lifestyle incentives, hardship allowances, housing and education allowances and grants, adequate facilities and working tools, and measures to improve occupational health and safety, including a working environment free from any type of violence, discrimination, and harassment. Critical to ensuring equitable deployment, and to minimise the risks of attrition and emigration of skilled personnel are the selection of trainees from, and delivery of training in, rural and underserved areas, financial and non-financial incentives, and regulatory measures or service delivery reorganization ([Buchan et al. 2013](#); [Esu et al. 2021](#); [Koblinsky et al. 2016](#); [WHO 2016a](#)).

An HRH policy study in rural Liberia showed that actively recruiting trainees from rural areas and exposing them to rural work conditions during their training, increasing pay levels in rural areas, and provision of transportation services to nurses and certified midwives in rural areas can maximise their motivation, retention, and performance in rural areas ([Vujicic et al. 2010](#)).

Strengthening the content and implementation of HRH plans as part of long-term national health and broader development strategies is needed to address prevalent labour market failures, including

shortages, maldistribution, and unemployment of health workers co-existing with unmet health needs. HRH development is a continuous process that requires a regular appraisal of results and feedback loops to inform and adjust priorities (WHO 2016a). The nurses' and midwives' unemployment crisis study in Ghana revealed that the policy of expanding the training of nurses, midwives, and doctors, including by private training institutions, as a response to the severe shortage of health workforce, resulted in substantial increases in the production levels of nurses and midwives even above the expectations of the ministry of health. However, this seemingly well-planned strategy suffered a decade of uncorrected implementation lapses resulting in a lingering need-based shortage of nurses and midwives at service delivery points whilst thousands of trained nurses and midwives remained unemployed for up to four years and constantly protested for jobs (Asamani et al. 2020).

The policy and regulatory environment for midwifery care should also be realigned with midwives' pre-service education and accreditation requirements. Despite having the potential to address most maternal and newborn health needs, in many countries, midwives are not authorised to perform within the full scope of their profession, and they lack the authorisation to deliver the signal functions of basic emergency obstetric and neonatal care (Koblinsky et al. 2016).

9.1.3 Building sustainable budgets and incentives

It is crucial to adopt a range of financial and non-financial incentives to improve management systems and the work environment in which the HRH operate, maximise worker motivation and performance, and minimise risks of attrition and emigration (WHO 2016a). A Cochrane review based on studies from Africa, Asia, and Latin America revealed that the insufficient salaries and benefits for skilled birth attendants exacerbated their poor living conditions and stress. This negatively affected their family life, making them less efficient in providing quality intrapartum and postnatal care services (Munabi-Babigumira et al. 2017). While continuing to advocate for an increase in the allocation of domestic resources to HRH, including the investment in capital and recurrent expenditure (including salaries) for skilled birth attendants serving vulnerable populations, development partners should also support countries to strengthen their capacity for mobilizing adequate resources for HRH from both traditional and innovative sources, including progressive tax collection and social health insurance (Bowser et al. 2014; Vujicic et al. 2012; WHO 2016a). In addition, decentralization of healthcare financing to local authorities can lead to better health workforce performance and retention in rural areas through the creation of additional revenue for the health sector, better use of existing financial resources, and the creation of financial incentives for health workers (Haji et al. 2010).

9.1.4 Enhancing workforce leadership supervision and management

Good leadership and management in healthcare services can be learned and practised at all levels. A leadership style that encourages innovation and teamwork and a more professional approach to HRH management can improve the quality of maternal healthcare services (O'Neil 2008). In a rapidly decentralizing healthcare system, the lack of human resource capacity in leadership and management at the primary healthcare level can lead to poor quality healthcare services (Perry 2008). Results from Mozambique's leadership and management development program (2008) showed that empowering primary care workers by integrating leadership strengthening into the day-to-day challenges that staff were facing in the health units without taking them away for long periods of expensive training and creation of participatory teams maximised the efficient use of resources, empowered staff to make a difference, and hence improved quality of healthcare services. The program offered decentralized health units the opportunity to work with communities to address the communities' needs. Through this program, managers from 40 countries have learned to work in teams to identify their priority challenges and act to implement effective responses. After the program, people no longer waited passively to be trained but instead proactively requested training in needed areas (Perry 2008). In Tanzania, leadership and managerial capacity-building training through two 5-days in-person workshops, onsite mentoring, and e-learning modules aimed at improving maternal and newborn health outcomes within primary healthcare facilities, created a more supportive workplace environment, and improved organizational performance, teamwork, job satisfaction, productivity and role clarity among healthcare workers, and maternal-perinatal healthcare services across the facilities over the three project years (Tomblin Murphy et al. 2022). Regulatory measures where obligations are attached to financial and non-financial incentives could attract skilled health personnel to rural and underserved areas (Esu et al. 2021). Enhancing and promoting the safety and protection of health personnel from obstruction, threats, and physical attacks can also improve the efficiency and retention of skilled personnel (WHO 2016a).

9.1.5 Strengthening community capacity and sustainable partnerships with development partners

Engaging communities in shared decisions and choices through improved woman-provider relations is vital. Investing in health literacy programs and empowering women and their families with knowledge and skills will encourage them to become critical stakeholders and assets to the health system and to collaborate actively in the production and quality assurance of care rather than passive service recipients. Health workers should have the sociocultural skills to effectively bridge between more empowered communities and more responsive health systems (WHO 2016a).

Development partners need to align their investments for HRH with coordinated and long-term national needs as expressed in national sector plans, adhering to aid effectiveness principles and with a particular focus on disadvantaged populations. The support should align education, employment, gender and health with national HRH development and sustainable HRH strengthening strategies rather than focusing on the current preferential short-term, disease-specific, in-service training (WHO 2016a).

9.2 Ensuring financial protection in healthcare to improve maternal healthcare services across the continuum

In our DHS data analyses across LLMICs, women from households with healthcare insurance were found to have higher odds of receiving maternal healthcare services across the continuum and quality maternal healthcare services across the continuum. Financial constraints underlie much of the poor access to maternal healthcare services across all settings, and financial hardship is likely to worsen further among those paying out-of-pocket for health, particularly in disadvantaged populations (Koblinsky et al. 2016; World Health Organization 2022). According to the World Health Statistics 2022 report, 435 million people globally were further pushed into extreme poverty due to impoverishing healthcare spending. The covid-19 pandemic is also likely to further significantly undermine financial protection (World Health Organization 2022). Disadvantaged population subgroups in LLMICs still face catastrophic expenditures (>10% of the household expenditure/income on health) due to emergency obstetric care. The establishment of large pre-payment and risk-pooling mechanisms, which reduce reliance on out-of-pocket spending, could curb catastrophic health expenditures in the near-term and long-term. Other financing instruments can also be deployed to promote access, such as cash transfers, microcredit, vouchers, and user fee removal (Bassani et al. 2013; Hatt et al. 2013; McKinnon et al. 2015). Reducing the burden of healthcare costs by removing user fees and targeted subsidies such as vouchers increase the demand for maternal healthcare among the poor (Mehra 2010). A study conducted in Zambia showed that removing user fees in primary healthcare facilities resulted in a 43% increase in the probability of giving birth in a health facility and a 36% increase in the probability of being assisted by skilled personnel during childbirth (Renard 2022). In addition, LLMICs should deliberately create a strong link between fiscal policy and health policy. To do so, taxation should be the most sustainable source of financing for healthcare, and governments should boost their efforts towards improving taxation. Considering the importance of financial stewardship, the focus should be placed on improving the state-citizen relationship through increased transparency and accountability to foster legitimacy and improve tax morale and voluntary tax compliance. Improving transparency includes participatory tax policy-making, the publication of tax revenue collected, and the ways in which taxes

are utilized. Improving accountability means creating a linkage between taxation and the provision of public goods and services, particularly health services, and this should be communicated to the public through different means to reach all segments of society. This includes the introduction of a pro-poor health financing policy that focuses on financial protection, not only for those on the verge of poverty but also for those who are already below the poverty line in both rural and urban areas, and increasing health care investment through social healthcare insurance and/or tax-based government funding (WHO 2022c). Additional investment in pay and recruitment, commodities, and infrastructure are also required to support free health-care policies, including staff pay increases for more demanding workloads (Ke, Saksena & Holly 2011; Kesmodel & Jølving 2011).

9.3. Effective HRH interventions to improve the provision of quality ANC

In chapter 5, it was identified that women who received their ANC visits at government health posts at the Primary Health Care level were less likely to receive all the recommended interventions during the ANC visits. This might be due to lack of access to adequate equipment and supplies, lack of readiness, and lack of required expertise and skills among healthcare providers in the health posts at village levels. Yet these healthcare facilities are nearest to communities in need.

9.3.1 Building a sustainable skills mix in primary health care

In resource-poor settings, implementing maternal and perinatal healthcare delivery models with an appropriate and sustainable skills mix is critical to provide equitable community-based, woman-centred, continuous, and integrated care that meets population health needs. As such, a renewed focus on a more diverse skills mix involving physicians, nurses, midwives, and laboratory technicians and a greater role for community health workers at the lowest level of primary healthcare is needed (Koblinsky et al. 2016; WHO 2016a). The diverse skills mix of physicians, nurses, midwives, and laboratory technicians from the higher level of primary, secondary, or tertiary healthcare should regularly visit the lowest primary care centres to provide scheduled, sustainable, and integrated ANC to pregnant mothers. In collaboration with community leaders, the community health workers should mobilize the community to create awareness about pregnancy complications, identify pregnant women early during the first trimester and bring them to the nearest government health posts (HSTP II Ethiopia 2021; WHO 2016a).

9.3.2 Employing task sharing, in-service training, and supervision

Coupled with regular in-service training and supportive supervision, shifting to and/or sharing with community health workers at primary healthcare essential and recommended maternal healthcare interventions during pregnancy can increase access to and availability of maternal healthcare services

without compromising performance or health outcomes and could be cost-effective (Dawson et al. 2014; WHO 2012a). Community health workers can provide pregnant women with routine iron and folate supplementation, oral intermittent preventive treatment for malaria for those living in endemic areas, and vitamin A supplementation for those living in areas where severe vitamin A deficiency is a serious public health problem. They can promote early initiation of ANC visits (during the first trimester) and sleeping under insecticide-treated bednets for pregnant women. In addition, they can provide counselling on pregnancy complications, birth preparedness and complication readiness (including skilled birth attendance), and companionship for pregnant women to healthcare facilities (Koblinsky et al. 2016; WHO 2012a).

9.4 Improving reproductive healthcare services

Universal access to reproductive healthcare services on need, such as modern family planning methods (including postpartum and post-abortion contraceptive methods), and safe abortion care services are among the 2030 SDGs targets (UNPD 2022).

In our DHS data analyses across LLMICs, it was identified that women who reported that the pregnancy for the last birth was unintended were less likely to receive the care continuum or quality maternal healthcare across the continuum.

9.4.1 Optimizing HRH roles

Beyond skilled health workers, task shifting to other roles, such as community health workers, can substantially expand access to family planning (including postpartum and post-abortion contraceptive services) and medication abortion services, and hence prevent unintended pregnancies, short birth intervals, or limit the family size in resource-poor settings (Lassi et al. 2013; Lewin et al. 2010). Task shifting coupled with adequate training and support can lead to increased job satisfaction by empowering providers with lower levels of training to expand their ability to address local health care needs (WHO 2016a).

In addition, global and local stakeholders should encourage a fundamental shift towards more woman-centred and family-centred reproductive healthcare services, including more functional linkages between reproductive healthcare services and other aspects of healthcare, such as combining family planning and newborn care provision during post-partum care visits, or family planning and abortion care services (Horwood et al. 2010; Koblinsky et al. 2016).

9.4.2 Strengthening reproductive healthcare services for vulnerable populations

In resource-poor settings, high fertility and unintended pregnancies are typically common, particularly among teenagers, and are often caused by sexual violence inflicted as a weapon of war ([Patton et al. 2016](#); [Save the Children 2014](#)). The principle of non-discrimination and the rights to the highest attainable standard of health, information and education, privacy, and life, provide the basis for the right to quality contraceptive information and services to every woman and teenage everywhere. The definitions of who has unmet need for family planning need to be expanded to include unmarried women, particularly teenagers ([Cottingham, Germain & Hunt 2012](#)).

9.5 Reducing gender inequality and improving uptake of quality maternal healthcare

The world is not on track to achieving gender equality by 2030. The deadline has been pushed further off track by the socioeconomic fallout of the pandemic and prevailing conflicts around the globe ([SDG Five 2022](#)). Women and girls remain disproportionately affected, struggling with lost jobs and livelihoods, derailed education, increased burdens of unpaid care work, and domestic violence. One in five young women worldwide (19%) were married in childhood in 2021. Child marriage is most common in sub-Saharan Africa, followed by South Asia, with the profound effects of the COVID-19 pandemic and conflicts ([SDG Five 2022](#)). Women across LLMICs, in particular, are disproportionately poor, have low education, and lack autonomy and decision-making power. Poverty and gender inequality pose significant barriers to access and utilization of maternal healthcare ([Mehra 2010](#)). In addition, a substantial proportion of women in LLMICs cannot still make decisions about their own healthcare ([SDG Five 2022](#)). In our DHS data analyses across LLMICs, it was found that women in the lowest income quintile, with the lowest education levels, and who cannot decide to use healthcare on their own had the lowest access to the maternal healthcare continuum and quality maternal healthcare services across the continuum.

9.5.1 Empowering women by targeting poverty and education to improve maternal health

The deployment of financing instruments such as conditional cash transfers (e.g., conditioned on accessing care and health education sessions), microcredits, vouchers, and user fee removal for vulnerable women can increase the demand for quality maternal healthcare and empower women (Bassani et al. 2013; Hatt et al. 2013; McKinnon, Harper & Kaufman 2015; Mehra 2010). Education empowers women and girls by decreasing poverty and enhancing employability and autonomy (Mehra 2010; Solar & Irwin 2010). In LLMICS, the 2030 SDGs of ensuring inclusive and equitable quality education, promoting lifelong learning opportunities for all, and achieving gender equality and empowering all women and girls, respectively, requires explicit programmatic and policy approaches (Mehra 2010; SDG Five 2022; SDG Four 2022). Deliberate efforts to expand and strengthen women's and girls' education and employment initiatives should be a priority for global and local stakeholders in LLMICs (Mehra 2010). Efforts should also be strengthened to ensure that laws, policies, budgets, and institutions in LLMICs advance gender equality (SDG Five 2022).

9.5.2 Empowering women through social support, networking, participatory learning, and action

Community-based participatory dialogues, training, and networking to change the existing harmful social norms that undermine women's autonomy and empowerment in LLMICs can bring sustainable normative shifts in the community, empower women, and increase their utilization of maternal healthcare. Three case studies conducted in Mali, Nepal, and Nigeria revealed that participants in community-based interventions could be effectively empowered to share their new knowledge and understandings about harmful social practices systematically with others in their networks, eventually facilitating social norms change (Cislaghi et al. 2019; Mehra 2010).

9.5.3 Encouraging men to support their partners to improve maternal and newborn health

In our DHS data analyses across LLMICs, it was found that women who had companionship support to healthcare facilities were more likely to receive the maternal healthcare continuum and quality maternal healthcare services across the continuum. Local healthcare providers in LLMICs should encourage and positively influence husbands to accompany and provide emotional support to their spouses while seeking healthcare. A systematic review of studies across low- and middle-income countries conducted by Tokhi et al. (2018) showed that engaging men in maternal and newborn healthcare improved ANC attendance, skilled birth attendance, health facility birth, PNC, birth and

complications preparedness, and maternal nutrition. The interventions to engage men also improved male partner support for women, couple communication, and joint decision-making (Tokhi et al. 2018). A randomised controlled trial conducted by Daniele (2017) in Burkina Faso showed that gender-transformative interventions to involve men as supportive partners in maternity care could improve adherence to recommended healthy practices among postpartum women. The intervention strategy involved men in facility-based maternity care, in an urban area with high antenatal care attendance. The intervention increased attendance at outpatient PNC (at least two consultations), exclusive breastfeeding at three months postpartum, effective modern contraception use at eight months postpartum, especially long-acting methods, and improved an unvalidated measure of relationship adjustment. The intervention appears to have worked mainly by increasing male knowledge on key topics and promoting couple communication and shared decision-making (Daniele 2017).

9.6 Strengths and limitations of the research

The strengths of the research presented in this thesis include a comprehensive literature review to identify effective HRH interventions to improve quality maternal healthcare across the continuum and the use of large sample sizes involving multiple nationally representative population-based surveys conducted in Ethiopia and across 28 LLMICs. This data was comprehensively analysed, employing generalizable and advanced statistical analytic techniques. There were, however, some limitations to the research. The DHSs rely on self-reported information in which recall bias can be an important issue, as interviewees are required to recollect events as far back as five years. The cross-sectional study design makes it difficult to establish causal associations. In addition, the most recent data from the DHSs were analysed, which dates back to 2016 for some countries, and there may be differences in the current rates for some countries. In addition, due to the lack of data availability, some recommended components of each care service, including ANC contact schedules, ultrasound scan during the first 24 weeks of gestation, the experience of care (respectful care), effective communication, a companion of choice during labour and delivery, and delayed umbilical cord clamping were missing.

9.7 Recommendations

Our research investigated and identified actionable strategies to improve the provision of quality maternal healthcare services, maternal healthcare services across the continuum, quality maternal healthcare services across the continuum, and maternal and neonatal health outcomes in LLMICs, including for disadvantaged sub-populations. The findings have important implications for health policy and programs in Ethiopia and other LLMICs. Policymakers in Ethiopia should standardize the provision of the recommended essential maternal healthcare interventions in all healthcare facilities. Policymakers and healthcare managers in LLMICs should invest resources to enhance the availability, performance, motivation, and retention of the health workforce. All quality maternal healthcare initiatives should be expanded to incorporate disadvantaged population subgroups, especially teenage mothers. Accountable and actionable policies should focus on enhancing women's and girls' rights in LLMICs and global and local stakeholders should double their efforts to tackle gender inequality and increase women's autonomy to make their own health decisions in line with the SDGs.

We recommend that the DHS program incorporate pertinent questions to assess and promote other critical WHO-recommended interventions, including early ultrasound scan during the first 24 months of pregnancy, delayed umbilical cord clamping, and care experience, including respectful care during care services to enhance quality maternal care. As a future research requirement, we recommend promoting the research and practice of pre-conception care services in LLMICs, as there are few studies or services in LLMICs. Future research on the association between recommended maternal healthcare services or HRH interventions and health outcomes, including maternal mortality, neonatal mortality, perinatal mortality, and low birth weight, would help identify pertinent, specific, and effective public health interventions in LLMICs to improve health outcomes.

9.8 Conclusions

This is the first study to investigate lay and/or skilled HRH interventions to support access to quality maternal healthcare services across the continuum in Ethiopia and other LLMICs. It also investigated the trends in, inequality in, and predictors of accessing quality maternal healthcare services across the continuum in Ethiopia and other LLMICs. Poverty and gender inequality still pose significant barriers to the utilization of quality maternal healthcare services across the continuum in Ethiopia and other LLMICs.

The studies conducted and presented in this thesis have identified several key initiatives that policymakers in LLMICs and their development partners should undertake:

1) Expand the fiscal space and allocate resources more equitably and efficiently across all levels of the healthcare system;

2) Strengthen the skilled health personnel's pre-service and in-service training to ensure a quantitative scale-up through an adequate and gender-balanced pipeline of qualified trainees from rural and remote areas;

3) Ensure a gender-balanced approach to health workforce deployment, management, and leadership;

4) Adopt financial and non-financial incentives to improve the HRH management systems and work environment in which they operate, enhance HRH motivation and performance, and decrease risks of attrition and emigration;

5) Adopt responsive skills mix and task sharing that harnesses inter-professional teams of HRH, supportive supervision, and training;

6) Engage communities in maternal healthcare decisions and choices;

7) Ensure availability of updated and standardized, high-quality clinical practice guidelines in all healthcare facilities;

8) Ensure financial protection in healthcare to avoid catastrophic expenditures and lower costs;

9) Expand reproductive healthcare services to include unmarried women, particularly adolescents;

10) Encourage men to support their partners to improve maternal and newborn health; and

11) Strengthen women's and girls' education, employment initiatives, social support, networking, and participatory learning and action to empower them and reduce gender inequality.

References

Agarwal, S., Curtis, S., Angeles, G., Speizer, I., Singh, K. & Thomas, J. 2019, 'Are community health workers effective in retaining women in the maternity care continuum? Evidence from India', *BMJ Global Health*, vol. 4, no. 4, p. e001557.

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 and Childbirth*, vol. 22, no. 1, pp. 1-12.

Ali, I., Akhtar, S.N., Chauhan, B.G., Malik, M.A. & Singh, K.D. 2020, 'Health Insurance Support on Maternal Health Care: Evidence from Survey Data in India', *medRxiv*.

Aliaga, A. & Ruilin, R. 2006, 'Cluster optimal sample size for demographic and health surveys', vol. 7, pp. 2-7.

Althabe, F., Bergel, E., Cafferata, M.L., Gibbons, L., Ciapponi, A., Alemán, A., Colantonio, L. & Palacios, A.R. 2008, 'Strategies for improving the quality of healthcare in maternal and child health in low-and middle-income countries: an overview of systematic reviews', *Paediatric and perinatal epidemiology*, vol. 22, pp. 42-60.

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*, vol. 6, no. 11, pp. e1186-e95.

Asamani, J.A., Amertil, N.P., Ismaila, H., Akugri, F.A. & Nabyonga-Orem, J. 2020, 'The imperative of evidence-based health workforce planning and implementation: lessons from nurses and midwives unemployment crisis in Ghana', *Human resources for health*, vol. 18, no. 1, pp. 1-6.

Asefa, A. & Bekele, D. 2015a, 'Status of respectful and non-abusive care during facility-based childbirth in a hospital and health centers in Addis Ababa, Ethiopia', *Reproductive health*, vol. 12, no. 1, p. 33.

Asefa, A. & Bekele, D. 2015b, 'Status of respectful and non-abusive care during facility-based childbirth in a hospital and health centers in Addis Ababa, Ethiopia', *Reproductive health*, vol. 12, no. 1, pp. 1-9.

ASQ 2022, *Statistical control charts. https://asq.org/quality-resources/control-chart. Accessed on 17th August 2022.*

Ayalew, F., Eyassu, G., Seyoum, N., van Roosmalen, J., Bazant, E., Kim, Y.M., Tekleberhan, A., Gibson, H., Daniel, E. & Stekelenburg, J. 2017, 'Using a quality improvement model to enhance providers' performance in maternal and newborn healthcare: a post-only intervention and comparison design', *BMC pregnancy and childbirth*, vol. 17, no. 1, p. 115.

Azevedo, W.F.d., Diniz, M.B., Fonseca, E.S.V.B.d., Azevedo, L.M.R.d. & Evangelista, C.B. 2015, 'Complications in adolescent pregnancy: systematic review of the literature', *Einstein (São Paulo)*, vol. 13, pp. 618-26.

Babalola, S. & Fatusi, A. 2009, 'Determinants of use of maternal health services in Nigeria-looking beyond individual and household factors', *BMC pregnancy and childbirth*, vol. 9, pp. 1-13.

Baker, A. 2001, *Crossing the quality chasm: a new health system for the 21st century*, vol. 323, British Medical Journal Publishing Group.

Bakwa-Kanyinga, F., Valerio, E.G., Bosa, V.L., Alfama, C.O., Sperb, M., Capp, E. & Vettorazzi, J. 2017, 'Adolescent pregnancy: Maternal and fetal outcomes in patients with and without preeclampsia', *Pregnancy hypertension*, vol. 10, pp. 96-100.

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 medical informatics and decision making*, vol. 16, no. 1, p. 84.

Balde, M.D., Nasiri, K., Mehrtash, H., Soumah, A.-M., Bohren, M.A., Irinyenikan, T.A., Maung, T.M., Thwin, S.S., Aderoba, A.K. & Vogel, J.P. 2020, 'Labour companionship and women's experiences of mistreatment during childbirth: results from a multi-country community-based survey', *BMJ global health*, vol. 5, no. Suppl 2, p. e003564.

Basinga, P., Gertler, P.J., Binagwaho, A., Soucat, A.L.B., Sturdy, J. & Vermeersch, C.M.J. 2011, 'Effect on maternal and child health services in Rwanda of payment to primary health-care providers for performance: an impact evaluation', *The Lancet*, vol. 377, no. 9775, pp. 1421-8.

Bassani, D.G., Arora, P., Wazny, K., Gaffey, M.F., Lenters, L. & Bhutta, Z.A. 2013, 'Financial incentives and coverage of child health interventions: a systematic review and meta-analysis', *BMC Public Health*, vol. 13, no. 3, pp. 1-13.

Basu, S., Andrews, J., Kishore, S., Panjabi, R. & Stuckler, D. 2012, 'Comparative performance of private and public healthcare systems in low-and middle-income countries: a systematic review', *PLoS medicine*, vol. 9, no. 6, p. e1001244.

Bayou, Y.T., Mashalla, Y.S. & Thupayagale-Tshweneagae, G. 2016, 'The adequacy of antenatal care services among slum residents in Addis Ababa, Ethiopia', *BMC pregnancy and childbirth*, vol. 16, no. 1, pp. 1-10.

Berhan, Y. & Berhan, A. 2014, 'Antenatal care as a means of increasing birth in the health facility and reducing maternal mortality: a systematic review', *Ethiopian journal of health sciences*, vol. 24, pp. 93-104.

Berhanu, D., Allen, E., Beaumont, E., Tomlin, K., Taddesse, N., Dinsa, G., Mekonnen, Y., Hailu, H., Balliet, M. & Lensink, N. 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*, vol. 16, no. 8, p. e0251706.

Biadgo, A., Legesse, A., Estifanos, A.S., Singh, K., Mulissa, Z., Kiflie, A., Magge, H., Bitewulign, B., Abate, M. & Alemu, H. 2021, 'Quality of maternal and newborn health care in Ethiopia: a cross-sectional study', *BMC health services research*, vol. 21, no. 1, pp. 1-10.

Binyaruka, P., Patouillard, E., Powell-Jackson, T., Greco, G., Maestad, O. & Borghi, J. 2015, 'Effect of paying for performance on utilisation, quality, and user costs of health services in Tanzania: a controlled before and after study', *PloS one*, vol. 10, no. 8, p. e0135013.

Bobo, F.T., Asante, A., Woldie, M. & Hayen, A. 2021, 'Poor coverage and quality for poor women: Inequalities in quality antenatal in nine East African countries', *Health Policy and Planning*.

Bohren, M.A., Hunter, E.C., Munthe-Kaas, H.M., Souza, J.P., Vogel, J.P. & Gülmezoglu, A.M. 2014, 'Facilitators and barriers to facility-based delivery in low-and middle-income countries: a qualitative evidence synthesis', *Reproductive health*, vol. 11, no. 1, pp. 1-17.

Bonfrer, I., Van de Poel, E. & Van Doorslaer, E. 2014, 'The effects of performance incentives on the utilization and quality of maternal and child care in Burundi', *Social Science & Medicine*, vol. 123, pp. 96-104.

Bowser, D., Sparkes, S.P., Mitchell, A., Bossert, T.J., Bärnighausen, T., Gedik, G. & Atun, R. 2014, 'Global Fund investments in human resources for health: innovation and missed opportunities for health systems strengthening', *Health policy and planning*, vol. 29, no. 8, pp. 986-97.

Bramer, W.M., Giustini, D., de Jonge, G.B., Holland, L. & Bekhuis, T. 2016, 'De-duplication of database search results for systematic reviews in EndNote', *Journal of the Medical Library Association: JMLA*, vol. 104, no. 3, p. 240.

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*, vol. 7, no. 5, pp. e624-e32.

Buchan, J., Couper, I.D., Tangcharoensathien, V., Thepannya, K., Jaskiewicz, W., Perfilieva, G. & Dolea, C. 2013, 'Early implementation of WHO recommendations for the retention of health workers in remote and rural areas', *Bulletin of the World Health Organization*, vol. 91, pp. 834-40.

Bylund, S., Målqvist, M., Peter, N. & Herzig van Wees, S. 2020, 'Negotiating social norms, the legacy of vertical health initiatives and contradicting health policies: a qualitative study of health professionals' perceptions and attitudes of providing adolescent sexual and reproductive health care in Arusha and Kilimanjaro region, Tanzania', *Global Health Action*, vol. 13, no. 1, p. 1775992.

Campbell, J. 2013, 'The route to effective coverage is through the health worker: there are no shortcuts', *Lancet*, vol. 381, no. 9868, p. 725.

Campbell, O.M.R., Graham, W.J. & Lancet Maternal Survival Series steering, g. 2006, 'Strategies for reducing maternal mortality: getting on with what works', *The lancet*, vol. 368, no. 9543, pp. 1284-99.

Carvajal–Aguirre, L., Amouzou, A., Mehra, V., Ziqi, M., Zaka, N. & Newby, H. 2017, 'Gap between contact and content in maternal and newborn care: An analysis of data from 20 countries in sub–Saharan Africa', *Journal of global health*, vol. 7, no. 2.

CASP 2018, 'Critical Appraisal Skills Programme, CASP (Qualitative) Checklist. https://casp-uk.net/casp-tools-checklists/'.

Cavazos-Rehg, P.A., Krauss, M.J., Spitznagel, E.L., Bommarito, K., Madden, T., Olsen, M.A., Subramaniam, H., Peipert, J.F. & Bierut, L.J. 2015, 'Maternal age and risk of labor and delivery complications', *Maternal and child health journal*, vol. 19, no. 6, pp. 1202-11.

Central Statistical, A. 2007, '2007 population and housing census of Ethiopia', Series 2007 population and housing census of Ethiopia Central Statistical Agency Addis Ababa, Ethiopia.

Central Statistical Agency-Ethiopia 2014, *Analytical Report on The 2013 National Labour Force Suervey Statistical Bulletin, Central Statistical Agency, Addis Ababa. http://www.csa.gov.et/survey-report/category/34-nlfs-2013*.

Chukwuma, A., Wosu, A.C., Mbachu, C. & Weze, K. 2017, 'Quality of antenatal care predicts retention in skilled birth attendance: a multilevel analysis of 28 African countries', *BMC pregnancy and childbirth*, vol. 17, no. 1, pp. 1-10.

Cislaghi, B., Denny, E.K., Cissé, M., Gueye, P., Shrestha, B., Shrestha, P.N., Ferguson, G., Hughes, C. & Clark, C.J. 2019, 'Changing social norms: the importance of "organized diffusion" for scaling up community health promotion and women empowerment interventions', *Prevention Science*, vol. 20, no. 6, pp. 936-46.

Corsi, D.J., Neuman, M., Finlay, J.E. & Subramanian, S.V. 2012, 'Demographic and health surveys: a profile', *International journal of epidemiology*, vol. 41, no. 6, pp. 1602-13.

Cottingham, J., Germain, A. & Hunt, P. 2012, 'Use of human rights to meet the unmet need for family planning', *The Lancet*, vol. 380, no. 9837, pp. 172-80.

Coyle, Y.M. & Battles, J.M. 1999, 'Using antecedents of medical care to develop valid quality of care measures', *International Journal for Quality in Health Care*, vol. 11, no. 1, pp. 5-12.

Croft, T.N., Marshall, A.M.J. & Allen, C.K., 'Guide to DHS statistics: DHS-7 (version 2).[Internet] Rockville, MD: ICF; 2020 May [cited 2021 Jan 23]', Series Guide to DHS statistics: DHS-7 (version 2).[Internet] Rockville, MD: ICF; 2020 May [cited 2021 Jan 23].

Croft, T.N., Marshall, A.M.J., Allen, C.K., Arnold, F., Assaf, S. & Balian, S. 2018, 'Guide to DHS statistics', *Rockville: ICF*, vol. 645.

CSA-Ethiopia 2001, 'Ethiopia Demographic and Health Survey 2000', *Central Statistics Authority, Addis Ababa*.

CSA-Ethiopia 2016, *https://bmcpediatr.biomedcentral.com/articles/10.1186/s12887-021-02901-y. Accessed on 28 September 2022*.

CSA-Ethiopia & I. C. F. I 2016, 'Ethiopian demographic and health survey 2016', *CSA and ICF International Addis Abeba, Ethiopia and Rockville, MD*.

CSA-Ethiopia, I.C.F. 2012, 'International: Ethiopia Demographic and Health Survey 2011', *Central Statistical Agency of Ethiopia and ICF International Addis Ababa, Ethiopia and Calverton, Maryland, USA*.

Daniele, M. 2017, 'Involving men in maternity care in Burkina Faso: an intervention study'.

Das, A., Gopalan, S.S. & Chandramohan, D. 2016, 'Effect of pay for performance to improve quality of maternal and child care in low-and middle-income countries: a systematic review', *BMC Public Health*, vol. 16, no. 1, p. 321.

Dawson, A. 2018, 'Meta-Synthesis of qualitative research', *Handbook of Research Methods in Health Social Sciences*.

Dawson, A.J., Buchan, J., Duffield, C., Homer, C.S.E. & Wijewardena, K. 2014, 'Task shifting and sharing in maternal and reproductive health in low-income countries: a narrative synthesis of current evidence', *Health policy and planning*, vol. 29, no. 3, pp. 396-408.

De Savigny, D. & Adam, T. 2009, *Systems thinking for health systems strengthening.* *https://apps.who.int/iris/handle/10665/44204*, World Health Organization.

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', *Reproductive Health*, vol. 11, no. 3, p. S1.

Dettrick, Z., Gouda, H.N., Hodge, A. & Jimenez-Soto, E. 2016, 'Measuring quality of maternal and newborn care in developing countries using demographic and health surveys', *PloS one*, vol. 11, no. 6, p. e0157110.

DHS Program 2023a, *The DHS program Methodology: DHS Survey Topics.* *https://dhsprogram.com/Methodology/Survey-Types/DHS.cfm*. **Accessed on 15 April, 2023.** .

DHS Program 2023b, *Proposal of a quality of care index (QOCI).* *https://dhsprogram.com/pubs/pdf/MR29/MR29.pdf*. *Accessed on 18 April, 2023.*

DHS Program 2023c, *Quality of care indictaors.* *https://dhsprogram.com/pubs/pdf/OF24/OF24.pdf*. *Accessed on 18 April, 2023.*

Di Blasio, P., Camisasca, E. & Miragoli, S. 2018, 'Childbirth related post-traumatic stress symptoms and maternal sleep difficulties: Associations with parenting stress', *Frontiers in psychology*, vol. 9, p. 2103.

Dickson, K.E., Simen-Kapeu, A., Kinney, M.V., Huicho, L., Vesel, L., Lackritz, E., de Graft Johnson, J., von Xylander, S., Rafique, N. & Sylla, M. 2014, 'Every Newborn: health-systems bottlenecks and strategies to accelerate scale-up in countries', *The Lancet*, vol. 384, no. 9941, pp. 438-54.

Donabedian, A. 1988, 'The quality of care: how can it be assessed?', *Jama*, vol. 260, no. 12, pp. 1743-8.

Duysburgh, E., Temmerman, M., Yé, M., Williams, A., Massawe, S., Williams, J., Mpembeni, R., Loukanova, S., Haefeli, W.E. & Blank, A. 2016, 'Quality of antenatal and childbirth care in rural health facilities in Burkina Faso, Ghana and Tanzania: an intervention study', *Tropical Medicine & International Health*, vol. 21, no. 1, pp. 70-83.

Edwards, C. & Saha, S. 2011, 'From home to hospital, a continuum of care: making progress towards Millennium Development Goals 4 and 5 in rural Bangladesh', *BJOG: An International Journal of Obstetrics & Gynaecology*, vol. 118, pp. 88-92.

Elezaj, E., Ramful, N., Cebotari, V. & Neubourg, C.D. 2019, *Gender Equality, Women's Empowerment and Child Wellbeing in Ethiopia*, UNICEF.

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 and childbirth*, vol. 20, no. 1, pp. 1-14.

Engineer, C.Y., Dale, E., Agarwal, A., Agarwal, A., Alonge, O., Edward, A., Gupta, S., Schuh, H.B., Burnham, G. & Peters, D.H. 2016, 'Effectiveness of a pay-for-performance intervention to improve maternal and child health services in Afghanistan: a cluster-randomized trial', *International journal of epidemiology*, vol. 45, no. 2, pp. 451-9.

EPHI and ICF 2021, 'Ethiopia mini demographic and health survey 2019: Final report', *Rockville, Maryland, USA: EPHI and ICF*.

Esu, E.B., Chibuzor, M., Aquaisua, E., Udoh, E., Sam, O., Okoroafor, S., Ongom, M., Effa, E., Oyo-Ita, A. & Meremikwu, M. 2021, 'Interventions for improving attraction and retention of health workers in rural and underserved areas: a systematic review of systematic reviews', *Journal of Public Health*, vol. 43, no. Supplement_1, pp. i54-i66.

Ethiopia Ministry of Health 2021, *Health Sector Transformation Plan II (HSTP II): 2020/21-2024/25 (2013 EFY-2017 EFY)*. *https://fp2030.org/sites/default/files/HSTP-II.pdf.*, MOH.

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 and childbirth*, vol. 19, no. 1, pp. 1-9.

FMOH Ethiopia 2005, 'Health sector strategic plan (HSDP-III) 2005/6-2009/10', Series Health sector strategic plan (HSDP-III) 2005/6-2009/10 Federal Ministry of Health Addis Ababa, Ethiopia.

Frenk, J., Chen, L., Bhutta, Z.A., Cohen, J., Crisp, N., Evans, T., Fineberg, H., Garcia, P., Ke, Y. & Kelley, P. 2010, 'Health professionals for a new century: transforming education to strengthen health systems in an interdependent world', *The lancet*, vol. 376, no. 9756, pp. 1923-58.

Gebre, E., Worku, A. & Bukola, F. 2018, 'Inequities in maternal health services utilization in Ethiopia 2000–2016: magnitude, trends, and determinants', *Reproductive health*, vol. 15, no. 1, pp. 1-9.

Gebrekirstos, L.G., Wube, T.B., Gebremedhin, M.H. & Lake, E.A. 2021, 'Magnitude and determinants of adequate antenatal care service utilization among mothers in Southern Ethiopia', *Plos one*, vol. 16, no. 7, p. e0251477.

Ghosh, R., Spindler, H., Morgan, M.C., Cohen, S.R., Begum, N., Gore, A., Mahapatra, T. & Walker, D.M. 2019, 'Diagnosis and management of postpartum hemorrhage and intrapartum asphyxia in a quality improvement initiative using nurse-mentoring and simulation in Bihar, India', *PloS one*, vol. 14, no. 7.

Girmaye, M. & Berhan, Y. 2016, 'Skilled antenatal care service utilization and its association with the characteristics of women's health development team in Yeky District, south-west Ethiopia: A multilevel analysis', *Ethiopian Journal of Health Sciences*, vol. 26, no. 4, pp. 369-80.

Gomez, P.P., Nelson, A.R., Asiedu, A., Addo, E., Agbodza, D., Allen, C., Appiagyei, M., Bannerman, C., Darko, P. & Duodu, J. 2018, 'Accelerating newborn survival in Ghana through a low-dose, high-frequency health worker training approach: a cluster randomized trial', *BMC pregnancy and childbirth*, vol. 18, no. 1, p. 72.

Haji, M., Durairaj, V., Zurn, P., Stormont, L. & Mapunda, M. 2010, 'Emerging opportunities for recruiting and retaining rural health workforce through decentralized health financing systems', *Bulletin of the World Health Organization*, vol. 88, pp. 397-9.

Hanefeld, J., Powell-Jackson, T. & Balabanova, D. 2017, 'Understanding and measuring quality of care: dealing with complexity', *Bulletin of the World Health Organization*, vol. 95, no. 5, p. 368.

Harden, A., Thomas, J., Cargo, M., Harris, J., Pantoja, T., Flemming, K., Booth, A., Garside, R., Hannes, K. & Noyes, J. 2018, 'Cochrane Qualitative and Implementation Methods Group guidance series—paper 5: methods for integrating qualitative and implementation evidence within intervention effectiveness reviews.', *Journal of clinical epidemiology*, vol. 97, pp. 70-8.

Harvey, S.A., Blandón, Y.C.W., McCaw-Binns, A., Sandino, I., Urbina, L., Rodríguez, C., Gómez, I., Ayabaca, P. & Djibrina, S. 2007, 'Are skilled birth attendants really skilled? A measurement method, some disturbing results and a potential way forward', *Bulletin of the World Health Organization*, vol. 85, pp. 783-90.

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', *Journal of health, population, and nutrition*, vol. 31, no. 4 Suppl 2, p. S67.

Higgins, J.P.T., Savović, J., Page, M.J. & Sterne, J.A.C. 2016, 'Revised Cochrane risk of bias tool for randomized trials (RoB 2.0). https://sites.google.com/site/riskofbiastool/welcome/rob-2-0-tool/archive-rob-2-0-2016', *Bristol: University of Bristol.* .

Hodgins, S. & D'Agostino, A. 2014, 'The quality–coverage gap in antenatal care: toward better measurement of effective coverage', *Global Health: Science and Practice*, vol. 2, no. 2, pp. 173-81.

Hofmeyr, G.J. 2005, 'Evidence-based intrapartum care', *Best Practice & Research Clinical Obstetrics & Gynaecology*, vol. 19, no. 1, pp. 103-15.

Horwood, C., Haskins, L., Vermaak, K., Phakathi, S., Subbaye, R. & Doherty, T. 2010, 'Prevention of mother to child transmission of HIV (PMTCT) programme in KwaZulu-Natal, South Africa: an evaluation of PMTCT implementation and integration into routine maternal, child and women's health services', *Tropical Medicine & International Health*, vol. 15, no. 9, pp. 992-9.

Hox, J.J., Moerbeek, M. & Van de Schoot, R. 2017, *Multilevel analysis: Techniques and applications*, Routledge.

Hsieh, H.-F. & Shannon, S.E. 2005, 'Three approaches to qualitative content analysis', *Qualitative health research*, vol. 15, no. 9, pp. 1277-88.

HSTP II Ethiopia 2021, *Health Sector Transformation Plan II (HSTP II) 2020/21 - 2024/25 (2013 EFY-2017 EFY). http://repository.iifphc.org/handle/123456789/1414. https://fp2030.org/sites/default/files/HSTP-II.pdf.* .

Hulton, L., Matthews, Z. & Stones, R.W. 2000, 'A framework for the evaluation of quality of care in maternity services', *University of Southampton*.

Institute of Medicine . Division of Health Care, S., Institute of Medicine . Committee to Design a Strategy for Quality, R., Assurance in, M. & United States. Health Care Financing, A. 1990, *Medicare: a strategy for quality assurance, volume ii: sources and methods*, vol. 2, National Academy Press.

International Household Survey Network 1994, 'Population and Housing Census 1994. https://catalog.ihsn.org/catalog/3601. Accessed on February 22 2022.', Series Population and Housing Census 1994. https://catalog.ihsn.org/catalog/3601. Accessed on February 22 2022.

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 services research*, vol. 17, no. 1, pp. 1-15.

James, K.S., Mishra, U.S. & Pallikadavath, S. 2022, 'Sequential impact of components of maternal and child health care services on the continuum of care in India', *Journal of Biosocial Science*, vol. 54, no. 3, pp. 450-72.

Joanna Briggs Institute 2017, 'The Joanna Briggs Institute critical appraisal tools for use in JBI systematic reviews: checklist for quasi-experimental studies (non-randomized experimental studies) 2017 [Available from: http://joannabriggs.org/research/critical-appraisal-tools.html. org/assets/docs/critical-appraisal-tools. ', *JBI_Quasi-Experimental_Appraisal_Tool2017. pdf*.

Joshi, C., Torvaldsen, S., Hodgson, R. & Hayen, A. 2014, 'Factors associated with the use and quality of antenatal care in Nepal: a population-based study using the demographic and health survey data', *BMC pregnancy and childbirth*, vol. 14, no. 1, pp. 1-11.

Kambala, C., Lohmann, J., Mazalale, J., Brenner, S., Sarker, M., Muula, A.S. & De Allegri, M. 2017, 'Perceptions of quality across the maternal care continuum in the context of a health financing intervention: Evidence from a mixed methods study in rural Malawi', *BMC health services research*, vol. 17, no. 1, p. 392.

Kassa, G.M., Arowojolu, A.O., Odukogbe, A.T.A. & Yalew, A.W. 2021, 'Adverse maternal outcomes of adolescent pregnancy in Northwest Ethiopia: A prospective cohort study', *Plos one*, vol. 16, no. 9, p. e0257485.

Ke, X., Saksena, P. & Holly, A. 2011, 'The determinants of health expenditure: a country-level panel data analysis', *Geneva: World Health Organization*, vol. 26, no. 1-28.

Kea, A.Z., Tulloch, O., Datiko, D.G., Theobald, S. & Kok, M.C. 2018, 'Exploring barriers to the use of formal maternal health services and priority areas for action in Sidama zone, southern Ethiopia', *BMC pregnancy and childbirth*, vol. 18, no. 1, pp. 1-12.

Kebede, A., Hassen, K. & Nigussie Teklehaymanot, A. 2016, 'Factors associated with institutional delivery service utilization in Ethiopia', *International journal of women's health*, pp. 463-75.

Kerber, K.J., de Graft-Johnson, J.E., Bhutta, Z.A., Okong, P., Starrs, A. & Lawn, J.E. 2007a, 'Continuum of care for maternal, newborn, and child health: from slogan to service delivery', *The Lancet*, vol. 370, no. 9595, pp. 1358-69.

Kerber, K.J., de Graft-Johnson, J.E., Bhutta, Z.A., Okong, P., Starrs, A. & Lawn, J.E. 2007b, 'Continuum of care for maternal, newborn, and child health: from slogan to service delivery', *Lancet*, vol. 370, no. 9595, pp. 1358-69.

Kesmodel, U.S. & Jølving, L.R. 2011, 'Measuring and improving quality in obstetrics–the implementation of national indicators in Denmark', *Acta obstetricia et gynecologica Scandinavica*, vol. 90, no. 4, pp. 295-304.

Ki-Moon, B. 2010, 'Global strategy for women's and children's health', *New York: United Nations*.

Koblinsky, M., Moyer, C.A., Calvert, C., Campbell, J., Campbell, O.M.R., Feigl, A.B., Graham, W.J., Hatt, L., Hodgins, S. & Matthews, Z. 2016, 'Quality maternity care for every woman, everywhere: a call to action', *The Lancet*, vol. 388, no. 10057, pp. 2307-20.

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 and childbirth*, vol. 21, no. 1, pp. 1-12.

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*, vol. 6, no. 11, pp. e1196-e252.

Kruk, M.E., Larson, E. & Twum-Danso, N.A.Y. 2016, 'Time for a quality revolution in global health', *The Lancet Global health*, vol. 4, no. 9, pp. e594-e6.

Kruske, S. & Barclay, L. 2004, 'Effect of shifting policies on traditional birth attendant training', *The Journal of Midwifery & Women's Health*, vol. 49, no. 4, pp. 306-11.

Kyngäs, H. & Kaakinen, P. 2020, 'Deductive Content Analysis. https://doi.org/10.1007/978-3-030-30199-6_3', in H. Kyngäs, K. Mikkonen & M. Kääriäinen (eds), *The Application of Content Analysis in Nursing Science Research*, Springer International Publishing, Cham, pp. 23-30.

Lama, T.P., Munos, M.K., Katz, J., Khatry, S.K., LeClerq, S.C. & Mullany, L.C. 2020, 'Assessment of facility and health worker readiness to provide quality antenatal, intrapartum and postpartum care in rural Southern Nepal', *BMC health services research*, vol. 20, no. 1, pp. 1-12.

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*, vol. 93, pp. 259-70G.

Larson, E., Gage, A.D., Mbaruku, G.M., Mbatia, R., Haneuse, S. & Kruk, M.E. 2019, 'Effect of a maternal and newborn health system quality improvement project on the use of facilities for childbirth: a cluster-randomised study in rural Tanzania', *Tropical Medicine & International Health*, vol. 24, no. 5, pp. 636-46.

Lassi, Z.S., Cometto, G., Huicho, L. & Bhutta, Z.A. 2013, 'Quality of care provided by mid-level health workers: systematic review and meta-analysis', *Bulletin of the World Health Organization*, vol. 91, pp. 824-33I.

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', *Human resources for health*, vol. 14, no. 1, p. 10.

Lattof, S.R., Tunçalp, Ö., Moran, A.C., Bucagu, M., Chou, D., Diaz, T. & Gülmezoglu, A.M. 2020, 'Developing measures for WHO recommendations on antenatal care for a positive pregnancy experience: a conceptual framework and scoping review', *BMJ open*, vol. 9, no. 4, p. e024130.

Leslie, H.H., Gage, A., Nsona, H., Hirschhorn, L.R. & Kruk, M.E. 2016, 'Training and supervision did not meaningfully improve quality of care for pregnant women or sick children in sub-Saharan Africa', *Health Affairs*, vol. 35, no. 9, pp. 1716-24.

Leventhal, D.G.P., Crochemore-Silva, I., Vidaletti, L.P., Armenta-Paulino, N., Barros, A.J.D. & Victora, C.G. 2021, 'Delivery channels and socioeconomic inequalities in coverage of reproductive, maternal, newborn, and child health interventions: analysis of 36 cross-sectional surveys in low-income and middle-income countries', *The Lancet Global Health*, vol. 9, no. 8, pp. e1101-e9.

Lewin, S., Munabi-Babigumira, S., Glenton, C., Daniels, K., Bosch-Capblanch, X., Van Wyk, B.E., Odgaard-Jensen, J., Johansen, M., Aja, G.N. & Zwarenstein, M. 2010, 'Lay health workers in primary and community health care for maternal and child health and the management of infectious diseases', *Cochrane database of systematic reviews*, no. 3.

Macpherson, I., Roqué-Sánchez, M.V., Legget, F.O., Fuertes, F. & Segarra, I. 2016, 'A systematic review of the relationship factor between women and health professionals within the multivariant analysis of maternal satisfaction', *Midwifery*, vol. 41, pp. 68-78.

Macro, O.R.C. 2006, 'Ethiopia demographic and health survey 2005', *Central Statistical Agency, Addis Ababa*.

Magge, H., Chilengi, R., Jackson, E.F., Wagenaar, B.H. & Kante, A.M. 2017, 'Tackling the hard problems: implementation experience and lessons learned in newborn health from the African health initiative', *BMC health services research*, vol. 17, no. 3, p. 829.

Marsh, A.D., Muzigaba, M., Diaz, T., Requejo, J., Jackson, D., Chou, D., Cresswell, J.A., Guthold, R., Moran, A.C. & Strong, K.L. 2020, 'Effective coverage measurement in maternal, newborn, child, and adolescent health and nutrition: progress, future prospects, and implications for quality health systems', *The Lancet Global Health*, vol. 8, no. 5, pp. e730-e6.

Maru, D., Maru, S., Nirola, I., Gonzalez-Smith, J., Thoumi, A., Nepal, P., Chaudary, P., Basnett, I., Udayakumar, K. & McClellan, M. 2017, 'Accountable care reforms improve women's and children's health in Nepal', *Health Affairs*, vol. 36, no. 11, pp. 1965-72.

Maxwell, R.J. 1992, 'Dimensions of quality revisited: from thought to action', *Quality in health care*, vol. 1, no. 3, p. 171.

Mayring, P. 2014, 'Qualitative content analysis: theoretical foundation, basic procedures and software solution'.

Mazur, A., Brindis, C.D. & Decker, M.J. 2018, 'Assessing youth-friendly sexual and reproductive health services: a systematic review', *BMC health services research*, vol. 18, no. 1, pp. 1-12.

McDougal, L., Atmavilas, Y., Hay, K., Silverman, J.G., Tarigopula, U.K. & Raj, A. 2017, 'Making the continuum of care work for mothers and infants: Does gender equity matter? Findings from a quasi-experimental study in Bihar, India', *PloS one*, vol. 12, no. 2, p. e0171002.

McKinnon, B., Harper, S. & Kaufman, J.S. 2015, 'Who benefits from removing user fees for facility-based delivery services? Evidence on socioeconomic differences from Ghana, Senegal and Sierra Leone', *Social science & medicine*, vol. 135, pp. 117-23.

McKinnon, B., Harper, S., Kaufman, J.S. & Bergevin, Y. 2015, 'Removing user fees for facility-based delivery services: a difference-in-differences evaluation from ten sub-Saharan African countries', *Health policy and planning*, vol. 30, no. 4, pp. 432-41.

McPake, B., Squires, A., Agya, M. & Araujo, E. 2015, 'The economics of health professional education and careers: insights from a literature review'.

Mehra, R. 2010, 'Targeting Poverty and Gender Inequality to Improve Maternal Health'.

Merién, A.E.R., Van de Ven, J., Mol, B.W., Houterman, S. & Oei, S.G. 2010, 'Multidisciplinary team training in a simulation setting for acute obstetric emergencies: a systematic review', *Obstetrics & Gynecology*, vol. 115, no. 5, pp. 1021-31.

Ministry of Health, E. 2017, *The Health Development Army: Its Origins, Development and Current Status - The Health Documentation Initiative.* http://repository.iifphc.org/handle/123456789/505.

Moher, D., Liberati, A., Tetzlaff, J. & Altman, D.G. 2009, 'Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement', *Annals of internal medicine*, vol. 151, no. 4, pp. 264-9.

Moller, A.-B., Petzold, M., Chou, D. & Say, L. 2017, 'Early antenatal care visit: a systematic analysis of regional and global levels and trends of coverage from 1990 to 2013', *The Lancet Global Health*, vol. 5, no. 10, pp. e977-e83.

Montgomery, D.C. 2007, *Introduction to statistical quality control*, John Wiley & Sons.

Montgomery, D.C. 2020, *Introduction to statistical quality control*, John Wiley & Sons.

Mordal, E., Hanssen, I., Kassa, A. & Vatne, S. 2021, 'Mothers' Experiences and Perceptions of Facility-based Delivery Care in Rural Ethiopia', *Health Services Insights*, vol. 14, p. 11786329211017684.

Munabi-Babigumira, S., Glenton, C., Lewin, S., Fretheim, A. & Nabudere, H. 2017, 'Factors that influence the provision of intrapartum and postnatal care by skilled birth attendants in low-and middle-income countries: a qualitative evidence synthesis', *Cochrane Database of Systematic Reviews*, no. 11.

Mwaniki, M.K., Vaid, S., Chome, I.M., Amolo, D. & Tawfik, Y. 2014, 'Improving service uptake and quality of care of integrated maternal health services: the Kenya Kwale District improvement collaborative', *BMC health services research*, vol. 14, no. 1, p. 416.

Negero, M.G., Mitike, Y.B., Worku, A.G. & Abota, T.L. 2018, 'Skilled delivery service utilization and its association with the establishment of Women's Health Development Army in Yeky district, South West Ethiopia: a multilevel analysis', *BMC research notes*, vol. 11, no. 1, pp. 1-9.

Negero, M.G., Sibbritt, D. & Dawson, A. 2021a, 'How can human resources for health interventions contribute to sexual, reproductive, maternal, and newborn healthcare quality across the continuum in low- and lower-middle-income countries? A systematic review', *Human Resources for Health*, vol. 19, no. 1, p. 54.

Negero, M.G., Sibbritt, D. & Dawson, A. 2021b, 'How can human resources for health interventions contribute to sexual, reproductive, maternal, and newborn healthcare quality across the continuum in low-and lower-middle-income countries? A systematic review', *Human resources for health*, vol. 19, no. 1, pp. 1-28.

Negero, M.G., Sibbritt, D. & Dawson, A. 2021c, *How can human resources for health interventions contribute to the quality of care in maternal health across the continuum in low-and lower-middle-income countries? A systematic review. PROSPERO 2020 CRD42020145038 Available from:* https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42020145038

Nelson, L.S. 1984, 'The Shewhart control chart—tests for special causes', *Journal of quality technology*, vol. 16, no. 4, pp. 237-9.

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. 2021, 'Using mHealth to Improve Timeliness and Quality of Maternal and Newborn Health in the Primary Health Care System in Ethiopia', *Global Health: Science and Practice*, vol. 9, no. 3, pp. 668-81.

O'Donnell, O., O'Neill, S., Van Ourti, T. & Walsh, B. 2016, 'Conindex: estimation of concentration indices', *The Stata Journal*, vol. 16, no. 1, pp. 112-38.

O'Neil, M.L. 2008, 'Human resource leadership: the key to improved results in health', *Human resources for health*, vol. 6, no. 1, pp. 1-4.

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*, vol. 10, no. 11, p. e036516.

Okawa, S., Gyapong, M., Leslie, H., Shibanuma, A., Kikuchi, K., Yeji, F., Tawiah, C., Addei, S., Nanishi, K. & Oduro, A.R. 2019, 'Effect of continuum-of-care intervention package on improving contacts and quality of maternal and newborn healthcare in Ghana: a cluster randomised controlled trial', *BMJ open*, vol. 9, no. 9, p. e025347.

Okuga, M., Kemigisa, M., Namutamba, S., Namazzi, G. & Waiswa, P. 2015, 'Engaging community health workers in maternal and newborn care in eastern Uganda', *Global health action*, vol. 8, no. 1, p. 23968.

Øvretveit, J. 1992, 'Health service quality: an introduction to quality methods for health services', *(No Title)*.

Owili, P.O., Muga, M.A., Mendez, B.R. & Chen, B. 2017, 'Quality of maternity care and its determinants along the continuum in Kenya: A structural equation modeling analysis', *PloS one*, vol. 12, no. 5, p. e0177756.

Patton, G.C., Sawyer, S.M., Santelli, J.S., Ross, D.A., Afifi, R., Allen, N.B., Arora, M., Azzopardi, P., Baldwin, W. & Bonell, C. 2016, 'Our future: a Lancet commission on adolescent health and wellbeing', *The Lancet*, vol. 387, no. 10036, pp. 2423-78.

Perry, C. 2008, 'Empowering primary care workers to improve health services: results from Mozambique's leadership and management development program', *Human resources for health*, vol. 6, no. 1, pp. 1-3.

Pirkle, C.M., Dumont, A., Traoré, M. & Zunzunegui, M.-V. 2013, 'Effect of a facility-based multifaceted intervention on the quality of obstetrical care: a cluster randomized controlled trial in Mali and Senegal', *BMC pregnancy and childbirth*, vol. 13, no. 1, p. 24.

Powers, D.A., Yoshioka, H. & Yun, M.-S. 2011, 'mvdcmp: Multivariate decomposition for nonlinear response models', *The Stata Journal*, vol. 11, no. 4, pp. 556-76.

Rabe-Hesketh, S. & Skrondal, A. 2008, *Multilevel and longitudinal modeling using Stata*, STATA press.

Radovich, E., Benova, L., Penn-Kekana, L., Wong, K. & Campbell, O.M.R. 2019, ''Who assisted with the delivery of (NAME)?'Issues in estimating skilled birth attendant coverage through population-based surveys and implications for improving global tracking', *BMJ global health*, vol. 4, no. 2, p. e001367.

Rahman, A., Moran, A., Pervin, J., Rahman, A., Rahman, M., Yeasmin, S., Begum, H., Rashid, H., Yunus, M. & Hruschka, D. 2011, 'Effectiveness of an integrated approach to reduce perinatal mortality: recent experiences from Matlab, Bangladesh', *BMC public health*, vol. 11, no. 1, p. 914.

Raven, J.H., Tolhurst, R.J., Tang, S. & Van Den Broek, N. 2012, 'What is quality in maternal and neonatal health care?', *Midwifery*, vol. 28, no. 5, pp. e676-e83.

Renard, Y. 2022, 'From fees to free: User fee removal, maternal health care utilization and child health in Zambia', *World Development*, vol. 156, p. 105891.

Renfrew, M.J., McFadden, A., Bastos, M.H., Campbell, J., Channon, A.A., Cheung, N.F., Silva, D.R.A.D., Downe, S., Kennedy, H.P. & Malata, A. 2014, 'Midwifery and quality care: findings from a new evidence-informed framework for maternal and newborn care', *The Lancet*, vol. 384, no. 9948, pp. 1129-45.

Rob, U. & Alam, M.M. 2014, 'Performance-based incentive for improving quality of maternal health services in Bangladesh', *International quarterly of community health education*, vol. 34, no. 4, pp. 303-12.

Roder-DeWan, S., Nimako, K., Twum-Danso, N.A.Y., Amatya, A., Langer, A. & Kruk, M. 2020, 'Health system redesign for maternal and newborn survival: rethinking care models to close the global equity gap', *BMJ Global Health*, vol. 5, no. 10, p. e002539.

Rowe, A.K., De Savigny, D., Lanata, C.F. & Victora, C.G. 2005, 'How can we achieve and maintain high-quality performance of health workers in low-resource settings?', *The Lancet*, vol. 366, no. 9490, pp. 1026-35.

Rurangirwa, A.A., Mogren, I., Nyirazinyoye, L., Ntaganira, J. & Krantz, G. 2017, 'Determinants of poor utilization of antenatal care services among recently delivered women in Rwanda; a population based study', *BMC Pregnancy and Childbirth*, vol. 17, no. 1, p. 142.

Rutstein, S.O. & Johnson, K. 2004, 'The DHS wealth index. DHS Comparative Reports No. 6. Calverton (MD): ORC Macro; 2004', Series The DHS wealth index. DHS Comparative Reports No. 6. Calverton (MD): ORC Macro; 2004.

Ryan, B.L., Krishnan, R.J., Terry, A. & Thind, A. 2019, 'Do four or more antenatal care visits increase skilled birth attendant use and institutional delivery in Bangladesh? A propensity-score matched analysis', *BMC Public Health*, vol. 19, no. 1, pp. 1-6.

Sacks, E. & Kinney, M.V. 2015, 'Respectful maternal and newborn care: building a common agenda', *Reproductive health*, vol. 12, no. 1, pp. 1-4.

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*, vol. 14, no. 4, p. e0215635.

Satti, H., Motsamai, S., Chetane, P., Marumo, L., Barry, D.J., Riley, J., McLaughlin, M.M., Seung, K.J. & Mukherjee, J.S. 2012, 'Comprehensive approach to improving maternal health and achieving MDG 5: report from the mountains of Lesotho', *PLoS One*, vol. 7, no. 8, p. e42700.

Save the Children 2014, 'State of the World's Mothers 2014: Saving mothers and children in humanitarian crises', Series State of the World's Mothers 2014: Saving mothers and children in humanitarian crises Author London, England.

Say, L. & Raine, R. 2007, 'A systematic review of inequalities in the use of maternal health care in developing countries: examining the scale of the problem and the importance of context', *Bulletin of the World Health Organization*, vol. 85, pp. 812-9.

SDG Five 2022, *Achieve gender equality and empower all women and girls. https://sdgs.un.org/goals/goal5. Accessed on 16 September 2022.* .

SDG Four 2022, *Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all. https://sdgs.un.org/goals/goal4.* .

Sepehri, A., Sarma, S., Simpson, W. & Moshiri, S. 2008, 'How important are individual, household and commune characteristics in explaining utilization of maternal health services in Vietnam?', *Social science & medicine*, vol. 67, no. 6, pp. 1009-17.

Shiva, L., Desai, G., Satyanarayana, V.A., Venkataram, P. & Chandra, P.S. 2021, 'Negative Childbirth Experience and Post-traumatic Stress Disorder-A Study Among Postpartum Women in South India', *Frontiers in Psychiatry*, vol. 12.

Sibley, L.M., Sipe, T.A. & Barry, D. 2012, 'Traditional birth attendant training for improving health behaviours and pregnancy outcomes', *Cochrane database of systematic reviews*, no. 8.

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', *Maternal and child health journal*, vol. 20, no. 2, pp. 281-9.

Singh, L., Dubey, R., Singh, P.K., Nair, S., Rai, R.K., Rao, M.V.V. & Singh, S. 2022, 'Coverage of quality maternal and newborn healthcare services in India: examining dropouts, disparity and determinants', *Annals of Global Health*, vol. 88, no. 1.

Solar, O. & Irwin, A. 2010, *A conceptual framework for action on the social determinants of health*, WHO Document Production Services.

Spector, J.M., Agrawal, P., Kodkany, B., Lipsitz, S., Lashoher, A., Dziekan, G., Bahl, R., Merialdi, M., Mathai, M. & Lemer, C. 2012, 'Improving quality of care for maternal and newborn health: prospective pilot study of the WHO safe childbirth checklist program', *PloS one*, vol. 7, no. 5, p. e35151.

Sserwanja, Q., Mukunya, D., Nabachenje, P., Kemigisa, A., Kiondo, P., Wandabwa, J.N. & Musaba, M.W. 2022, 'Continuum of care for maternal health in Uganda: A national cross-sectional study', *PloS one*, vol. 17, no. 2, p. e0264190.

Sserwanja, Q., Nuwabaine, L., Gatasi, G., Wandabwa, J.N. & Musaba, M.W. 2022, 'Factors associated with utilization of quality antenatal care: a secondary data analysis of Rwandan demographic health survey 2020', *BMC health services research*, vol. 22, no. 1, p. 812.

StataCorp LLC 2022, *Stata/SE 16 for the windows. https://www.stata.com/terms-of-use/*.

The Harvard Chan School Centre of Excellence in Maternal and Child Health, 'Quality antenatal care. https://www.mhtf.org/topics/antenatal-care/. Accessed on **October 10 August 2021**', *Maternal Health Task Force*, weblog.

The Harvard Chan School Centre of Excellence in Maternal and Child Health 2021, 'Quality of Maternal Health Care. https://www.mhtf.org/topics/quality-of-maternal-health-care/. Accessed 24 August 2021 ', *Maternal Health Task Force*, weblog.

Tinker, A., ten Hoope-Bender, P., Azfar, S., Bustreo, F. & Bell, R. 2005, 'A continuum of care to save newborn lives', *The Lancet*, vol. 365, no. 9462, pp. 822-5.

Tokhi, M., Comrie-Thomson, L., Davis, J., Portela, A., Chersich, M. & Luchters, S. 2018, 'Involving men to improve maternal and newborn health: a systematic review of the effectiveness of interventions', *PloS one*, vol. 13, no. 1, p. e0191620.

Tomblin Murphy, G., Mtey, G., Nyamtema, A., LeBlanc, J., Rigby, J., Abel, Z. & Mselle, L.T. 2022, 'Building leadership and managerial capacity for maternal and newborn health services', *BMC Health Services Research*, vol. 22, no. 1, pp. 1-13.

Tong, A., Flemming, K., McInnes, E., Oliver, S. & Craig, J. 2012, 'Enhancing transparency in reporting the synthesis of qualitative research: ENTREQ', *BMC medical research methodology*, vol. 12, no. 1, p. 181.

Tsui, A., Ukwuani, F., Guilkey, D. & Angeles, G. 2003, 'A comparative multi-level analysis of health program effects on individual use of reproductive and sexual health services', *Measure evaluation bulletin*, vol. 6, pp. 1-12.

Tunçalp, Ö., Were, W.M., MacLennan, C., Oladapo, O.T., Gülmezoglu, A.M., Bahl, R., Daelmans, B., Mathai, M., Say, L. & Kristensen, F. 2015a, 'Quality of care for pregnant women and newborns—the WHO vision', *BJOG: an international journal of obstetrics & gynaecology*, vol. 122, no. 8, pp. 1045-9.

Tunçalp, Ö., Were, W.M., MacLennan, C., Oladapo, O.T., Gülmezoglu, A.M., Bahl, R., Daelmans, B., Mathai, M., Say, L. & Kristensen, F. 2015b, 'Quality of care for pregnant women and newborns—the WHO vision', *Bjog*, vol. 122, no. 8, p. 1045.

UN SDGs 2022, *The Sustainable Development Goals. https://sdgs.un.org/goals#goals. Accessed on 17 June 2022*.

UNHC 2022, *Universal Health Coverage Partnership. https://www.uhcpartnership.net/country-profile/ethiopia/. Accessed on 28 August 2022*.

UNICEF 2022, ' Maternal and newborn health. Newborns and mothers are still dying in appalling numbers – mostly from preventable causes. https://www.unicef.org/health/maternal-and-newborn-health. Accessed on February 21 2022.', Series Maternal and newborn health. Newborns and mothers are still dying in appalling numbers – mostly from preventable causes. https://www.unicef.org/health/maternal-and-newborn-health. Accessed on February 21 2022.

United Nations Population, F. 2014, 'The state of the world's midwifery 2014: a universal pathway: a woman's right to health', Series The state of the world's midwifery 2014: a universal pathway: a woman's right to health UNFPA New York.

UNPD 2022, *World Contraceptive Use. https://www.un.org/development/desa/pd/data/world-contraceptive-use. Family Planning Indicators. Estimates and Projections of Family Planning*

Indicators 2022. *https://www.un.org/development/desa/pd/node/3288*. *Accessed on 15 September 2022*.

Usman, M., Banerjee, A. & Srivastava, S. 2021, 'Association between maternal health continuum of care and child Survival: Evidence from a population based survey', *Children and Youth Services Review*, vol. 128, p. 106134.

Usmanova, G., Lalchandani, K., Srivastava, A., Joshi, C.S., Bhatt, D.C., Bairagi, A.K., Jain, Y., Afzal, M., Dhoundiyal, R. & Benawri, J. 2021, 'The role of digital clinical decision support tool in improving quality of intrapartum and postpartum care: experiences from two states of India', *BMC pregnancy and childbirth*, vol. 21, no. 1, pp. 1-12.

Vieira, C., Portela, A., Miller, T., Coast, E., Leone, T. & Marston, C. 2012, 'Increasing the use of skilled health personnel where traditional birth attendants were providers of childbirth care: a systematic review', *PLoS One*, vol. 7, no. 10.

Vujicic, M., Alfano, M., Ryan, M., Wesseh, C.S. & Brown-Annan, J. 2010, 'Policy options to attract nurses to rural Liberia: evidence from a discrete choice experiment'.

Vujicic, M., Weber, S.E., Nikolic, I.A., Atun, R. & Kumar, R. 2012, 'An analysis of GAVI, the Global Fund and World Bank support for human resources for health in developing countries', *Health policy and planning*, vol. 27, no. 8, pp. 649-57.

Wabiri, N., Chersich, M., Shisana, O., Blaauw, D., Rees, H. & Dwane, N. 2016, 'Growing inequities in maternal health in South Africa: a comparison of serial national household surveys', *BMC pregnancy and childbirth*, vol. 16, no. 1, pp. 1-12.

Wagstaff, A. 2004, *The Millennium Development Goals for health: rising to the challenges*, World Bank Publications.

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.

Waiswa, P., Pariyo, G., Kallander, K., Akuze, J., Namazzi, G., Ekirapa-Kiracho, E., Kerber, K., Sengendo, H., Aliganyira, P. & Lawn, J.E. 2015, 'Effect of the Uganda Newborn Study on care-seeking and care practices: a cluster-randomised controlled trial', *Global health action*, vol. 8, no. 1, p. 24584.

Waldenström, U. & Turnbull, D. 1998, 'A systematic review comparing continuity of midwifery care with standard maternity services', *BJOG: An International Journal of Obstetrics & Gynaecology*, vol. 105, no. 11, pp. 1160-70.

Wang, H., Frasco, E., Takesue, R. & Tang, K. 2021, 'Maternal education level and maternal healthcare utilization in the Democratic Republic of the Congo: an analysis of the multiple indicator cluster survey 2017/18', *BMC Health Services Research*, vol. 21, no. 1, pp. 1-13.

Wang, W. & Hong, R. 2013a, *Completing the continuum of care for maternal and newborn Heath in Cambodia: who drops out?*, ICF International.

Wang, W. & Hong, R. 2013b, 'The continuum of care for maternal and newborn health in Cambodia: where are the gaps and why? A population-based study', *The Lancet*, vol. 381, p. S145.

Wang, W., Temsah, G. & Mallick, L. 2014, *Health insurance coverage and its impact on maternal health care utilization in low-and middle-income countries*, ICF International.

Wehrmeister, F.C., Restrepo-Mendez, M.-C., Franca, G.V.A., Victora, C.G. & Barros, A.J.D. 2016, 'Summary indices for monitoring universal coverage in maternal and child health care', *Bulletin of the World Health Organization*, vol. 94, no. 12, p. 903.

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 healthcare in sub-Saharan Africa: a systematic review', *Systematic reviews*, vol. 5, no. 1, p. 137.

WHO-HRH action framework 2012, 'HRH action framework. *https://www.capacityproject.org/framework/*', *WHO Geneva*.

WHO 1978, *Primary healthcare: A joint report. https://apps.who.int/iris/handle/10665/39225*, World Health Organization.

WHO 2006a, *Quality of care: a process for making strategic choices in health systems*, World Health Organization.

WHO 2006b, *The world health report 2006: working together for health. https://apps.who.int/iris/handle/10665/43432*. , World Health Organization.

WHO 2010, *Packages of interventions for family planning, safe abortion care, maternal, newborn and child health. https://apps.who.int/iris/handle/10665/70428*. , World Health Organization.

WHO 2011, *WHO guidelines on preventing early pregnancy and poor reproductive health outcomes among adolescents in developing countries. https://www.who.int/publications/i/item/9789241502214*., World Health Organization.

WHO 2012a, *WHO recommendations: optimizing health worker roles to improve access to key maternal and newborn health interventions through task shifting. https://apps.who.int/iris/handle/10665/77764*., World Health Organization, Geneva.

WHO 2012b, *WHO recommendations: optimizing health worker roles to improve access to key maternal and newborn health interventions through task shifting. https://apps.who.int/iris/handle/10665/77764*. , World Health Organization.

WHO 2014a, *Every newborn: an action plan to end preventable deaths. World Health Organization. https://apps.who.int/iris/handle/10665/127938. Accessed 25 June 2022*.

WHO 2014b, *WHO recommendations on postnatal care of the mother and newborn. https://www.who.int/publications/i/item/9789241506649*. , World Health Organization.

WHO 2015a, 'Pregnancy, childbirth, postpartum and newborn care: a guide for essential practice. https://www.who.int/publications/i/item/9789241549356.

WHO 2015b, *Strategies towards ending preventable maternal mortality (EPMM). World Health Organization. https://apps.who.int/iris/handle/10665/153544. Accessed 25 June 2022*.

WHO 2016a, 'Global strategy on human resources for health: workforce 2030. https://www.who.int/publications/i/item/9789241511131'.

WHO 2016b, 'Standards for improving quality of maternal and newborn care in health facilities. https://www.who.int/publications/i/item/9789241511216'.

WHO 2016c, *WHO recommendations on antenatal care for a positive pregnancy experience. https://www.who.int/publications/i/item/9789241549912*, World Health Organization.

WHO 2017, *Human rights and health. https://www.who.int/news-room/fact-sheets/detail/human-rights-and-health. Accessed on June 02, 2022*.

WHO 2018a, 'Definition of skilled health personnel providing care during childbirth: the 2018 joint statement by WHO. https://www.who.int/publications/i/item/WHO-RHR-18.14. ', Series Definition of skilled health personnel providing care during childbirth: the 2018 joint statement by WHO. https://www.who.int/publications/i/item/WHO-RHR-18.14. UNFPA, UNICEF, ICM, ICN, FIGO and IPA.

WHO 2018b, *WHO recommendations on intrapartum care for a positive childbirth experience. https://www.who.int/publications/i/item/9789241550215*, World Health Organization.

WHO 2019a, *Ethiopia - National Maternal Death Surveillance and Response System Annual Report 2010 EFY. https://www.afro.who.int/publications/ethiopia-national-maternal-death-surveillance-and-response-system-annual-report-2010. Accessed on 20 September 2022*.

WHO 2019b, 'Trends in maternal mortality 2000 to 2017: estimates by WHO, UNICEF, UNFPA, World Bank Group and the United Nations Population Division'.

WHO 2019c, *World health statistics 2019: Monitoring health for the SDGs (sustainable development goals). Geneva: World Health Organization. https://www.who.int/publications/i/item/9789241565707*.

WHO 2021a, *Raising the importance of postnatal care. https://www.who.int/activities/raising-the-importance-of-postnatal-care Accessed on October 11 2021*.

WHO 2021b, *World health statistics 2021: Monitoring health for the SDGs, sustainable development goals. https://www.who.int/publications/i/item/9789240027053*.

WHO 2022a, *Equiplot. International Center for Equity in Health. https://www.equidade.org/equiplot . Accessed on 17 January 2022.*

WHO 2022b, *Maternal Health. https://www.who.int/health-topics/maternal-health#tab=tab_2. accessed on 19 September 2022.*

WHO 2022c, *Tracking Universal Health Coverage in the WHO African Region, 2022. https://www.afro.who.int/publications/tracking-universal-health-coverage-who-african-region-2022. , World Health Organization. Regional Office for Africa.*

WHO 2022d, 'WHO recommendations on maternal and newborn care for a positive postnatal experience. https://www.who.int/publications/i/item/9789240045989'.

WHO, UNPF & UNICEF 2015, *Pregnancy, childbirth, postpartum and newborn care. A guide for essential practice (3rd edition). https://www.who.int/maternal_child_adolescent/documents/imca-essential-practice-guide/en/,* World Health Organization, United Nations Population Fund, UNICEF.

WHO, USAID & Global Health Workforce Alliance 2020, *Human Resources for Health Action Framework. https://www.capacityproject.org/framework/. https://www.who.int/teams/health-workforce/workforcealliance*.

WHO QC 2019, 'Quality of care for maternal, newborn, child and adolescent health. https://www.who.int/teams/maternal-newborn-child-adolescent-health-and-ageing/quality-of-care. Accessed on February 21 2022.', Series Quality of care for maternal, newborn, child and adolescent health. https://www.who.int/teams/maternal-newborn-child-adolescent-health-and-ageing/quality-of-care. Accessed on February 21 2022.

Wolfe, A. 2001, 'Institute of Medicine Report: crossing the quality chasm: a new healthcare system for the 21st century', *Policy, Politics, & Nursing Practice*, vol. 2, no. 3, pp. 233-5.

Worku, A.G., Yalew, A.W. & Afework, M.F. 2013, 'Factors affecting utilization of skilled maternal care in Northwest Ethiopia: a multilevel analysis', *BMC international health and human rights*, vol. 13, no. 1, pp. 1-11.

World Bank 2016, *New country classifications by income level: 2019-2020. https://datahelpdesk.worldbank.org/knowledgebase/articles/906519. http://chartsbin.com/view/2438. Accessed 28 September 2022.*

World Bank 2019, *New country classifications by income level: 2019-2020. https://datahelpdesk.worldbank.org/knowledgebase/articles/906519Accessed. 19 May 2022.*

World Bank 2023, *Population Growth (Annual %)-Ethiopia. https://data.worldbank.org/indicator/SP.POP.GROW?locations=ET. Accessed on April 10, 2023.*

World Health Organization 2002, *WHO antenatal care randomized trial: manual for the implementation of the new model.*, 9241546298, World Health Organization.

World Health Organization 2018, *WHO recommendations on intrapartum care for a positive childbirth experience.*, World Health Organization.

World Health Organization 2021, 'World health statistics 2021: monitoring health for the SDGs, sustainable development goals. '.

World Health Organization 2022, *World health statistics 2022: monitoring health for the SDGs, sustainable development goals. https://www.who.int/publications/i/item/9789240051157. ,* World Health Organization.

World Health Statistics 2021, *World health statistics 2021: monitoring health for the SDGs, sustainable development goals.*, Geneva.

Yaya, Y., Eide, K.T., Norheim, O.F. & Lindtjørn, B. 2014, 'Maternal and neonatal mortality in south-west Ethiopia: estimates and socio-economic inequality', *PloS one*, vol. 9, no. 4, p. e96294.

Yeneabat, T., Hayen, A., Getachew, T. & Dawson, A. 2022, 'The effect of national antenatal care guidelines and provider training on obstetric danger sign counselling: a propensity score matching analysis of the 2014 Ethiopia service provision assessment plus survey', *Reproductive Health*, vol. 19, no. 1, pp. 1-14.

Zeng, W., Shepard, D.S., Nguyen, H., Chansa, C., Das, A.K., Qamruddin, J. & Friedman, J. 2018, 'Cost–effectiveness of results-based financing, Zambia: a cluster randomized trial', *Bulletin of the World Health Organization*, vol. 96, no. 11, pp. 760-71.

Zhang, T., Wang, H., Wang, X., Yang, Y., Zhang, Y., Tang, Z. & Wang, L. 2020, 'The adverse maternal and perinatal outcomes of adolescent pregnancy: a cross sectional study in Hebei, China', *BMC Pregnancy and Childbirth*, vol. 20, pp. 1-10.

Appendices

Table A1 1: Human resources for health interventions and their effects on SRMNH care quality across the continuum in low-and lower-middle-income countries, 2020.

Reference	Context	Intervention	Duration of intervention	Type of health worker	Intervention setting	Method	Effects of intervention	Quality of the study
(Agarwal et al. 2019) (Agarwal et al. 2019)	India	Training and deployment of lay personnel to provide: health education, linkage of women to healthcare facilities, and home-based ANC and PNC services.	06 years	Accredited Social Health Activist	Primary care (Community based)	Indian Human Development Survey (IHDS)-II (2011-2012 data): Secondary data analysis	Exposure to ASHA agents: significantly associated with ANC-1 and SPAB use across the continuum; no significant impact on ≥ 4 ANC or PNC use between exposed and non-exposed women; 12% increase in women receiving at least some of the services; 8.8% decrease in women receiving no services; it is not significantly associated with completion of all services along the continuum.	Moderate
(Ayalew et al. 2017) (Ayalew et al. 2017)	Ethiopia	Standards-Based Management and Recognition (SBM-R) approach (multi-faceted interventions): BEmONC training; supportive supervision; audit and site mentoring; sector-wide leadership; quality improvement team in each facility; mobilizing financial resources; and community involvement	03 years	Doctors, health officers, midwives, and nurses.	Primary healthcare (8 Health centres) and 3 secondary care Hospitals	A post-only intervention versus comparison facilities design: Observations of service delivery using structured checklists to measure provider performance in ANC, uncomplicated labour and delivery care, and immediate PNC	A significant difference of 22 pp for each newborn and mother PNC skill area; significant positive impact on maternal and newborn health providers' performance during labour and delivery and immediate PNC services, but not during ANC services.	High
(Balakrishnan et al. 2016) (Balakrishnan et al. 2016)	India	Mobile technology – a health system strengthening multi-stakeholder cooperation (mHealth platform): Community-based frontline health workers training on mHealth platform and provision of maternal and child healthcare; supportive	02 years	ASHAs, Anganwadi workers, Auxiliary nurse-midwives, and	Primary care (Community based)	A quasi-experimental study with pre and post-implementation evaluation at intervention, and control areas: Coverage of quality indicators of maternal-child healthcare continuum compared with control	Implementation blocks had higher coverage of all the 07 quality indicators as compared to the control and the previous year-intervention area vs previous year vs control: registration within the 1st trimester (15% vs 10% vs 10%), complete ≥3 ANC visits (56% vs 51% vs 48%), at least 1TT vaccine (79% vs 74% vs 80%), ≥90 Iron and Folic Acid Tablets (62% vs 50% vs 49%), health facility birth (84% vs 59% vs 67%), breastfeeding within 1 hr of birth (98% vs 73% vs 73%), at least 1 PNC home visit (28% vs 18% vs 10%); there was equity of services across castes for all indicators- scheduled castes/tribes vs other castes: registration within the 1st trimester (15% vs 15%), complete ≥3 ANC contacts (55% vs 56%), at least 1 TT vaccine (77%	High

		supervision; and mobilizing financial resources		lady health supervisors		area and the previous year.	vs 79%), ≥90 Iron and Folic Acid Tablets (60% vs 62%), health facility birth (78% vs 87%), breastfeeding within 1 hr of birth (95% vs 95%), at least 1 PNC home visit (29% vs 28%); timely capture of data compared to paper-based reporting: Average time lag of 72 days (≈2.5 months) is overcome by instant data capture with the mHealth platform
(Basinga et al. 2011) (Basinga et al. 2011)	Rwanda	Quarterly Performance-based payment for healthcare providers, directly observed supervision, leadership, and hospital team advisory group	18-23 months	Doctors and mid-level cadres	Primary care (Primary health centres)	Prospective impact evaluation between P4P facilities (intervention) and traditional input-based funding facilities (controls); baseline and end-line surveys at facilities and households; Difference in differences analysis (DiD) where p-value was the cluster-adjusted t-test	Greatest effect on indicators that had the highest payment rates and needed the least effort from the service provider: an increase of 0·157 standard deviations (p=0·02) in ANC quality (against Rwandan prenatal clinical care practice guidelines), 7.2 % increase in Tetanus vaccine injections during ANC (p=0·057), no improvements in ≥ 4 ANC coverage (p=0·825), 23% increase in facility birth in the intervention group (p=0·017).	High
(Binyaruka et al. 2015) (Binyaruka et al. 2015)	Tanzania	Biannual P4P for health workers and district and regional health managers targeting eight specific MCH care services, leadership	13 months	Skille personnel	Primary healthcare (health centres, faith-based and parastatal dispensaries, and public dispensaries) and secondary care hospitals	A Controlled Before and After household and facility survey study: DiD analysis (effect-β)	A 0.05 (β: 0.05; p=0.03) increase in the patient satisfaction score for non-targeted services, A 5.0% reduction in out of pocket payment for birth (β: -5.0; p=0.023). No evidence of effect of P4P on patient experience of care for targeted services: At least 2 doses of intermittent preventive malaria treatment (IPT) during ANC (p=0.001), HIV treatment during ANC (p=0.893), health facility birth (p=0.001), polio vaccine at birth (p= 0.093), PNC (p=0.823), post-natal family planning (p=0.844), ANC contents (p=0.118), interpersonal care satisfaction during birth (p=0.505), staff kindness during birth (p=0.088), waiting time (p=0.636), consultation time (p=0.650).	High
(Bonfrer, Poel and Doorslaer 2014) (Bonfrer, Van de	Burundi	Performance-based financing (PBF); Quarterly quality assessment by local regulatory authorities	01-04 years	Doctor, nurse, and midwife	Primary healthcare facilities	Burundi Demographic and Health Survey-BDHS (2010-2011) data; the difference in differences analysis;	No significant effect on first-trimester ANC, ≥1 ANC visit or BP measurement during pregnancy; significant impact with 10 pp increase (p<0.001) on ≥1 anti-tetanus vaccination during ANC and with 5pp increase on SPAB for women where PBF was in place from the start of pregnancy; No significant effect on neonatal mortality; No impact on equitable care: higher probability of BP measurement during	High

Poel & Van Doorslaer 2014)						provinces with PBF vs. without PBF	pregnancy among non-poor; a significant increase in SPAB (p<0.028) among the non-poor, and no effect on SPAB among the poor.	
(Duysburgh et al. 2016) (Duysburgh et al. 2016)	Rural Burkina Faso, Ghana, and Tanzania	A computer-assisted clinical decision support system (eCDSS) and performance-based incentives: Performance productivity; Job satisfaction; Financial and non-financial incentives; Incentive policies; Local research stakeholder cooperation (eCDSS maintenance)	02 years	Medical officer, Assistant medical officer, Clinical officer, Assistant clinical officer, nurse/ midwife and auxiliary nurse/ midwife	Rural primary healthcare facilities	An intervention study: 06 intervention and 06 non-intervention PHC facilities in each country; Assessment of quality of care in each facility by health facility surveys, direct observation of antenatal and childbirth care, patient satisfaction exit interviews, and reviews of patient records and maternal and child health registers; Pre- vs. post-intervention and intervention vs. non-intervention health facilities' quality assessment.	No significant difference in quality scores of ANC and delivery care to pre-intervention time or non-intervention facilities' scores. Total ANC observation quality scores (pre vs post intervention: 0.83 vs 0.87, p=0.06; intervention vs non-intervention facilities at end line: 0.87 vs 0.86, p=0.33); Total ANC satisfaction survey quality scores (pre vs post intervention: 0.42 vs 0.71, p=0.09; intervention vs non-intervention facilities at end line: 0.71 vs 0.55, p=0.73); Total ANC patient record review quality scores (pre vs post intervention: 0.75 vs 0.82, p=0.03; intervention vs non-intervention facilities at end line: 0.82 vs 0.71, p=0.03); Total childbirth observation quality scores (pre vs post intervention: 0.65 vs 0.75, p=0.01; intervention vs non-intervention facilities at end line: 0.75 vs 0.68, p=0.11); Total childbirth satisfaction survey quality scores: (pre vs post intervention: 0.70 vs 0.84, p=0.71; intervention vs non-intervention facilities at end line: 0.84 vs 0.83, p=0.90); Total BEmONC signal functions scores (pre vs post intervention: 0.75 vs 0.72, p=0.09; intervention vs non-intervention facilities at end line: 0.72 vs 0.68, p=0.97); History taking on vaginal bleeding-ANC observation scores (pre vs post intervention: 0.22 vs 0.32, p=0.17; intervention vs non-intervention facilities at end line: 0.32 vs 0.19, p=0.02); Counselling on vaginal bleeding-ANC observation scores (pre vs post intervention: 0.49 vs 0.43, p=0.65; intervention vs non-intervention facilities at end line: 0.43 vs 0.42, p=0.80); History taking on vaginal bleeding-childbirth observation scores (pre vs post intervention: 0.32 vs 0.32, p=0.20; intervention vs non-intervention facilities at end line: 0.32 vs 0.31, p=0.54); Administer oxytocin after childbirth-childbirth observation scores (pre vs post intervention: 0.92 vs 0.96, p=0.70; intervention vs non-intervention facilities at end line: 0.96 vs 0.91, p=0.72); Monitoring uterine retraction after childbirth-childbirth observation scores (pre vs post intervention: 0.41 vs 0.60, p=0.02; intervention vs non-intervention facilities at end line: 0.60 vs 0.56, p=0.17); Assessing vaginal bleeding after childbirth-childbirth observation scores (pre vs post intervention: 0.60 vs 0.78, p=0.10; intervention vs non-intervention facilities at end line: 0.78 vs 0.72, p=0.38); ANC satisfaction scores-counselling on vaginal bleeding (pre vs post intervention: 0.44 vs 0.47, p=0.91; intervention vs non-intervention	High

							facilities at end line: 0.47 vs 0.17, p=0.79); Women who received oxytocin (%)-Childbirth record review (pre vs post intervention: 89 vs 89, p=0.96; intervention vs non-intervention facilities at end line: 89 vs 96, p<0.01); Checking BP- ANC observation scores (pre vs post intervention: 0.98 vs 0.97, p=0.96; intervention vs non-intervention facilities at end line: 0.97 vs 0.93, p=0.77); Lab proteinuria examination-ANC observation scores (pre vs post intervention: 0.32 vs 0.47, p=0.03; intervention vs non-intervention facilities at end line: 0.47 vs 0.22, p<0.01); Counselling on hypertensive disorders danger signs-ANC observation scores (pre vs post intervention: 0.45 vs 0.43, p=0.68; intervention vs non-intervention facilities at end line: 0.43 vs 0.37, p=0.57); Monitoring BP-Childbirth observation scores (pre vs post intervention: 0.53 vs 0.68, p=0.04; intervention vs non-intervention facilities at end line: 0.68 vs 0.62, p=0.30); Counselling on hypertensive disorder danger signs-ANC satisfaction scores (pre vs post intervention: 0.02 vs 0.42, p=0.17; intervention vs non-intervention facilities at end line: 0.42 vs 0.19, p=0.90); Lab proteinuria exam-ANC record review (pre vs post intervention: 0.51 vs 0.69, p=0.11; intervention vs non-intervention facilities at end line: 0.69 vs 0.29, p=0.01); Partograph correctly used-childbirth observation (pre vs post intervention: 0.58 vs 0.75, p=0.03; intervention vs non-intervention facilities at end line: 0.75 vs 0.60, p=0.15); Deliveries with correctly completed partograph (%)-Record review (pre vs post intervention: 42 vs 70, p<0.01; intervention vs non-intervention facilities at end line: 70 vs 48, p<0.01).	
(Edwards and Sahab 2011) (Edwards & Saha 2011)	Rural Banglade sh	Skills-based training; Collaboration and teamwork at all levels; Community involvement; Monthly supportive supervision; Leadership	06 years	Village health volunte ers, commu nity health worker s, commu nity health assistan ts, and commu nity	Primary care (healthca re centres and communi ty based), and General hospital (Compre hensive essential obstetric and	Country case study: Lutheran Aid to Medicine in Bangladesh (LAMB) Integrated Rural Maternal and Child Healthcare' Home-to-Hospital, Continuum-of-Care' approach	LAMB areas vs. national sample: care received by women (≥1 ANC: 81% vs. 52%; SPAB: 32.2% vs. 18%; caesarean section rate: 4.8% vs. 2.7%; and PNC: 85% vs. 22%); a higher proportion of poor women (in wealth quintile-1) received ANC, SPAB, caesarean section, and PNC; the gap in service use between the poorest and the richest women is much smaller.	Modera te

				skilled personnel	newborn care)			
(Engineer et al. 2016) ([Engineer et al. 2016](#))	Afghanistan	Quarterly Pay-for-Performance (P4P) for health workers; Mobilizing financial resources	23-25 months	Skilled personnel	Primary healthcare facilities	A cluster-randomized trial: End line household survey and quality assessment in health facilities in P4P and comparison areas	The P4P had no significant impact on increasing coverage or equity (by wealth index) of targeted MCH services at population level (P4P vs comparison): Modern contraception (10.7% vs 11.2%; p=0.90); ANC (56.2% vs 55.6%; p=0.94); SPAB (33.9% vs 28.5%, p=0.17); PNC (31.2% vs 30.3%; p=0.98); Equity in SPAB /concentration index (0.1758 vs 0.1000; p= 0.3); Quality of care (P4P vs comparison): Overall Client Satisfaction and Perceived Quality of Care Index (76.5% vs 75.1%; p=0.2); Health Worker Satisfaction Index (63.8% vs 63.4%; p=0.9); Health Worker Motivation Index (72.7% vs 72%; p=0.4); Quality of care/ history taking and physical examinations index (76.4% vs 72.3%; p= 0.01); Quality of care/client counselling index (35.3% vs 29.3%; p= 0.01); Quality of care/time spent with client index (14.5% vs 8.6%; p= 0.05).	Selection: LR Performance: LR Attrition: LR Detection: LR Reporting: LR
(Ghosh R. et al. 2019) ([Ghosh et al. 2019](#))	India	Multi-faceted onsite nurse mentoring and simulation (Diagnosis and management of intrapartum asphyxia and PPH): Skills demonstrations, didactic sessions, high-fidelity simulation, bedside mentoring, and team training during actual patient care were the mentoring activities; Weekly nurse-mentoring, PRONTO International's simulation, team training; NGO collaboration	20 months	Auxiliary Nurses and general nurse-midwives	BEmONC facilities at Primary care	A quasi-experimental (b/n facilities) and a longitudinal (within facilities) comparison studies over time	Between-facility comparisons across phases: Diagnosis was higher in final week of intervention (intrapartum asphyxia: 4.2–5.6%, PPH: 2.5–5.4%) relative to the 1st week (intrapartum asphyxia: 0.7–3.3%, PPH: 1.2– 2.1%); Within-facility comparisons: Intrapartum asphyxia Dx among all livebirths increased from 2.5% in week-1 to 4.8% in week-5, after which it reduced to 4% through week-7, PPH Dx increased from week-1 through 5 (from 1.6% to 4.4%) after which it decreased through week-7 (3.1%); Facility performance index-on a scale of 100 from baseline (1st 3 wks.) to end line ($\geq$4 wks.): Median intrapartum care score (IQR)=[21 (8-29) - 58 (42-67)], median newborn care score (IQR)=[42 (35-50) -71 (58-79)]; Diagnosis per additional week of mentoring, adjusted incidence rate ratios (IRR, 95% CI): Asphyxia (Wks. 1-5: 1.21(1.13, 1.29), p<0.001; Wks. 5-7: 0.91(0.82, 1.01), p=0.073; PPH (Wks. 1-5: 1.17 (1.05, 1.31), p=0.006; Wks. 5-7: 0.86 (0.77, 0.97), p=0.017; Management per additional week of mentoring (IRR, 95%CI): Asphyxia [(Radiant warmer: 1.05 (1.01, 1.09), p=0.005; Drying-stimulation: 1.05 (1.02, 1.08), p=0.003; Suctioning: 1.03 (0.99, 1.06), p=0.127; Positive pressure ventilation (PPV):1.09 (1.02, 1.15), p=0.007] and PPH [IV fluids: 1.01 (0.97, 1.04), p=0.688; Uterotonics: 0.99 (0.95, 1.03), p=0.700]	High
(Gomez et al. 2018) ([Gomez](#)	Ghana	Onsite, low-dose, high-frequency training in BEmONC of registered or certified skilled personnel: two 4-day low-dose	18 months	Midwives	40 secondary care public and	A cluster-randomized trial: Prospective intrapartum stillbirths and 24-hr newborn mortality for 12	36% reduction (ARR: 0.64; 95% CI: 0.53–0.77; p<0.001) in 1st 1-6 months of implementation and 52% reduction (ARR: 0.48; 95%CI: 0.36–0.63; p<0.001) in second 7-12 months of implementation in intrapartum stillbirth rates as compared to pre-intervention period, respectively; 59% reduction (ARR: 0.41; 95% CI: 0.32–0.51;	Selection: SC Performance: LR

et al. 2018)		sessions, high-frequency practice sessions using anatomic models and mentoring with SMS reminder messages and quizzes; Clinical simulation; Follow-up mentorship and appraisal (mobile or onsite); Mobilizing financial resources		missiona ry hospitals	months. Baseline mortality rates were collected retrospectively 6 months pre-intervention.	p<0.001) in 1st 1-6 months and 70% reduction (ARR: 0.30; p<0.001) in 2nd 7-12 months in 24-hr newborn mortality rates as compared to pre-intervention period, respectively.	Attritio n: LR Detecti on: LR Reporti ng: LR
(Kambala et al. 2017) (Kambala et al. 2017)	Rural Malawi	RBF for Maternal and Newborn Health initiative: Quarterly performance-based financing (supply-side financial incentive upon attainment of a predefined set of indicators, 70% for staff bonuses and 30% for health facility's operational activities, health management teams were rewarded with financial incentives based on the overall performance of a district as a measure of the adequacy of supervision) and financial incentives to women for delivering in a health facility (demand-side incentive, conditional cash transfers to mothers for giving birth in a health facility); Health workers advisory group; Mobilizing financial resources; Refresher in-service training on antenatal management, obstetric care, and quality assurance; RBF policy	03 years	Healthc are manage rs, skilled personn el	33 primary and secondar y EmOC facilities (Basic and compreh ensive)	Mixed method prospective sequential controlled pre-and post-test study over intervention vs. control facilities: Client exit interviews, In-depth interviews and FGDs with women and In-depth interviews with health service providers; Difference-in-Differences analysis (DiD)	End-term vs baseline cohorts (DiD adjusted): Mean effect estimate of women's perceptions on interpersonal relations (ANC: −0.2, p=0.56; L&D: -0.1, p=0.70; PNC:−0.3, p=0.45); Mean effect estimate of women's perceptions on quality of amenities (ANC: −0.2, p=0.54; L&D: -0.3, p=0.45; PNC: -0.49, p= 0.14); Mean effect estimate of women's perceptions on technical care (ANC: −0.2; p=0.39; L&D: -0.1, p=0.85; PNC: -0.31, p=0.38). No significant effect on women's perceptions of technical care, quality of amenities, and interpersonal relations for any of the three sets of services observed (ANC, L&D, and PNC); Increased the proportion of women reporting to have received medications/treatment during childbirth. Qualitative interviews: Most women reported improved health service provision as a result of the intervention; Drugs, equipment, and supplies were readily available due to the RBF4MNH; Instances of neglect, disrespect, and verbal abuse during the process of care; Increased workload resulting from an increased number of women seeking services at RBF4MNH facilities.	Modera te

(Larson et al. 2019) (Larson et al. 2019)	Rural Tanzania	In-service training; Mentoring; Supportive Supervision; Peer outreach.	04 years	Mid-level cadres	Primary care (community-based and primary care clinics)	A cluster-randomized study: Baseline (2012) and end line (2016) household surveys in control and intervention catchments; difference-in-differences analysis (DiD)	Total study population-DiD: Improved quality of ANC/contents of ANC [Adjusted (A) RR: 1.64; 95% CI: 1.00–2.71]; perceived quality of ANC (ARR: 1.14; 95% CI: 0.88–1.47); perceived obstetric care quality at intervention facility (ARR: 1.13; 95% CI: 0.79–1.62); reduced payment for obstetric care at intervention facility (ARR: -3.76; 95% CI: -7.02 - -0.49). Previous home births-DiD: Improved quality of ANC/contents of ANC (ARR: 2.31; 95% CI: 1.44–3.71); improved perceived quality of ANC (ARR: 1.57; 95% CI: 1.07–2.31); perceived obstetric care quality at intervention facility (ARR: 1.12; 95% CI: 0.78–1.59); reduced payment for obstetric care at intervention facility (ARR: -2.24; 95% CI: -4.76 - 0.28).	Selection: LR Performance: SC Attrition: LR Detection: LR Reporting: LR
(Magge et al. 2017) (Magge et al. 2017)	Rwanda	Monthly onsite, regular clinical mentorship and training on evidence-based life-saving maternal and newborn care; Learning collaborative to build healthcare workers' leadership in data utilization for continuous quality improvement (QI); Mobilizing financial resources; Procurement and distribution of essential equipment and supplies	18 months	Nurses, community health supervisors, data officers, and health facility and district leadership	Primary care (Community-based and health centres), and secondary care hospitals	A retrospective case study using the quantitative method: Pre-post intervention evaluation	Pre vs post-intervention: $\geq$ 4 ANC (23% vs 38%); 1st trimester ANC (23% vs 34%); Pregnant women with premature rupture of membrane (PROM) treated with antibiotics (24% vs. 38%); Pregnant women with preterm labour treated with corticosteroids (26% vs 75%); SPAB (87% vs. 95%); Time to C-section in minutes [median, (IQR): 99 (50–195) vs. 72 (59–77)]; Immediate skin-to-skin care after delivery (19% vs. 87%); Newborns checked for danger signs within 24 hr of birth (47% vs. 98%).	Moderate
(Maru et al. 2017) (Maru et al. 2017)	Rural, remote Nepal	Accountable public-private partnership through integrating community health workers into facility-based care: CHWs conduct surveillance of conditions in the community, triage, referral, and care coordination with healthcare facilities; Government's performance-based accountable payment	18 months	Community health workers	Primary healthcare (Community-based, village clinics/health posts) and secondary care district hospitals	A prospective pre-post pilot study: a household-level census survey to compare population-level maternal, newborn, and child healthcare indicators to the baseline.	Pre- vs post-intervention: $\geq$ 4 ANC [(Increased by 6.4 pp); coverage increased (83% vs 90%)]; health facility birth [(increased by 11.8 pp; p<0.001); coverage increased (81% vs 93%)]; postnatal contraception [(rate increased by 27.5 pp; p<0.001); Coverage increased (19% vs 47%)]; Infant mortality rate (18.3/1000 vs 12.5/1000); 95% received ultrasound examination by month 8 or 9 of pregnancy.	Moderate

Human resources for health interventions and their effects on SRMNH care quality across the continuum (continued)

(McDougal et al. 2017) (McDougal et al. 2017)	India	Training, mobilizing, monitoring, and empowering government Frontline workers (FLWs) and community outreach (home-based) interventions: Job aids and tools; Mobile service training course for FLWs to expand and refresh their knowledge of life-saving RMNCH behaviours; community involvement; mobilizing financial resources; local policy	02 years	Accredited social health activists (ASHAs), Auxiliary nurse midwives, and Anganwadi (Social Service) workers	Primary care (community-based and primary healthcare facilities)	A two-armed quasi-experimental study (intervention vs. control areas); house to house survey of women aged 15–49 with a 0–5-month-old child at baseline and follow-up; Difference-in-differences (DiD) analyses	The mean number of services/behaviours used along the RMNH continuum of care (CoC) was significantly higher in intervention areas as compared to control areas at follow-up (0.94 vs. 0.51 health services/behaviours; p<0.0001); Overall RMNH CoC coverage in intervention areas increased by 0.41 (Coefficient: 0.41; 95% CI: 0.24–0.59; p<0.001) health services/behaviours as compared to the control areas: DiD: ≥4 ANC (p=0.23); SPAB (p=0.98); Nothing applied to the cord (p=0.01); Skin-to-skin care (p=0.03); First bath delayed by ≥2 days (p=0.26); Breastfed child within 1 hour of birth (p=0.39); PNC visit for mother or baby within 48 hours (p=0.69); Post-partum contraception (p<0.01); Child exclusively breastfed (p=0.47); Gender equity interaction analysis showed diminished intervention effects on ANC, SPAB and exclusive breastfeeding for women married as minors.	High
(Mwaniki et al. 2014) (Mwaniki et al. 2014)	Rural Kenya	Quality improvement 'collaborative' health worker advising: regular meeting of a group of health workers from different health facilities that work on the same set of quality indicators to examine performance gaps in service delivery, the causes of these gaps, and solutions to address them; Employee relations; Leadership; Community involvement	20 months	Healthcare managers, skilled personnel, community health workers, and traditional birth attendants	Primary care (3 health centres and 17 dispensaries), and 1 government-run secondary care hospital	A pre-and post-implementation evaluation: Data were collected and entered into routine govt. registers daily by the teams and were then used to evaluate 20 indicators of care quality improvement activities monthly.	ANC visits in the first trimester (<16 weeks G.A) increased significantly (8% to 24%; p=0.002), and those making ≥4 ANC visits significantly increased (37% to 64%; p<0.001); ANC visits per month with standardized care substantially increased (<40% to 80-100%; p<0.001) within 03 to 06 months; SPAB significantly increased per month from (33% to 52%; p=0.012); Pregnant women actively referred from the community (by community representatives) to health facilities for ANC, and birth care significantly increased (13 per month to 81 per month; p<0.001).	Moderate

Human resources for health interventions and their effects on SRMNH care quality across the continuum (continued)

(Okawa et al. 2019) (Okawa et al. 2019)	Rural Ghana	Orientation of supervisors and healthcare providers in the continuum of care (CoC); Distribution of CoC cards to women, home visits to provide PNC within 48 hrs for those who missed the first 24 hrs visit; Mobilizing financial resources; Monthly supervision and monitoring; Capacity building to lead sector-wide collaboration	12 months	Doctor, midwife, nurse, community health officer, and community health nurse, and health assistant	Primary healthcare (community-based, private clinics, health centres) and secondary care district hospital	A cluster randomized controlled trial: baseline and follow-up survey to measure adequate contacts (≥ 4 ANC, SPAB, and three timely contacts within 6 weeks postnatal) and quality care (six components during ANC, 3 during peripartum care (PPC), and 14 during postnatal); difference-in-differences analysis (DiD)	The interventions improved contacts with healthcare providers and quality of care during PNC, not in ANC or IPC, regular contacts with healthcare providers did not guarantee quality of care: 12.6% of women in the intervention group received all 6 items during ANC (4.9% baseline), 33.6% received all 3 items during PPC (23.8% baseline) and 41.5% of women and their newborns received all 14 items during PNC (11.5% baseline); Adjusted DiD estimators: no significant changes across the three phases: ANC (p=0.61), PPC (p=0.69) and PNC (p=0.35); The percentage of adequate contacts with high-quality care in the intervention group in the follow-up survey and the adjusted DiD estimators (with baseline adequate contacts for ANC, PPC and PNC of 4.9%, 20.2% and 1.3%, respectively) were 12.6% and 2.2 (p=0.61) at ANC, 31.5% and 1.9 (p=0.73) at PPC and 33.7% and 12.3 (p=0.13) at PNC in the intention-to-treat design (real world-effectiveness of the intervention), whereas 13.0% and 2.8 (p=0.54) at ANC, 34.2% and 2.7 (p=0.66) at PPC and 38.1% and 18.1 (p=0.02) at PNC in the per-protocol design (ideal world-designated by possession of continuum-of-care card); In intention-to-treat design, 76.9% of women in the intervention group in the follow-up survey had adequate contacts during ANC; however, only 12.6% had quality-adjusted adequate contacts; 82.0% SPAB, while only 31.5% had SPAB with high-quality care; during PNC, 62.2% of women and their newborns had adequate contacts, however, only 33.7% had quality-adjusted adequate PNC contacts.	Selection: LR Performance: LR Attrition: LR Detection: LR Reporting: LR
(Okuga et al. 2015) (Okuga et al. 2015)	Uganda	Recruitment, training, immediate deployment and incentivization of CHWs; skilled personnel's in-service training and provision of essential equipment and supplies: Selected by the community; 07 days training on identifying pregnant women, and make two pregnancy home visits and three postnatal home visits in the first week after birth; Financial and non-financial incentives (t-shirt, briefcase	02 years	Community health workers and skilled personnel	Primary care (community-based and primary healthcare facilities)	A community-based cluster randomized control trial: in-depth interviews (IDIs) and focus group discussions (FGDs) involving facility-based health workers, members of the District Health Team, village leaders, mothers with children less than 6 months of age, and CHWs both from urban and rural areas	CHWs highly appreciated in the community and seen as important contributors to maternal and newborn health at a grassroots level; More women attending ANC during the first trimester; Husbands/partners save money, provide women with money for emergencies, transport, and babies' needs; Women attend to their health needs during pregnancy; Women recognize danger signs; More births at health facilities; Women experience a caring attitude from health workers; Women with CHW referral slips are seen faster at hospital or health unit; Women put only salty water on the baby's umbilical cord rather than animal dung and herbs; Bathing is delayed instead of immediately practiced; More women taking their newborn babies to health facilities for PNC and immunization; Immediate breastfeeding at birth and continuous breastfeeding; More women giving colostrum.	Moderate

		and certificate, and transport allowance); Directly observed supervision visits by nurses/midwives and group supervision meetings monthly then quarterly; Mobilizing financial resources.					
(Pirkle et al. 2013) (Pirkle et al. 2013)	Mali and Senegal	Maternal death review (auditing maternal deaths in the facility), workshops on obstetrical best experiences, and periodic visits by international experts: a six-day workshop to train and certify health professional leaders in EmOC best practice, audit techniques, and sexual and reproductive rights; A multidisciplinary audit committee established in each facility to undertake a monthly audit according to the WHO guidelines; Staff trained in best practice obstetric care; Educational outreach sessions every three months and re-certification; International observatories; Leadership; Supportive supervision; Mobilizing financial resources.	02 years	Doctors, midwives, and nurses.	Referral hospitals (Comprehensive EmOC centres)	A cluster randomized controlled trial: One pre-intervention year and two intervention years to measure obstetric care quality in the post-intervention year. A criterion-based clinical audit (CBCA) to measure patient history, clinical examination, laboratory examination, birth care, and PNC; reviewing patient charts; t-test analysis.	Women treated at intervention hospitals have, on average, 5 pp greater CBCA scores than those treated at control hospitals (β: 0.052; 95% CI: 0.003–0.102; p=0.04): Intervention vs control hospitals: Initial interview CBCA scores (82.3% vs 81.1%); First clinical exam CBCA scores (86.4% vs 80.5%; p<0.05); Laboratory exams CBCA scores (33.3% vs 31.7%); Birth care CBCA scores (63.3% vs 62.8%); Postnatal monitoring CBCA scores (56.2% vs 46.1%; p<0.05); Significantly more women received good quality care (>70% criteria attainment): (44.1% vs 29.7%; p<0.001); Significantly greater CBCA scores in women treated (68.2 vs 64.5; p<0.05)	Selection: LR Performance: LR Attrition: LR Detection: LR Reporting: LR
(Rahman et al. 2011) (Rahman et al. 2011)	Bangladesh	Community involvement in bi-monthly pregnancy surveillance, home-based care through CHWs; Health facility-based training on management of normal and complicated deliveries and newborn complications for doctors and midwives,	02 years	Doctors, midwives, and CHWs	Primary care (community-based, healthcare centre), secondary care	Pre and Post-intervention community-based survey at intervention and comparison areas; Difference-in-differences analysis	Intervention area: Perinatal mortality decreased by odds of 36% as compared to pre-intervention period (AOR: 0.64; 95% CI: 0.52-0.78); Significant reduction in perinatal mortality in intervention area as compared to the comparison area (p=0.018); Post-Intervention area: Early pregnancy (GA: 12-14 weeks) ANC home visit: 94.3%, late pregnancy (GA: 32-34 weeks) ANC home visit: 77%; Post vs pre-intervention area: Health facility ANC visits (ANC 3+: 78% vs 38%, ANC 2: 12% vs 43%, ANC 1: 6% vs 15%), Health facility birth (72% vs 55%; p <0.001), Cesarean section rates (16% vs 8%; p <0.001), <1	High

		standard guidelines development and implementation for management of maternal and newborn complications; Mobilizing Financial resources			district hospital, and tertiary care hospitals		day timing of first newborn bath (4% vs 30%; p <0.001), Colostrum as first newborn food (96% vs 83%; p< 0.001); <30 minute timing of first breast feeding (81% vs 61%; p <0.001), Preterm births (before 37-week gestation) significantly decreased (12.3% vs 16.8%; p < 0.001); Intervention vs comparison areas: Still birth rate (23/1000 births vs 31/1000 births), Early neonatal deaths (17/1000 live births vs 27/1000 live births); Perinatal mortality rate (3.2% vs 5.6%).	
(Satti et al. 2012) (Satti et al. 2012)	Rural mountain ous Lesotho	Training and performance-based incentives: 3 months training of 100 women, mostly TBAs, to identify pregnant women and accompany them to a health centre for ANC, birth care, and PNC services (clinic-affiliated maternal health workers); Deployment of a nurse-midwife to the health centre to provide ANC and birth care and supervise the maternal health workers; Public-private sectors partnership	02 years	Traditi onal birth attenda nts (TBAs), nurse-midwif e	Primary care (commun ity-based and primary healthcar e centre)	Before and after secondary data analysis of ANC and delivery registers	The average number of ANC 1 visit increased from 20 to 31 per month; 520 women tested for HIV during the ANC 1 visit, where 94% were with unknown status compared to 18 new PMTCT clients registered in the year preceding the program; VDRL (syphilis) testing for 644 women (86% of ANC 1 visit); Haemoglobin testing for 637 women (85% of ANC 1 visit); 218 mothers (122 in year 2) admitted to maternal waiting houses (55% of health facility birth); 178 health facility birth in the 1st year of the program and 216 in the 2nd year, compared to 46 in the year preceding the program; 49 women with complications successfully transferred to the district hospital; No maternal deaths among the women in the program.	Modera te
(Waiswa et al. 2015) (Waiswa et al. 2015)	Rural Uganda	Training CHWs for 5 days on the identification of pregnant women in their community, and undertaking two home visits during pregnancy and three visits after birth at or as close to days 1, 3, and 7 reinforced by directly observed supervision; 6 days in-service training for SABs in 20 public and private health facilities on goal-oriented ANC, managing maternal complications, infection prevention, managing normal labour and partograph use, neonatal	02 years	Comm unity health worker s and skilled personn el	Primary care (commun ity-based and primary healthcar e facilities)	A cluster-randomized controlled trial: community-based baseline and end-line surveys; t-test analysis (p) for comparison between intervention and control end lines	The interventions provided improved maternal and essential newborn care practices to poorer families- Intervention vs control clusters: ≥4 ANC visits (47% vs 43.6%; p= 0.165); Mothers with knowledge of two or more pregnancy-related danger signs (32.7% vs 38%; p=0.126); Mothers received ≥1 home visit during pregnancy (68.2% vs 7.3%; p<0.001); SPAB (79.6% vs 78.9%; p=0.826); Use of TBAs dropped by (5.7% vs 0%); Women visited by a CHW in the first week after birth (62.8% vs 5.8%; p<0.001); Newborn put to the breast within 1 hour of birth (72.6% vs 66%; p=0.0116); Newborn given colostrum (93.4% vs 91.2%; p=0.086); Baby exclusively breastfed in first month of life (81.8% vs 75.9%; p=0.042); Newborn placed skin-to-skin with mother within 1 hour of birth (80.7% vs 74.2%; p=0.071); Newborn wrapped immediately after birth (99.6% vs 99.8%; p=0.562); First bath delayed ≥24 hours after birth (49.6% vs 35.5%; p<0.001); Cord cut with clean instrument (88.1% vs 84.4%; p=0.074); Nothing applied to umbilical cord after cutting (63.9% vs 53.1%; p=0.002); LBW babies given kangaroo mother care (22.4% vs 9.3%; p=0.089).	Selecti on: LR Perfor mance: LR Attritio n: LR Detecti on: LR Reporti ng: LR

		resuscitation, care of the sick newborn, and extra care for small babies using kangaroo mother care; Community involvement; Non-financial Incentives (t-shirt, briefcase, certificate); travel refund; Mobilizing financial resources						
(Zeng et al. 2018) (Zeng et al. 2018)	Rural Zambia	Results-based and input-based financing; Mobilizing financial resources: With the RBF, health facilities were provided with incentives tied to performance on pre-agreed MCH care indicators. Sixty percent of the incentive payment was used for staff bonuses, and 40% was used for operational activities. In IBF, health facilities received funding only for operational activities that were not tied to performance.	27 months	Skilled personnel	Primary healthcare facilities	A triple-matched cluster randomized trial: Before and after trial household and facility surveys; Difference in Differences (DiD) analysis	RBF districts-DiD: Coverages were improved by 19.5% for injectable contraceptives (p< 0.05), -1.5% ANC, 3% IPT in pregnancy (p<0.05), 12.8% SPAB (p<0.01), 8.2% PNC (p<0.05) and 6.1% to 20.4% infant vaccinations as compared to controls; IBF districts-DiD: Coverages were improved by -2.3% for injectable contraceptives, 0% ANC, 0.7% IPT in pregnancy, 17.5% SPAB (p<0.01), 13.2% PNC (p<0.01) and 0.3% to 5.6% infant vaccinations as compared to controls; RBF districts-DiD: Coverages were improved by 21.8% for injectable contraceptives (p< 0.05), -1.5% ANC, 2.3% IPT in pregnancy, -4.9% SPAB, -5.1% PNC and -1% to 18.6% infant vaccinations as compared to IBF districts; RBF districts: Quality of care index-DiD: improved by 9.7% for injectable contraceptives, 2.9% for ANC, 3.1% for SPAB, 2.3% for PNC and 3.8% for infant vaccinations as compared to the controls; IBF districts: Quality of care index-DiD: improved by 4.8% for injectable contraceptives, 2.8% for ANC, 2.4% for SPAB, 3% for PNC and 0.6% for infant vaccinations as compared to the controls; RBF districts: Quality of care index-DiD: Improved by 4.9% for injectable contraceptives, 0% for ANC, 0.7% for SPAB, -0.8% for PNC and 3.2% for infant vaccinations as compared to IBF districts; Pregnant women and children <5 years in RBF districts gained 604 and 14,574 QALYs, respectively, while pregnant women and children <5 years in IBF districts gained 302 and 8,274 QALYs, respectively as compared to the controls; Pregnant women and children <5 years in RBF districts gained 302 and 6,300 QALYs, respectively as compared to the IBF districts; Incremental cost–effectiveness ratios of US$ 809 and 413 per QALY gained for RBF and IBF districts, respectively as compared to controls. Incremental cost-effectiveness ratio of US$ 1324 per QALY gained for RBF districts as compared to the IBF districts.	Selection: LR Performance: LR Attrition: LR Detection: LR Reporting: LR

Table A2 1: HRH intervention and areas of intervention, WHO.

HRH Intervention	Definition	Areas of intervention
Policy	Rules, regulations, and legislation for conditions of employment, work standards, and development of the health workforce.	Professional standards, licensing, and accreditation Authorized scopes of practice for health cadres Political, social, and financial decisions and choices that impact HRH Employment law and rules for civil service and other employers
Finance	Obtaining, allocating, and disbursing adequate funding for human resources.	Setting levels of salaries and allowances Budgeting and projections for HRH intervention resource requirements including salaries, allowances, education, incentive packages, etc. Increasing fiscal space and mobilizing financial resources (e.g., government, Global Fund, PEPFAR, donors) Data on HRH expenditures (e.g., National Health Accounts, etc.)
Education	Production and maintenance of a skilled workforce.	Pre-service education tied to health needs In-service training (e.g., distance and blended, continuing education) The capacity of training institutions Training of community health workers and non-formal care providers.
Partnership	Formal and informal linkages aligning key stakeholders (e.g. service providers, sectors, donors, priority disease programs) to maximize the use of resources for HRH.	Mechanisms and processes for multi-stakeholder cooperation (inter-ministerial committees, health worker advisory groups, observatories, donor coordination groups) Public-private sector agreements Community involvement in care, treatment, and governance of health services
Leadership	Capacity to provide direction, to align people, to mobilize resources, and to reach goals.	Identify, select and support HRH champions and advocates Capacity for leadership and management at all levels Capacity to lead multi-sector and sector-wide collaboration Strengthening professional associations to provide leadership amongst their constituencies

HR management systems	Integrated use of data, policy, and practice to plan for necessary staff, recruit, hire, deploy, develop and support health workers.	Personnel systems: workforce planning (including staffing norms), recruitment, hiring, and deployment Work environment and conditions: employee relations, workplace safety, gender equity, job satisfaction, and career development HR information system integration of data sources to ensure timely availability of accurate data required for planning, training, appraising, and supporting the workforce Performance management: performance appraisal, supervision, and productivity Staff retention: financial and non-financial incentives.

Table A3 1: Definitions of skilled health personnel and lay health personnel.

Category	Definition	Different names
Skilled health personnel providing care during childbirth	Competent maternal and newborn health (MNH) professionals educated, trained and regulated to national and international standards. They are competent to 1. Provide and promote evidence-based, human-rights-based, quality, socioculturally sensitive, and dignified care to women and newborns; 2. Facilitate physiological processes during labour and delivery to ensure a clean and positive childbirth experience; and 3. Identify and manage or refer women and/or newborns with complications (Skilled health personnel, 2018) (WHO 2018a). In addition, as part of an integrated team of MNH professionals (including midwives, nurses, obstetricians, paediatricians, and anaesthetists), they perform all signal functions of emergency maternal and newborn care to optimize the health and well-being of women and newborns. (In different countries, these competencies are held by professionals with varying occupational titles). Women, however, have difficulty identifying specific healthcare cadres and hence skilled personnel. Linking information concerning the facility where the service was provided, and improving documentation associated with classifying country cadres as 'skilled' can enhance the identification and measurement of coverage of skilled maternity care services (Radovich et al. 2019).	Assistant medical officer, clinical officer (e.g., in Malawi), medical licentiate practitioner, health officer (e.g., Ethiopia), physician assistant, surgical technician, medical technician non-physician clinician, clinical officer (e.g., in Tanzania, Uganda, Kenya, Zambia), medical assistant, clinical associate, non-physician clinician, auxiliary nurse, nurse assistant, enrolled nurses, auxiliary midwife, registered midwife, midwife, community midwife, family doctor, general practitioners, medical doctor, registered nurse, nurse practitioner, clinical nurse specialist, advance practice nurse, practice nurse, licensed nurse, diploma nurse, BS nurse, nurse clinician, and nurse.

| Lay health personnel | Any health worker who performs functions related to healthcare delivery; was trained in some way in the context of the intervention; but has received no formal professional or paraprofessional certificate or tertiary education degree (Lewin 2005). | Community health worker, traditional birth attendant, village health worker, treatment supporter, promotors, traditional midwives (Guatemala), dayas (Egypt), dai (Pakistan), and bidan kampong (Malaysia). |

Table A4 1: The inclusion and exclusion criteria applied to the screening of studies for the review

Included	Excluded
Explicit management, leadership, partnership, finance, education, and/or policy-related HRH intervention.	Without any of the six health workforce interventions
HRH intervention related to SRMNH care services and quality across the continuum	Quality of care for single SRMNH care (either pre-conception, antenatal, intrapartum, or postnatal care service)
Skilled and/or lay health personnel	Health care managers and/leaders not directly involved in healthcare services
The outcomes were related to maternal and/or neonatal health care.	HRH intervention not related to maternal and/or neonatal health outcomes
Primary research	Review studies, discursive or descriptive outlines of projects.
The study conducted in low- and lower-middle-income countries	Studies in upper-middle and/or high-income countries.
Publication years were ≥2000	<2000 year of publication
The studies were in English	Non-English

Table A5 1: Search Strategy and keywords: How can human resources for health interventions contribute to the quality of care in maternal health across the continuum in low-and lower-middle-income countries?

PubMed	#1 AND #2 AND #3 AND #4 AND #5 = 606			
Human resources for health intervention (#1)	Quality (#2)	Continuum (#3)	Maternal health care (#4)	Low-and lower-middle-income countries (#5)
"Organization and Administration"[MH] OR "Health Personnel"[MH] OR Health Personnel[TIAB] OR Health workforce[TIAB] OR Health Care Provider*[TIAB] OR Health worker*[TIAB] OR physician[TIAB] OR Doctor[TIAB] OR "Nursing"[MH] OR Nurs*[TIAB] OR Midwi*[TIAB] OR Community Health Worker*[TIAB] OR Community Health Aide*[TIAB] OR Traditional Birth Attendant*[TIAB] OR Intervention[TIAB] OR "Education"[MH] OR Education[TIAB] OR Curricul*[TIAB] OR Educational Measurement*[TIAB] OR Educational Assessment*[TIAB] OR Teaching[TIAB] OR Training[TIAB] OR Capacity Building[TIAB] OR Staff Development[TIAB] OR Human Resources Development[TIAB] OR Partnership[TIAB] OR "Economics"[MH] OR Economic*[TIAB] OR Supervision[TIAB] OR Administration[TIAB] OR Logistics[TIAB] OR Motivation[MH] OR Motivation[TIAB] OR Incentive*[TIAB]	"Health Care Quality, Access, and Evaluation"[MH] OR "Quality of Health Care"[MH] OR Quality[TIAB] OR Optimal Care*[TIAB] OR "Diffusion of Innovation"[MH] OR Innovation Diffusion[TIAB] OR Health Worker Performance[TIAB] OR Care Standard[TIAB] OR Clinical Competenc*[TIAB] OR Protocol Compliance[TIAB] OR Evaluation Stud*[TIAB] OR Outcome Assess*[TIAB] OR Effective health care[TIAB] OR "Cost-Benefit Analysis"[MH] OR Cost Benefit Analysis[TIAB] OR Cost Effectiveness[TIAB] OR Cost-Utility	"Continuity of Patient Care"[MH] OR Continuum of Care[TIAB] OR Care Continuum[TIAB] OR Continuity of Care[TIAB] OR Care Continuity[TIAB] OR "Comprehensive Health Care"[MH] OR Comprehensive Healthcare[TIAB] OR Comprehensive care[TIAB] OR Patient-Centered Care[TIAB] OR Person-Centred Care[TIAB] OR	"Reproductive Health Services"[MH] OR Reproductive Health Serv*[TIAB] OR Preconception Care[TIAB] OR Perinatal Care[TIAB] OR "Maternal Health"[MH] OR Maternal Health[TIAB] OR "Maternal Health Services"[MH] OR "Maternal Welfare"[MH] OR Maternal Welfare[TIA	"Developing Countries"[MH] OR "Developing Countr*"[TIAB] OR "Poverty"[MH] OR "Low-Income Population*"[TIAB] OR Least Developed Countries[TIAB] OR "Less Developed Nation*"[TIAB] OR Low Income Countries[TIAB] OR "Third World Countr*"[TIAB] OR "Third World Nation*"[TIAB] OR Lower Middle Income Countries[TIAB] OR Afghanistan*[TIAB] OR Benin*[TIAB] OR "Burkina Fas*"[TIAB] OR Burundi*[TIAB] OR Central African Republic[TIAB] OR Chad[TIAB] OR Congo[TIAB] OR Eritrea*[TIAB] OR Ethiopia*[TIAB] OR Gambia[TIAB] OR Guinea[TIAB] OR Haiti*[TIAB] OR North Korea[TIAB] OR Liberia*[TIAB] OR Madagascar[TIAB] OR Malawi[TIAB] OR Mali[TIAB] OR Mozambiqu*[TIAB] OR Nepal[TIAB] OR Niger[TIAB] OR Rwanda*[TIAB] OR Sierra Leone*[TIAB] OR Somalia*[TIAB] OR Sudan*[TIAB] OR Syria*[TIAB] OR Tajikistan*[TIAB] OR Tanzania*[TIAB] OR Togo[TIAB] OR Uganda[TIAB] OR Yemen*[TIAB] OR Angola*[TIAB] OR Bangladesh*[TIAB] OR Bhutan*[TIAB] OR Bolivia*[TIAB] OR Cabo Verde[TIAB] OR Cambodia*[TIAB] OR Cameroon*[TIAB] OR Comoros*[TIAB] OR Cote d'Ivoire[TIAB] OR Ivory Coast[TIAB] OR Djibouti*[TIAB] OR Egypt*[TIAB] OR El Salvador*[TIAB] OR Ghana[TIAB] OR Honduras*[TIAB] OR India*[TIAB] OR Indonesia*[TIAB] OR Kenya[TIAB] OR Kiribati*[TIAB]

OR "Employment"[MH] OR Employment[TIAB] OR Recruitment[TIAB] OR "Leadership"[MH] OR Leadership[TIAB] OR "Intersectoral Collaboration"[MH] OR Intersectoral Collaboration[TIAB] OR Intersectoral Cooperation[TIAB] OR "Community Participation"[MH] OR Community Involvement[TIAB] OR Competency assess*[TIAB] OR "Certification"[MH] OR certificati*[TIAB] OR "Licensure"[MH] OR Licensing[TIAB] OR Skill Mix[TIAB] OR Skills Mix[TIAB] OR Skill-Mix[TIAB] OR Staffing and Scheduling[TIAB] OR Task-Sharing[TIAB] OR Job Sharing[TIAB] OR "Delegation, Professional"[MH] OR Professional Delegation[TIAB] OR Task Shifting[TIAB] OR Night Shift Work[TIAB] OR "Policy"[MH] OR Policy[TIAB] OR Legislation[MH] OR Legislation[TIAB]	Analysis[TIAB] OR People-centred[TIAB] OR Satisfaction[TIAB] OR "Patient Safety"[MH] OR Patient Safet*[TIAB] OR "Evidence-Based Practice"[MH] OR Evidence Based Practice[TIAB] OR Evidence Based Health Care[TIAB] OR Evidence Based Healthcare[TIAB] OR "Culturally Competent Care"[MH] OR Culturally Competent Care[TIAB] OR Culturally Congruent Care[TIAB] OR Culturally Competent Health Care [TIAB] OR Health Equity[TIAB]	Patient Focused Care[TIAB] OR Primary Health Care[TIAB] OR Primary Healthcare[TIAB]	B] OR Maternal-Child Health Service*[TIAB]	OR Kyrgyz*[TIAB] OR Kirgizstan[TIAB] OR Kirghizia[TIAB] OR Lao PDR[TIAB] OR Laos[TIAB] OR Laos[TIAB] OR Lesotho[TIAB] OR Mauritania*[TIAB] OR Melanesia*[TIAB] OR Micronesia*[TIAB] OR Moldov*[TIAB] OR Mongolia*[TIAB] OR Morocc*[TIAB] OR Myanmar*[TIAB] OR Nicaragua*[TIAB] OR Nigeria[TIAB] OR Pakistan*[TIAB] OR Papua New Guinea[TIAB] OR Philippine*[TIAB] OR Sao Tome and Principe[TIAB] OR Senegal*[TIAB] OR Solomon Islands[TIAB] OR Swaziland*[TIAB] OR Timor-Leste*[TIAB] OR East Timor[TIAB] OR Tunisia*[TIAB] OR Tuvalu*[TIAB] OR Ukrain*[TIAB] OR Uzbekistan*[TIAB] OR Vanuatu*[TIAB] OR Vietnam*[TIAB] OR West Bank[TIAB] OR Gaza[TIAB] OR Zambia*[TIAB] OR Zimbabwe*[TIAB]
Web of Science/Core Collection	#1 AND #2 AND #3 AND #4 AND #5 = 503			
Human resources for health intervention (#1)	Quality (#2)	Continuum (#3)	Maternal health care (#4)	Low-and lower-middle-income countries (#5)
TS=(Health near/3 Workforce) OR TS=(Health near/3 Personnel) OR TS=(Health* near/3 Force) OR TS=(health* near/3 professional*) OR TS=(Health* near/3 Provider*) OR TS=(Health* near/3 manpower) OR TS=(Health* near/3 Worker*) OR TS=Physician* OR TS=Doctor* OR	TS=Quality OR TS=(Optim* near/3 *Care) OR TS=(health* near/3 evaluation*) OR TS=(Standard* near/3 *care) OR TS=Satisfaction OR	TS=(Continuity near/3 *Care) OR TS=Continuum OR TS=(Comprehensive near/3 *Care) OR	TS=(Reproductive near/3 Health*) OR TS=(Reproductive near/3 *care) OR TS=(Preconception near/3	TS=(Low* near/4 Income) OR TS=(Low* near/3 middle) OR TS= "Developing Countr*" OR TS=(Least near/3 Countr*) OR TS="Third World" OR TS=Afghanistan* OR TS=Benin* OR TS= "Burkina Fas*" OR TS=Burundi* OR TS= "Central African Republic" OR TS=Chad* OR TS=Congo* OR TS=Eritrea* OR TS=Ethiopia* OR TS=Gambia* OR TS=Guinea* OR TS=Haiti* OR TS= "North Korea"

TS=practitioner* OR TS=Nurs* OR TS=Midwi* OR TS="community health aide*" OR TS="community health officer*" OR TS=(medical near/3 auxiliary) OR TS="traditional birth attendant*" OR TS=Intervention* OR TS=education* OR TS=Residency OR TS=internship OR TS=Training* OR TS=Teaching* OR TS=Curricul* OR TS=(Capacity near/3 Building) OR TS=(Personnel near/3 Management) OR TS=(Human near/3 Development) OR TS=Incentive* OR TS=Staffing OR TS=Scheduling OR TS=Partnership OR TS=Collaboration OR TS=Cooperation OR TS=Financ* OR TS=Budget* OR TS=Supervision OR TS=Motivation* OR TS=Leadership* OR TS=(Community near/3 Participation) OR TS=(Community near/3 Involvement) OR TS=(Competency near/3 Assessment) OR TS=Certificati* OR TS=accreditation* OR TS=Licens* OR TS=(Skill* near/3 Mix*) OR TS=(Task near/3 Sharing) OR TS=(Job near/3 Sharing) OR TS=(Task near/3 Shifting) OR TS=(Shift* near/3 Work*) OR TS=Policy OR TS=Legislation*	TS=Safe* OR TS=(*Care near/3 Performance) OR TS=Competen* OR TS=(Guideline near/3 Adherence) OR TS=(Outcome near/3 Assessment) OR TS=(Effective near/3 *care) OR TS=(Cost* near/3 Analysis) OR TS=(Cost near/3 Effective*) OR TS=(People near/3 centred) OR TS=(Evidence near/3 Practice) OR TS=(Evidence near/3 *Care) OR TS=(Cultur* near/3 congruent) OR TS=(*cultural near/3 care) OR TS=Equit*	TS=(Patient near/3 Care) OR TS=(Person near/3 Care) OR TS=(Primary near/3 *Care)	*Care) OR TS=(Perinatal near/3 *Care) OR TS=(Matern* near/3 Health*) OR TS=(Matern* near/3 *care) OR TS=(Maternal near/3 Welfare) OR TS=(Maternal near/3 Service*)	OR TS=Liberia* OR TS=Madagascar* OR TS=Malawi* OR TS=Mali* OR TS=Mozambiqu* OR TS=Nepal* OR TS=Niger* OR TS=Rwanda* OR TS= "Sierra Leone*" OR TS=Somali* OR TS=Sudan* OR TS=Syria* OR TS=Tajikistan* OR TS=Tanzania* OR TS=Togo* OR TS=Uganda* OR TS=Yemen* OR TS=Angola* OR TS=Bangladesh* OR TS=Bhutan* OR TS=Bolivia* OR TS= "Cabo Verde" OR TS=Cambodia* OR TS=Cameroon* OR TS=Comoros* OR TS= "Cote d'Ivoire" OR TS= "Ivory Coast" OR TS=Djibouti* OR TS=Egypt* OR TS= "El Salvador*" OR TS=Ghana* OR TS=Honduras* OR TS=India* OR TS=Indonesia* OR TS=Kenya* OR TS=Kiribati* OR TS=Kyrgyz* OR TS=Kirghizia* OR TS= "Lao PDR" OR TS=Laos* OR TS=Lesotho* OR TS=Mauritania* OR TS=Melanesia* OR TS=Micronesia* OR TS=Moldov* OR TS=Mongolia* OR TS=Morocc* OR TS=Myanmar* OR TS=Nicaragua* OR TS=Pakistan* OR TS= "Papua New Guinea" OR TS=Philippine* OR TS= "Sao Tome and Principe" OR TS=Senegal* OR TS= "Solomon Islands" OR TS=Swaziland* OR TS= "Timor-Leste*" OR TS= "East Timor" OR TS=Tunisia* OR TS=Tuvalu* OR TS=Ukrain* OR TS=Uzbekistan* OR TS=Vanuatu* OR TS=Vietnam* OR TS= "West Bank" OR TS=Gaza* OR TS=Zambia* OR TS=Zimbabwe*
SCOPUS	#1 AND #2 AND #3 AND #4 AND #5 = 276			
Human resources for health intervention (#1)	Quality (#2)	Continuum (#3)	Maternal health care (#4)	Low-and lower-middle-income countries (#5)

TITLE-ABS("Health workforce") OR TITLE-ABS("Health Personnel") OR TITLE-ABS("Health Care Provider") OR TITLE-ABS("Health worker") OR TITLE-ABS(Physician*) OR TITLE-ABS(Doctor*) OR TITLE-ABS(Nurs*) OR TITLE-ABS(Midwi*) OR TITLE-ABS("Community Health Worker") OR TITLE-ABS("Community Health Aide") OR TITLE-ABS("Village Health Worker") OR TITLE-ABS("Traditional Birth Attendant") OR TITLE-ABS(Intervention*) OR TITLE-ABS(Education*) OR TITLE-ABS(Curricul*) OR TITLE-ABS("Educational Measurement") OR TITLE-ABS("Educational Assessment") OR TITLE-ABS(Teaching*) OR TITLE-ABS(Training*) OR TITLE-ABS("Capacity Building") OR TITLE-ABS("Staff Development") OR TITLE-ABS("Human Resources Development") OR TITLE-ABS("Personnel Management") OR TITLE-ABS(Partnership) OR TITLE-ABS(Economic*) OR TITLE-ABS(Financ*) OR TITLE-ABS(Supervision*) OR TITLE-ABS(Administration) OR TITLE-ABS(Logistics) OR TITLE-ABS(Motivation) OR TITLE-ABS(Incentive*) OR TITLE-ABS(Employment) OR TITLE-ABS(Recruitment*) OR TITLE-ABS(Leadership*) OR TITLE-ABS("Intersectoral Collaboration") OR TITLE-ABS("Intersectoral Cooperation")	TITLE-ABS(Quality) OR TITLE-ABS("Optimal care") OR TITLE-ABS("Diffusion of Innovation") OR TITLE-ABS("Innovation Diffusion") OR TITLE-ABS("Health Worker Performance") OR TITLE-ABS(Standard) OR TITLE-ABS("Clinical Competence") OR TITLE-ABS("Guideline Adherence") OR TITLE-ABS(Evaluation*) OR TITLE-ABS("Outcome Assessment") OR TITLE-ABS(Effective*) OR TITLE-ABS("Cost Benefit Analysis") OR TITLE-ABS("People Centred") OR TITLE-ABS(Satisfaction) OR TITLE-ABS(Safe) OR TITLE-ABS(Timely) OR TITLE-ABS(Efficient) OR TITLE-ABS(Equitable) OR TITLE-ABS("Evidence-Based Practice") OR TITLE-ABS("Evidence Based Health Care") OR TITLE-ABS("Evidence Based Healthcare") OR TITLE-ABS(Respectful) OR	TITLE-ABS(Continuity) OR TITLE-ABS(Continuum) OR TITLE-ABS("Transitional Care") OR TITLE-ABS(Comprehensive) OR TITLE-ABS("Patient-Centered Care") OR TITLE-ABS("Person-centred care") OR TITLE-ABS("Primary health care") OR TITLE-ABS("Primary Healthcare") OR TITLE-ABS("Integrated Care")	TITLE-ABS("Reproductive Health Service") OR TITLE-ABS("Preconception Care") OR TITLE-ABS("Perinatal Care") OR TITLE-ABS("Maternal Health") OR TITLE-ABS("Maternity Care") OR TITLE-ABS("Maternal Welfare") OR TITLE-ABS("Maternal-Child Health Service") OR TITLE-ABS("Maternal and Child Health") OR TITLE-ABS("Maternal-Newborn-Child Health") OR	TITLE-ABS("Developing Country") OR TITLE-ABS("Poor Country") OR TITLE-ABS("Low-Income Country") OR TITLE-ABS("Least Developed Country") OR TITLE-ABS("Less Developed Nation") OR TITLE-ABS("Third World Country") OR TITLE-ABS("Third World Nation") OR TITLE-ABS("lower middle income country") OR TITLE-ABS("Low and Lower Middle Income Country") OR TITLE-ABS(Afghanistan*) OR TITLE-ABS(Benin*) OR TITLE-ABS("Burkina Fas*") OR TITLE-ABS(Burundi*) OR TITLE-ABS("Central African Republic") OR TITLE-ABS(Chad*) OR TITLE-ABS(Congo*) OR TITLE-ABS(Eritrea*) OR TITLE-ABS(Ethiopia*) OR TITLE-ABS(Gambia*) OR TITLE-ABS(Guinea*) OR TITLE-ABS(Haiti*) OR TITLE-ABS("North Korea") OR TITLE-ABS(Liberia*) OR TITLE-ABS(Madagascar*) OR TITLE-ABS(Malawi*) OR TITLE-ABS(Mali*) OR TITLE-ABS(Mozambiqu*) OR TITLE-ABS(Nepal*) OR TITLE-ABS(Niger*) OR TITLE-ABS(Rwanda*) OR TITLE-ABS("Sierra Leone*") OR TITLE-ABS(Somalia*) OR TITLE-ABS(Syria*) OR TITLE-ABS(Tajikistan*) OR TITLE-ABS(Tanzania*) OR TITLE-ABS(Togo*) OR TITLE-ABS(Uganda*) OR TITLE-ABS(Yemen*) OR TITLE-ABS(Angola*) OR TITLE-ABS(Bangladesh*) OR TITLE-ABS(Bhutan*) OR TITLE-ABS(Bolivia*) OR TITLE-ABS("Cabo Verde") OR TITLE-ABS(Cambodia*) OR TITLE-ABS(Cameroon*) OR TITLE-ABS(Comoros*) OR TITLE-ABS("Cote d'Ivoire") OR TITLE-ABS(Djibouti*) OR TITLE-ABS(Egypt*) OR TITLE-ABS("El Salvador*") OR TITLE-ABS(Ghana*) OR TITLE-ABS(Honduras*) OR TITLE-ABS(India*) OR TITLE-ABS(Indonesia*) OR TITLE-ABS(Kenya*) OR TITLE-ABS(Kiribati*) OR TITLE-ABS(Kyrgyz*) OR TITLE-ABS(Kirgizstan*) OR TITLE-ABS(Kirghizia*) OR TITLE-ABS("Lao PDR") OR TITLE-ABS(Laos*) OR TITLE-ABS(Lesotho*) OR TITLE-ABS(Mauritania*) OR TITLE-

OR TITLE-ABS("Community Participation") OR TITLE-ABS("Community Involvement") OR TITLE-ABS("Competency assessment") OR TITLE-ABS("Certification") OR TITLE-ABS("Medical Licensure") OR TITLE-ABS(Licens*) OR TITLE-ABS("Supportive Supervision") OR TITLE-ABS("Skill Mix") OR TITLE-ABS("Staffing and Scheduling") OR TITLE-ABS(" Task-Sharing") OR TITLE-ABS("Job Sharing") OR TITLE-ABS("Professional Delegation") OR TITLE-ABS("Task Shifting") OR TITLE-ABS("Shift Work Schedule") OR TITLE-ABS("Night Shift Work") OR TITLE-ABS(Policy*) OR TITLE-ABS(Legislation*)	TITLE-ABS("Culturally Congruent Care") OR TITLE-ABS("Culturally Competent") OR TITLE-ABS(Equity)		TITLE-ABS("Maternal, Newborn, and Child Health")	ABS(Melanesia*) OR TITLE-ABS(Micronesia*) OR TITLE-ABS(Moldova*) OR TITLE-ABS(Mongolia*) OR TITLE-ABS(Morocco*) OR TITLE-ABS(Myanmar*) OR TITLE-ABS(Nicaragua*) OR TITLE-ABS(Pakistan*) OR TITLE-ABS("Papua New Guinea") OR TITLE-ABS(Philippines*) OR TITLE-ABS("Sao Tome and Principe") OR TITLE-ABS(Senegal*) OR TITLE-ABS("Solomon Islands") OR TITLE-ABS(Sudan*) OR TITLE-ABS(Swaziland*) OR TITLE-ABS("Timor-Leste*") OR TITLE-ABS("East Timor") OR TITLE-ABS(Tunisia*) OR TITLE-ABS(Tuvalu*) OR TITLE-ABS(Ukraine*) OR TITLE-ABS(Uzbekistan*) OR TITLE-ABS(Vanuatu*) OR TITLE-ABS(Vietnam*) OR TITLE-ABS("West Bank") OR TITLE-ABS(Gaza*) OR TITLE-ABS(Zambia*) OR TITLE-ABS(Zimbabwe*)
CINAHL	#1 AND #2 AND #3 AND #4 AND #5 = 167			
Human resources for health intervention (#1)	Quality (#2)	Continuum (#3)	Maternal health care (#4)	Low-and lower-middle-income countries (#5)
"Health workforce" OR (MH "Health Personnel+" OR "Health Personnel" OR "Health Care Provider*" OR "Health worker*" OR "Physician*" OR "Doctor" OR MH "Schools, Nursing" OR "Nurs*" OR "Midwi*" OR "Community Health Worker*" OR "Barefoot Doctor*" OR MH "Rural Health Personnel" OR "Village Health Worker*" OR "Traditional Birth Attendant*" OR "Intervention" OR "Education" OR "Curricul*" OR MH "Education, Health Sciences+" OR MH "Cross Training" OR MH "Curriculum+" OR MH "Education, Clinical+" OR MH "Education, Competency-Based" OR MH "Educational Measurement+" OR MH "Teaching+" OR MH "Staff Development+" OR	(MH "Quality of Health Care+" OR "Quality of Health Care" OR "Health care quality" OR "Quality of Healthcare" OR "Healthcare Quality" OR "Quality of Care" OR "Optimal Care*" OR MH "Clinical Competence+" OR "Clinical competence" OR MH "Cultural Competence" OR MH "Cultural Safety" OR "Culturally	(MH "Continuity of Patient Care+" OR "Continuum of Care" OR "Care Continuum" OR "Continuity of Care" OR "Care Continuity" OR MH "Health	(MH "Reproductive Care (Saba CCC)+" OR "Reproductive Health" OR "Preconception Care" OR "Perinatal Care" OR MH "Perinatal Care (Saba CCC)+" OR MH "Maternal Health	(MH "Developing Countries" OR "Developing Countr*" OR "Low-Income Population*" OR "Least Developed Countries" OR "Less Developed Nation*" OR MH "Low and Middle Income Countries" OR "Low Income Countries" OR "Third World Countr*" OR "Third World Nation*" OR "Lower Middle Income Countries" OR "Afghanistan*" OR "Benin*" OR "Burkina Fas*" OR "Burundi*" OR "Central African Republic" OR "Chad" OR "Congo" OR "Eritrea*" OR "Ethiopia*" OR "Gambia" OR "Guinea" OR "Haiti*" OR "North Korea" OR "Liberia*" OR "Madagascar" OR "Malawi" OR "Mali"

"Inservice Training" OR "Teaching" OR "Training" OR "Capacity Building" OR "Staff Development" OR MH "Management+" OR "Management" OR MH "Consortia+" OR "Partnership" OR "Intersectoral Collaboration" OR "Intersectoral Cooperation" OR MH "Salaries and Fringe Benefits+" OR MH "Reimbursement, Incentive" OR MH "Comparable Worth" OR "Incentive*" OR MH "Economics+" OR "Economics" OR MH "Financing, Organized+" OR "Financ*" OR MH "Clinical Supervision" OR MH "Fieldwork" OR MH "Student Supervision" OR "Supervision" OR MH "Leadership" OR "Leadership" OR MH "Nursing Management+" OR MH "Health Policy+" OR "Policy" OR MH "Practice Acts+" OR MH "Practice Guidelines" OR "Health Legislation" OR "Legislation" OR MH "Public Relations+" OR "Community Participation" OR MH "Community Role" OR MH "Competency Assessment" OR "Competency assess*" OR MH "Certification+" OR "Certification" OR MH "Licensure+" OR MH "Career Mobility+" OR MH "Personnel Selection+" OR MH "Personnel Staffing and Scheduling+" OR "Supportive Supervision" OR "Skill Mix" OR "Task-Sharing" OR "Task Shifting" OR MH "Shiftwork")	Competent Care" OR MH "National Vocational Qualifications" OR MH "Guideline Adherence" OR "Guideline Adherence" OR MH "Quality Assurance+" OR MH "Quality Assessment+" OR MH "Professional Compliance" OR MH "Outcomes (Health Care)+" OR "Effective health care" OR MH "Cost Benefit Analysis" OR "Cost-Benefit Analysis" OR "Cost Effectiveness" OR MH "Patient Satisfaction+" OR "Patient Satisfaction" OR MH "Patient Safety+" OR "Patient Safety" OR MH "Medical Practice, Evidence-Based" OR "Evidence-Based Practice" OR "Evidence based care" OR "Equity")	Care Delivery, Integrated" OR "Comprehensive Health Care" OR "Comprehensive Healthcare" OR "Comprehensive care" OR MH "Patient Centered Care" OR "Patient-Centered Care" OR "Patient-Centered Care" OR MH "Primary Health Care" OR MH "Transitional Care" OR "Primary Healthcare")	Services+" OR MH "Maternal-Child Care+" OR "Maternal Health" OR MH "Obstetric Care+" OR MH "Prenatal Care (Iowa NIC)" OR MH "Delivery, Obstetric+" OR MH "Women's Health" OR MH "Maternal Welfare" OR MH "Maternal-Child Welfare" OR "Maternal Welfare" OR "Maternal-Child Health")	OR "Mozambiqu*" OR "Nepal" OR "Niger" OR "Rwanda*" OR "Sierra Leone*" OR "Somalia*" OR "Sudan*" OR "Syria*" OR "Tajikistan*" OR "Tanzania*" OR "Togo" OR "Uganda" OR "Yemen*" OR "Angola*" OR "Bangladesh*" OR "Bhutan*" OR "Bolivia*" OR "Cabo Verde" OR "Cambodia*" OR "Cameroon*" OR "Comoros*" OR "Cote d'Ivoire" OR "Djibouti*" OR "Egypt*" OR "El Salvador*" OR "Ghana" OR "Honduras*" OR "India*" OR "Indonesia*" OR "Kenya" OR "Kiribati*" OR "Kyrgyz*" OR "Kirgizstan" OR "Kirghizia" OR "Lao PDR" OR "Laos" OR "Laos" OR "Lesotho" OR "Mauritania*" OR "Melanesia*" OR "Micronesia*" OR "Moldova*" OR "Mongolia*" OR "Morocco*" OR "Myanmar*" OR "Nicaragua*" OR "Nigeria" OR "Pakistan*" OR "Papua New Guinea" OR "Philippines*" OR "Sao Tome and Principe" OR "Senegal*" OR "Solomon Islands" OR "Swaziland*" OR "Timor-Leste*" OR "East Timor" OR "Tunisia*" OR "Tuvalu*" OR "Ukraine*" OR "Uzbekistan*" OR "Vanuatu*" OR "Vietnam*" OR "West Bank" OR "Gaza" OR "Zambia*" OR "Zimbabwe*")
EMBASE/OVID	#1 AND #2 AND #3 AND #4 AND #5 = 200			
Human resources for health intervention (#1)	Quality (#2)	Continuum (#3)	Maternal health care (#4)	Low-and lower-middle-income countries (#5)

215

Health workforce.ab,ti. OR Health care personnel/ OR health auxiliary/ OR health care manpower/ OR lay health worker/ OR Health personnel.ab,ti. OR "Physician*".ab,ti. OR "Doctor*".ab,ti. OR "practitioner*".ab,ti. OR "gynaecologist*".ab,ti. OR "obstetrician*".ab,ti. OR exp nurse/ OR "Nurs*".ab,ti. OR exp midwife/ OR "Midwi*".ab,ti. OR "Community Health Worker*".ab,ti. OR "Village Health Worker*".ab,ti. OR traditional birth attendant/ OR "Traditional Birth Attendant*".ab,ti. OR "Education*".ab,ti. OR exp education/ OR Preservice Education.mp. OR Preservice training.mp. OR medical education/ OR curriculum/ OR "Curricul*".ab,ti. OR "Training*".ab,ti. OR in service training/ OR Inservice Training.ab,ti. OR Capacity Building.ab,ti. OR Staff Development.mp. OR personnel management/ OR health care personnel management/ OR "salary and fringe benefit"/ OR skill mix/ OR team building/ OR Skill Mix.ab,ti. OR "Incentive*".ab,ti. OR "Organization and Administration".mp. OR	exp health care quality/ OR health care quality.mp. OR Quality of Health care.mp. OR Quality of Healthcare.mp. OR Quality of Care.mp. OR Optimal Care.mp. OR Quality Improvement.mp. OR total quality management/ OR Diffusion of Innovation.mp. OR mass communication/ OR Standard of Care.mp. OR competence/ OR clinical competence/ OR cultural competence/ OR nursing competence/ OR professional competence/ OR "Competenc*".ab,ti. OR Guideline Adherence.mp. OR protocol compliance/ OR evaluation study.mp. OR program evaluation.mp. OR Outcome assessment.mp. OR Outcome assessment.ab,ti. OR Effective health care.mp. OR Cost-Benefit Analysis.mp. OR "cost benefit analysis"/ OR Cost Effectiveness.mp.	Continuity of Patient Care.mp. OR exp patient care/ OR Continuum of Care.mp. OR Care Continuum. mp. OR Continuity of Care.mp. OR Care Continuity.m p. OR Comprehens ive Health Care.mp. OR health care/ OR Comprehens ive care.mp. OR Patient-Centered Care.mp. OR Person-Centred Care.mp. OR Primary Health Care.mp. OR primary medical care/	"Reproductive Health Service*".ab,ti. OR Preconception Care.mp. OR prepregnancy care/ OR exp perinatal care/ OR Perinatal Care.mp. OR Maternal Health.mp. OR exp maternal welfare/ OR Maternal Health Service.mp. OR exp maternal health service/ OR "Maternal Health Service*".ab,ti. OR exp maternal care/ OR Maternal-Child Health Service.mp.	exp developing country/ OR "Developing Countr*".ab,ti. OR exp lowest income group/ OR Least Developed Countries.mp. OR exp low income country/OR exp lowest income group/ OR "Low-income countr*".ab,ti. OR Third World Countries.mp. OR Lower Middle Income Countries.mp. OR exp middle income country/ OR "Lower-Middle Income Countr*".ab,ti. OR (Low and lower middle income countr*).ab,ti. OR "Afghanistan*".ab,ti. OR "Benin*".ab,ti. OR "Burkina Fas*".ab,ti. OR "Burundi*".ab,ti. OR Central African Republic.ab,ti. OR "Chad*".ab,ti. OR "Congo*".ab,ti. OR "Eritrea*".ab,ti. OR "Ethiopia*".ab,ti. OR "Gambia*".ab,ti. OR "Guinea*".ab,ti. OR "Haiti*".ab,ti. OR North Korea.ab,ti. OR "Liberia*".ab,ti. OR "Madagascar*".ab,ti. OR "Malawi*".ab,ti. OR "Mali*".ab,ti. OR "Mozambiqu*".ab,ti. OR "Nepal*".ab,ti. OR "Niger*".ab,ti. OR "Rwanda*".ab,ti. OR "Sierra Leone*".ab,ti. OR "Somalia*".ab,ti. OR "Sudan*".ab,ti. OR "Syria*".ab,ti. OR "Tajikistan*".ab,ti. OR "Tanzania*".ab,ti. OR "Togo*".ab,ti. OR "Uganda*".ab,ti. OR "Yemen*".ab,ti. OR "Angola*".ab,ti. OR "Bangladesh*".ab,ti. OR "Bhutan*".ab,ti. OR "Bolivia*".ab,ti. OR Cabo Verde.ab,ti. OR "Cambodia*".ab,ti. OR "Cameroon*".ab,ti. OR "Comoros*".ab,ti. OR Cote d'Ivoire.ab,ti. OR Ivory Coast.ab,ti. OR "Djibouti*".ab,ti. OR "Egypt*".ab,ti. OR "El Salvador*".ab,ti. OR "Ghana*".ab,ti. OR "Honduras*".ab,ti. OR "India*".ab,ti. OR "Indonesia*".ab,ti. OR "Kenya*".ab,ti. OR "Kiribati*".ab,ti. OR "Kyrgyz*".ab,ti. OR "Kirghizia*".ab,ti. OR Lao PDR.ab,ti. OR

Partnership.mp. OR "Partnership*".ab,ti. OR Intersectoral Collaboration.mp. OR intersectoral collaboration/ OR public-private partnership/ OR finance/ OR Finance.mp. OR "Supervision*".ab,ti. OR Supportive Supervision.mp. OR Employment.mp. OR Leadership.mp. OR leadership/ OR Community Participation.mp. OR community participation/ OR Competency assessment.mp. OR certification/ OR accreditation/ OR Licensing.mp. OR licensing/ OR Task-Sharing.mp. OR Task Shifting.mp. OR health care policy/ OR Health policy.mp. OR Health Legislation.mp.	OR "cost utility analysis"/ OR economic evaluation/ OR Patient Satisfaction.mp. OR patient satisfaction/ OR safety/ OR patient safety/ OR Safety.ab,ti. OR Evidence-Based Practice.mp. OR Evidence based practice/ OR evidence based medicine/ OR Evidence Based Health Care.mp. OR Culturally Competent Care.mp. OR transcultural care/ OR Health Equity.mp. OR health equity/			"Laos*".ab,ti. OR "Lesotho*".ab,ti. OR "Mauritania*".ab,ti. OR "Melanesia*".ab,ti. OR "Micronesia*".ab,ti. OR "Moldov*".ab,ti. OR "Mongolia*".ab,ti. OR "Morocc*".ab,ti. OR "Myanmar*".ab,ti. OR "Nicaragua*".ab,ti. OR "Pakistan*".ab,ti. OR Papua New Guinea.ab,ti. OR "Philippine*".ab,ti. OR (Sao Tome and Principe).ab,ti. OR "Senegal*".ab,ti. OR Solomon Islands.ab,ti. OR "Swaziland*".ab,ti. OR "Timor-Leste*".ab,ti. OR East Timor.ab,ti. OR "Tunisia*".ab,ti. OR "Tuvalu*".ab,ti. OR "Ukrain*".ab,ti. OR "Uzbekistan*".ab,ti. OR "Vanuatu*".ab,ti. OR "Vietnam*".ab,ti. OR West Bank.ab,ti. OR "Gaza*".ab,ti. OR "Zambia*".ab,ti. OR "Zimbabwe*".ab,ti.
Cochrane Library/trials	#1 AND #2 AND #3 AND #4 AND #5 = 171			
Human resources for health intervention (#1)	Quality (#2)	Continuum (#3)	Maternal health care (#4)	Low-and lower-middle-income countries (#5)
([mh "Health Workforce"] OR [mh ^"Health Personnel"] OR (Health* next Personnel) OR (Health* next *force) OR (health* next professional) OR (Health* next Provider) OR (Health* next worker) OR (Health* next manpower) OR Physician* OR Doctor* OR practitioner* OR Nurs* OR [mh Midwifery] OR Midwi* OR "community health aide" OR "community health officer" OR (medical near/3 auxiliary) OR "traditional birth attendant" OR [mh "Clinical Trial"] OR Intervention* OR [mh Education] OR Education* OR Literacy OR Residency OR	([mh "Quality of Health Care"] OR Quality OR (Optim* next Care) OR [mh "Health Care Evaluation Mechanisms"] OR Evaluation OR Standard* OR [mh "Patient Satisfaction"] OR Satisfaction OR Safe* OR (*Care next Performance) OR [mh "Clinical Competence"] OR [mh "Cultural Competency"]	([mh ^"Continuity of Patient Care"] OR (Continuity near/3 Care) OR (Continuum near/3 Care) OR Continuum OR	([mh "Reproductive Health Services"] OR (Reproductive next Health*) OR (Reproductive near/3 care) OR [mh "Preconception Care"] OR (Preconception next *Care) OR [mh "Perinatal	([mh Poverty] OR (Low* near/5 Income) OR (Low* next middle*) OR [mh "Developing Countries"] OR (Developing next Countries) OR "Least-Developed" OR "Third-World" OR "Under-Developed" OR "Less-Developed" OR Afghanistan* OR Benin* OR "Burkina Faso" OR Burundi* OR "Central African Republic" OR Chad* OR Congo* OR Eritrea* OR Ethiopia* OR Gambia* OR Guinea* OR Haiti* OR "North Korea" OR Liberia* OR Madagascar* OR Malawi* OR Mali* OR Mozambiqu* OR Nepal* OR Niger* OR Rwanda* OR "Sierra Leone*" OR Somali*

Internship OR Training OR Teaching OR Curricul* OR (Capacity near/3 Building) OR (Personnel near/3 Management) OR (Human near/3 Development) OR [mh "Staff Development"] OR [mh ^Motivation] OR Incentiv* OR Staff* OR Scheduling OR [mh "Public-Private Sector Partnerships"] OR [mh "Intersectoral Collaboration"] OR Partnership OR Collaboration OR Cooperation OR [mh "Financial Management"] OR Financ* OR Budget* OR [mh "Organization and Administration"] OR [mh "Inservice Training"] OR Supervision OR Motivation OR Leadership OR [mh "Community Participation"] OR (Community near/3 Participation) OR (Community near/3 Involvement) OR [mh "Competency-Based Education"] OR (Competency near/3 Assessment) OR [mh Certification] OR Certification* OR accreditation* OR [mh Licensure] OR Licens* OR (Skill* next Mix) OR (Task near/3 Sharing) OR (Job near/3 Sharing) OR (Task near/3 Shifting) OR (Shift near/3 Work) OR [mh ^"Health Policy"] OR Policy OR Legislation):ti,ab,kw	OR Competenc* OR (Guideline near/3 Adherence) OR [mh ^"Outcome Assessment (Health Care)"] OR (Outcome near/3 Assessment) OR [mh "Comparative Effectiveness Research"] OR (Effective next *care) OR [mh "Cost-Benefit Analysis"] OR (Cost near/3 Analysis) OR (Cost next Effective*) OR (People next centred) OR [mh "Evidence-Based Practice"] OR (Evidence near/3 Practice) OR (Evidence near/3 Care) OR (Cultur* next congruent) OR (*cultural next care) OR [mh "Health Equity"] OR Equit*):ti,ab,kw	(Compreh ensive next *Care) OR (Patient near/3 Care) OR (Person near/3 Care) OR (Primary near/3 Care)):ti,a b,kw	Care"] OR (Perinatal next *Care) OR [mh "Maternal Health"] OR [mh "Maternal Health Services"] OR (Maternal near/5 Health) OR (Matern* next *care) OR [mh "Maternal Welfare"] OR (Matern* next Welfare) OR (Maternal near/5 Service)):ti,ab,kw	OR Sudan* OR Syria* OR Tajikistan* OR Tanzania* OR Togo* OR Uganda* OR Yemen* OR Angola* OR Bangladesh* OR Bhutan* OR Bolivia* OR "Cabo Verde" OR Cambodia* OR Cameroon* OR Comoros* OR "Cote d'Ivoire" OR "Ivory Coast" OR Djibouti* OR Egypt* OR "El Salvador*" OR Ghana* OR Honduras* OR India* OR Indonesia* OR Kenya* OR Kiribati* OR Kyrgyz* OR Kirghizia* OR "Lao PDR" OR Laos* OR Lesotho* OR Mauritania* OR Melanesia* OR Micronesia* OR Moldov* OR Mongolia* OR Morocc* OR Myanmar* OR Nicaragua* OR Pakistan* OR "Papua New Guinea" OR Philippine* OR "Sao Tome and Principe" OR Senegal* OR "Solomon Islands" OR Swaziland* OR "Timor-Leste*" OR "East Timor" OR Tunisia* OR Tuvalu* OR Ukrain* OR Uzbekistan* OR Vanuatu* OR Vietnam* OR "West Bank" OR Gaza* OR Zambia* OR Zimbabwe*):ti,ab,kw

Date of retrieval for all databases: 21/08/2019; Search date limiter: 01/01/2000

Methodological quality appraisal

Table A6 1: Quality of randomized controlled trials (RCTs): Adopted from the revised Cochrane risk of bias (ROB 2.0) tool for randomized trials, 2016.

Study	Selection bias	Performance bias	Attrition bias	Detection bias	Reporting bias
Engineer et al. (RCT)	1.1. Yes 1.2. Yes 1.3. No Risk of bias judgement: Low risk	2.1. PY 2.2. PY 2.3. No 2.4. NA 2.5. No 2.6. NA Risk of bias judgement: Low risk	3.1. Yes 3.2. NA 3.3. NA Risk of bias judgement: Low risk	4.1. No 4.2. NA Risk of bias judgement: Low risk	5.1. No 5.2. No Risk of bias judgement: Low risk
Gomez et al. (RCT)	1.1. Yes 1.2. Yes 1.3. Yes Risk of bias judgement: Some concerns	2.1. Yes 2.2. PY 2.3. No 2.4. NA 2.5. No 2.6. NA Risk of bias judgement: Low risk	3.1. Yes 3.2. NA 3.3. NA Risk of bias judgement: Low risk	4.1. No 4.2. NA Risk of bias judgement: Low risk	5.1. No 5.2. No Risk of bias judgement: Low risk
Larson et al. (RCT)	1.1. Yes 1.2. Yes 1.3. No Risk of bias judgement: Low risk	2.1. No 2.2. NI 2.3. No 2.4. NA 2.5. PY 2.6. No Risk of bias judgement: Some concerns	3.1. Yes 3.2. NA 3.3.NA Risk of bias judgement: Low risk	4.1. No 4.2. NA Risk of bias judgement: Low risk	5.1. No 5.2. No Risk of bias judgement: Low risk
Okawa et al. (RCT)	1.1. Yes 1.2. Yes 1.3. No Risk of bias judgement:	2.1. PY 2.2. Yes 2.3. No 2.4. NA	3.1. Yes 3.2. NA 3.3. NA Risk of bias judgement:	4.1. PY 4.2. No Risk of bias judgement: Low risk	5.1. No 5.2. No Risk of bias judgement: Low risk

	Low risk	2.5. PN 2.6. NA Risk of bias judgement: Low risk	Low risk		
Pirkle et al. (RCT)	1.1. Yes 1.2. Yes 1.3. PN Risk of bias judgement: Low Risk	2.1. PN 2.2. PN 2.3. NA 2.4. NA 2.5. No 2.6. NA Risk of bias judgement: Low risk	3.1. Yes 3.2. NA 3.3. NA Risk of bias judgement: Low risk	4.1. PN 4.2. NA Risk of bias judgement: Low risk	5.1. No 5.2. No Risk of bias judgement: Low risk
Waiswa et al. (RCT)	1.1. Yes 1.2. Yes 1.3. No Risk of bias judgement: Low risk	2.1. PN 2.2. Yes 2.3. No 2.4. NA 2.5. No 2.6. NA Risk of bias judgement: Low risk	3.1. Yes 3.2. NA 3.3. NA Risk of bias judgement: Low risk	4.1. NI 4.2. No Risk of bias judgement: Low risk	5.1. No 5.2. No Risk of bias judgement: Low risk
Zeng et al. (RCT)	1.1. NI 1.2. Yes 1.3. No Risk of bias judgement: Low risk	2.1. NI 2.2. PY 2.3. No 2.4. NA 2.5. No 2.6. NA Risk of bias judgement: Low risk	3.1. Yes 3.2. NA 3.3. NA Risk of bias judgement: Low risk	4.1. PY 4.2. No Risk of bias judgement: Low risk	5.1. No 5.2. No Risk of bias judgement: Low risk

Signalling questions:
1. Selection bias (Randomization process):
1.1. Was the allocation sequence random?
1.2. Was the allocation sequence concealed until participants were recruited and assigned to interventions?
1.3. Were there baseline imbalances that suggest a problem with the randomization process?
2. Performance bias (Deviations from intended interventions) - Intention-to-treat (ITT) analysis:
2.1. Were participants aware of their assigned intervention during the trial?
2.2. Were carers and trial personnel aware of participants' assigned intervention during the trial?
2.3. If Y/PY/NI to 2.1 or 2.2: Were there deviations from the intended intervention beyond what would be expected in usual practice?
2.4. If Y/PY to 2.3: Were these deviations from intended intervention unbalanced between groups and likely to have affected the outcome?
2.5. Were any participants analysed in a group different from the one to which they were assigned?
2.6. Was there potential for a substantial impact (on the estimated effect of intervention) of analysing participants in the wrong group?
3. Attrition bias (Missing outcome data):
3.1. Were outcome data available for all, or nearly all, participants randomized?
3.2. If N/PN/NI to 3.1: Are the proportions of missing outcome data and reasons for missing outcome data similar across intervention groups?
3.3. If N/PN/NI to 3.1: Is there evidence that results were robust to the presence of missing outcome data?
4. Detection bias (measurement of the outcome):
4.1. Were outcome assessors aware of the intervention received by study participants?
4.2. If Y/PY/NI to 4.1: Was the assessment of the outcome likely to be influenced by knowledge of intervention received?
5. Bias in reporting (Selection of the reported result):
Are the reported outcome data likely to have been selected, on the basis of the results, from:
5.1. Multiple outcome measurements (e.g., scales, definitions, time points) within the outcome domain?
 5.2. Multiple analyses of the data?

Table A7 1: Quality of quasi-experimental, prospective (pre/post), post-only and comparison, and post-only studies: Adopted from the JBI Critical Appraisal Checklist for Quasi-Experimental Studies (non-randomized experimental studies).

Study	1	2	3	4	5	6	7	8	9	Overall quality[*]
Agarwal et al.	U	Y	Y	Y	N	NA	Y	Y	Y	6/9 (Moderate)
Ayalew et al.	Y	Y	Y	Y	N	Y	Y	Y	Y	8/9 (High)
Balakrishnan et al.	Y	U	Y	Y	Y	U	Y	Y	Y	7/9 (High)
Basinga et al.	Y	U	Y	Y	Y	U	Y	Y	Y	7/9 (High)
Binyaruka et al.	Y	U	Y	Y	Y	U	Y	Y	Y	7/9 (High)
Bonfrer et al.	Y	Y	Y	Y	N	NA	Y	Y	Y	7/9 (High)
Duysburgh et al.	Y	U	Y	Y	Y	NA	Y	Y	Y	7/9 (High)
Edwards et al.	Y	U	U	Y	N	N	Y	Y	Y	5/9 (Moderate)
Ghosh et al.	Y	Y	Y	N	Y	Y	Y	Y	Y	8/9 (High)
Magge et al.	Y	U	Y	N	Y	U	Y	Y	Y	6/9 (Moderate)
Maru et al.	Y	U	Y	N	Y	U	Y	Y	Y	6/9 (Moderate)
McDougal et al.	Y	Y	Y	Y	Y	NA	Y	Y	Y	8/9 (High)
Mwaniki et al.	U	U	Y	N	Y	Y	Y	Y	N	5/9 (Moderate)
Rahman et al.	Y	N	Y	Y	Y	Y	U	Y	Y	7/9 (High)
Rob et al.	Y	U	U	Y	Y	U	U	N	N	3/9 (Low)
Satti et al.	Y	U	Y	N	Y	U	Y	Y	N	5/9 (Moderate)

Signalling questions:

1. Is it clear in the study what is the 'cause' and what is the 'effect'
(i.e. there is no confusion about which variable comes first)? Yes (Y)/No (N)/Unclear (U)/ Not Applicable (NA)

2. Were the participants included in any comparisons similar? Y/N/U/NA

3. Were the participants included in any comparisons receiving similar treatment/care, other than the exposure or intervention of interest? Y/N/U/NA

4. Was there a control group? Y/N/U/NA

5. Were there multiple measurements of the outcome both pre and post the intervention/exposure? Y/N/U/NA

6. Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analyzed? Y/N/U/NA

7. Were the outcomes of participants included in any comparisons measured in the same way? Y/N/U/NA

8. Were outcomes measured in a reliable way? Y/N/U/NA

9. Was appropriate statistical analysis used? Y/N/U/NA
*A study with "yes" responses greater or equal to seven out of nine was considered a high quality, the one scoring four to six "yes" responses was considered a moderate quality and the one scoring less than four "yes" responses was considered a low quality.

Table A8 1: Quality of qualitative and mixed method studies: The CASP

Signalling questions	Kambala et al.	Okuga et al.
Was the research design appropriate to address the aims of the research?	Yes –& justification provided Mixed methods-informed by multidimensional definition of Quality	Yes but no overall design/approach or methodology described
Was the recruitment strategy appropriate to the aims of the research?	Unclear – participants appear appropriate but no explanation of how they were selected or recruitment processes sampling for diversity focused on intervention sites informed by quant phase	Unclear –description of who took part but not of how they were selected or recruitment processes
Was the data collected in a way that addressed the research issue?	Yes but- no rationale for inclusion of interviews and FGDs given	Yes - but- no rationale for inclusion of interviews and FGDs given
Has the relationship between researcher and participants been adequately considered?	No	No
Have ethical issues been taken into consideration?	Yes	Yes
Was the data analysis sufficiently rigorous?	Directed content analysis based on definition of quality Yes	Manifest content analysis sparse detail of analysis process
Is there a clear statement of findings?	Yes	Yes
How valuable is the research?	Recommendation to local settings but no explicit indication of external validity	Recommendation to local settings and external validity. Yes, valuable
Overall comments	Moderate quality	Moderate quality

Table A9 1: Women's use of maternal healthcare services across the continuum using characteristics for selected variables in 28 LLMICs, DHS 2016-2021.

Country name	Received 1st ANC during the first trimester (%)		Received 4+ ANC visits (%)		The pregnancy was wanted (%)		Mother had to get permission to seek care (%)		Lack of companion was the problem to access care (%)		Distance to a H. facility was the problem to access care (%)		The mother was a teenager at birth (%)		Number of living children (%)		Preceding Birth interval (full years) (%)	
	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	≥5	1-4	<2	≥2
Angola [2016]	563 (16.8)	669 (32.8)	222 (10.2)	1,010 (31.3)	534 (25.1)	698 (21.3)	960 (26.5)	272 (15.2)	943 (25.5)	289 (16.9)	621 (25.4)	611 (20.6)	985 (23.0)	247 (22.2)	284 (17.9)	928 (24.8)	172 (18.4)	735 (22.1)
Bangladesh [2018]	865 (39.2)	835 (64.8)	640 (33.8)	1,060 (66.2)	306 (39.1)	1,395 (51.4)	1,517 (49.6)	184 (41.8)	979 (52.7)	721 (44.1)	1,079 (53.0)	622 (42.5)	1,198 (47.4)	503 (51.9)	20 (12.3)	1,649 (50.0)	79 (36.4)	810 (40.9)
Benin [2018]	1,376 (49.7)	1,926 (70.5)	1,273 (46.9)	2,029 (72.9)	1,019 (65.1)	2,283 (58.0)	2,743 (65.1)	559 (43.5)	2,839 (63.9)	462 (43.8)	2,385 (66.0)	917 (48.5)	2,872 (60.1)	430 (59.4)	786 (53.8)	2,433 (62.6)	345 (59.4)	2,150 (58.2)
Burundi [2017]	1,334 (48.3)	1,588 (60)	1,332 (51.0)	1,589 (56.8)	1,011 (49.8)	1,911 (56.5)	2,792 (54.5)	130 (45.3)	2,462 (55.0)	459 (49.3)	2,036 (56.2)	886 (49.4)	2,688 (53.7)	234 (58.2)	926 (49.8)	1,938 (55.9)	377 (55.1)	1,939 (51.2)
Cameroon [2019]	1,177 (49.2)	1,159 (75.8)	484 (33.6)	1,853 (74.6)	605 (63.9)	1,731 (58.2)	1,689 (65.5)	647 (48.1)	1,833 (64.8)	503 (45.9)	1,572 (69.9)	764 (45.6)	1,920 (60.7)	416 (54.6)	558 (50.6)	1,721 (62.8)	325 (53.7)	1,387 (58.5)
Ethiopia [2016]	427 (12.5)	299 (33.4)	235 (8.2)	491 (34.2)	163 (14.1)	563 (17.9)	588 (22.3)	139 (8.3)	538 (23.6)	188 (9.3)	485 (28.5)	241 (9.3)	663 (17.4)	64 (12.5)	159 (10.1)	547 (20.5)	45 (7.8)	468 (16.4)
Gambia [2020]	1,460 (81.2)	1,079 (81.1)	481 (74.2)	2,058 (83.0)	585 (80.1)	1,954 (81.5)	2,450 (81.2)	88 (79.2)	2,276 (81.7)	263 (76.4)	1,945 (84.7)	594 (71.2)	2,265 (81.0)	274 (82.3)	685 (75.1)	1,797 (83.4)	243 (76.9)	1,726 (80.4)
Guinea [2018]	830 (38.3)	440 (51.3)	627 (32.3)	642 (59.4)	209 (37.6)	1,061 (42.9)	996 (45.3)	274 (33.0)	996 (47.2)	274 (30.0)	831 (52.9)	439 (30.1)	1,013 (41.4)	257 (44.3)	306 (35.0)	930 (44.6)	109 (37.3)	855 (39.9)
Haiti [2017]	253 (22.3)	576 (44.7)	144 (16.0)	685 (45.0)	465 (30.7)	364 (40.2)	775 (35.3)	55 (24.1)	706 (36.9)	123 (24.0)	561 (42.4)	269 (24.4)	741 (35.1)	88 (28.1)	92 (18.9)	712 (37.7)	58 (22.8)	407 (28.6)
India [2021]	15,089 (56.9)	48,600 (80.0)	21,276 (57.9)	42,413 (84.0)	5,203 (64.0)	58,486 (73.9)	54,323 (74.7)	9,366 (64.3)	52,785 (74.8)	10,904 (65.5)	49,179 (75.1)	14,510 (66.6)	56,981 (73.3)	6,708 (70.2)	2,125 (50.7)	60,937 (74.1)	8,784 (66.5)	27,666 (70.1)
Indonesia [2017]	873 (69.9)	4,867 (90.7)	355 (53.2)	5,384 (90.5)	980 (86.6)	4,760 (87.0)	5,416 (87.4)	322 (77.4)	4,422 (87.9)	1,317 (83.0)	5,172 (88.5)	566 (73.3)	5,364 (87.6)	376 (76.1)	218 (66.2)	5,484 (87.9)	285 (76.4)	3,515 (86.6)
Liberia [2020]	435 (68.5)	1,136 (77.9)	156 (56.2)	1,416 (77.9)	688 (73.0)	884 (76.7)	1,326 (75.1)	246 (74.8)	1,288 (77.3)	284 (66.1)	1,108 (77.9)	464 (68.9)	1,257 (76.0)	315 (71.5)	360 (69.9)	1,186 (76.7)	112 (74.7)	1,029 (76.4)
Mali [2018]	1,096 (40.8)	993 (68.0)	819 (34.7)	1,270 (71.0)	366 (48.1)	1,723 (50.9)	1,588 (53.9)	501 (41.7)	1,812 (55.2)	277 (32.1)	1,640 (56.3)	450 (36.3)	1,728 (50.1)	361 (51.7)	678.6 (45.1)	1,370 (53.4)	298 (46.3)	1,357 (49.1)
Mauritania	631	1,307	929	1,008	381	1,557	1,430	508	1,408	529	1,242	695	1,680	258	552	1,353	238	1,263

[2021]	(33.6)	(50.1)	(34.1)	(57.2)	(35.5)	(45.6)	(46.6)	(35.9)	(45.9)	(37.4)	(50.0)	(34.8)	(43.9)	(39.1)	(36.7)	(46.7)	(34.7)	(43.5)
Myanmar [2016]	480 (46.9)	439 (68.0)	213 (30.8)	706 (72.2)	74 (45.6)	845 (56.1)	895 (56.5)	24 (27.9)	678 (60.4)	241 (44.0)	759 (62.4)	160 (35.3)	859 (55.6)	60 (48.1)	58 (28.1)	842 (58.5)	33 (26.7)	472 (50.6)
Nepal [2016]	228 (34.0)	791 (60.5)	142 (24.7)	877 (62.6)	214 (47.3)	805 (52.8)	766 (55.4)	253 (42.6)	343 (64.0)	676 (46.9)	479 (62.7)	540 (44.5)	773 (50.6)	246 (54.7)	34 (23.4)	975 (53.6)	74 (32.4)	411 (43.7)
Nigeria [2018]	3,043 (28.8)	1,383 (58.8)	679 (12.0)	3,748 (51.6)	731 (42.5)	3,696 (33.0)	4,064 (35.6)	362 (23.8)	3,914 (36.0)	512 (24.9)	3,517 (37.9)	910 (24.9)	4,037 (35.8)	390 (23.5)	982 (22.5)	3,344 (40.0)	667 (34.9)	2,634 (30.8)
Pakistan [2018]	749 (42.5)	1,655 (76.2)	701 (37.7)	1,703 (82.0)	375 (59.4)	2,028 (61.4)	1,979 (65.7)	422 (45.9)	917 (66.4)	1,483 (58.2)	1,465 (68.7)	935 (52.0)	2,209 (61.8)	194 (54.3)	369 (41.1)	2,006 (67.0)	563 (56.0)	1,154 (58.1)
Papua N. Guinea [2018]	1,266 (40.9)	315 (57.7)	528 (26.5)	1,053 (63.8)	558 (45.0)	1,019 (43.1)	1,199 (49.6)	362 (31.1)	1,057 (55.2)	504 (30.3)	853 (61.3)	708 (32.3)	1,409 (43.0)	171 (47.1)	243 (29.6)	1,314 (47.3)	239 (39.0)	870 (40.4)
Philippines [2017]	885 (70.8)	2,165 (87.4)	280 (53.0)	2,770 (86.6)	986 (83.7)	2,063 (81.0)	2,825 (83.6)	224 (64.5)	2,588 (85.4)	461 (66.5)	2,352 (85.6)	697 (71.4)	2,703 (82.0)	346 (80.7)	296 (63.6)	2,726 (84.4)	389 (71.9)	1,634 (80.7)
Rwanda [2020]	1,012 (72.4)	1,518 (82.6)	1,236 (72.3)	1,294 (84.7)	1,090 (75.0)	1,439 (80.8)	2,462 (78.8)	68 (60.6)	2,187 (78.0)	343 (79.1)	1,943 (78.7)	587 (76.5)	2,379. (78.0)	150 (81.0)	473 (70.7)	2,007 (80.1)	236 (68.6)	1,592 (77.4)
Senegal [2019]	545 (58.8)	1,126 (80.4)	666 (62.4)	1,005 (79.7)	259 (67.2)	1,399 (72.6)	1,509 (72.0)	161 (70.1)	1,419 (74.5)	252 (59.6)	1,249 (77.5)	421 (59.0)	1,481 (71.8)	189 (72.2)	385 (61.8)	1,252 (75.4)	133 (58.1)	1,049 (69.6)
Sierra Leone [2019]	1,766 (79.8)	1,469 (84.5)	574 (70.7)	2,660 (84.8)	636 (82.8)	2,598 (81.7)	2,422 (83.0)	813 (78.6)	2,475 (82.7)	760 (79.5)	1,733 (86.0)	1,501 (77.6)	2,670 (81.2)	565 (85.2)	750 (78.1)	2,412 (83.2)	260 (81.0)	2,129 (80.3)
Tajikistan [2017]	580 (73.5)	1,582 (93.5)	645 (73.8)	1,517 (94.4)	134 (83.6)	2,028 (87.4)	1,777 (90.0)	385 (76.1)	1,743 (90.1)	419 (76.7)	1,721 (90.2)	440 (76.9)	2,015 (87.3)	147 (84.9)	122 (76.1)	2,013 (87.8)	557 (85.8)	984 (85.9)
Tanzania [2016]	1,272 (39.3)	542 (58.5)	765 (35.3)	1,050 (52.5)	630 (40.8)	1,185 (45.2)	1,571 (43.9)	244 (41.3)	1,295 (45.0)	519 (40.3)	1,088 (48.8)	727 (37.5)	1,443 (42.6)	372 (47.5)	304 (27.4)	1,479 (49.4)	163 (30.1)	1,027 (41.3)
Timor Leste [2016]	286 (22.9)	672 (41.5)	67 (9.8)	891 (40.8)	74 (39.2)	883 (33.1)	701 (38.9)	257 (24.1)	686 (41.1)	272 (22.7)	637 (43.0)	320 (23.1)	893 (33.8)	64 (28.8)	161 (24.0)	783 (36.2)	168 (27.6)	492 (32.2)
Uganda [2016]	2,314 (55.1)	1,041 (61.3)	1,122 (47.8)	2,234 (62.8)	1,540 (54.4)	1,816 (59.1)	3,190 (57.0)	165 (54.1)	2,661 (57.8)	695 (53.5)	2,169 (62.1)	1,187 (49.3)	2,771 (56.9)	584 (56.8)	892 (49.2)	2,407 (60.2)	510 (53.0)	1,948 (54.4)
Zambia [2019]	1,668 (68.5)	1,069 (72.7)	939 (65.0)	1,798 (73.1)	1,143 (67.7)	1,594 (71.9)	2,626 (70.7)	111 (58.6)	2,429 (72.4)	308 (56.0)	1,917 (74.2)	820 (62.1)	2,157 (70.1)	581 (70.1)	654 (61.6)	2,045 (73.4)	209 (60.3)	1,753 (69.1)
All 28 countries [2016-2021]	42,502 (47.3)	81,241 (75.1)	37,529 (45.5)	86,215 (74.6)	20,959 (55.4)	102,767 (64.2)	106,578 (65.3)	17,141 (49.6)	99,678 (66.0)	24,042 (51.3)	91,736 (68.3)	31,982 (50.3)	109,152 (63.1)	14,592 (58.2)	13,474 (42.1)	108,592 (66.5)	13,474 (42.1)	108,592 (66.5)

Table A10 1: Percent distribution of women who had a live birth within five years preceding the survey by the recommended interventions received during pregnancy, intrapartum, and postnatal care according to study countries, LLMICs (2016-2021).

Country name	All the recommended interventions during pregnancy, childbirth & postnatal (%)	All the recommended interventions during pregnancy & childbirth only (%)	All the recommended interventions during pregnancy & postnatal only (%)	All the recommended interventions during pregnancy only (%)	All the recommended interventions during childbirth & postnatal only (%)	All the recommended interventions during childbirth only (%)	All the recommended interventions during postnatal only (%)	None (%)	Total number of women (100%)
Angola [2016]	63 (0.74)	958 (11.27)	95 (1.12)	2,304 (27.12)	24 (0.28)	465 (5.47)	57 (0.67)	4,530 (53.33)	8,495
Benin [2018]	317 (3.51)	819 (9.07)	499 (5.53)	1,568 (17.37)	288 (3.19)	1,081 (11.97)	586 (6.48)	3,872 (42.87)	9,031
Burundi [2017]	5 (0.05)	91 (1.02)	14 (0.15)	396 (4.43)	18 (0.20)	735 (8.22)	137 (1.53)	7,546 (84.40)	8,941
Cameroon [2019]	282 (4.26)	612 (9.26)	500 (7.57)	1,738 (26.29)	94 (1.42)	324 (4.90)	253 (3.83)	2,808 (42.47)	6,613
Ethiopia [2016]	11 (0.15)	236 (3.10)	23 (0.30)	641 (8.44)	17 (0.22)	340 (4.48)	35 (0.46)	6,287 (82.84)	7,590
Gambia [2020]	78 (1.45)	244 (4.55)	333 (6.20)	2,174 (40.46)	44 (0.83)	207 (3.85)	169 (3.15)	2,122 (39.51)	5,372
Guinea [2018]	8 (0.15)	235 (4.28)	45 (0.83)	883 (16.10)	14 (0.25)	336 (6.13)	49 (0.90)	3,917 (71.38)	5,488
Haiti [2017]	104 (2.12)	223 (4.57)	268 (5.48)	1,709 (34.95)	31 (0.64)	119 (2.43)	116 (2.38)	2,319 (47.42)	4,890
India [2021]	20,745 (11.86)	10,389 (5.94)	26,527 (15.16)	23,105 (13.21)	11,536 (6.59)	11,997 (6.86)	20,933 (11.97)	49,715 (28.42)	174,947
Liberia [2020]	146 (3.62)	276 (6.86)	632 (15.69)	1,598 (39.69)	32 (0.80)	79 (1.95)	226 (5.60)	1,038 (25.78)	4,026
Mali [2018]	31 (0.47)	285 (4.30)	71 (1.07)	1,073 (16.21)	27 (0.41)	364 (5.50)	109 (1.65)	4,663 (70.40)	6,623
Mauritania [2021]	15 (0.19)	200 (2.60)	47 (0.60)	1,050 (13.62)	12 (0.16)	414 (5.37)	128 (1.66)	5,840 (75.79)	7,705

Nepal [2016]	169 (4.23)	439 (10.97)	243 (6.08)	835 (20.89)	59 (1.49)	359 (8.99)	117 (2.93)	1,776 (44.43)	3,998
P.N.Guin ea [2018]	97 (1.43)	154 (2.28)	122 (1.80)	504 (7.46)	234 (3.46)	665 (9.84)	450 (6.66)	4,533 (67.07)	6,759
Rwanda [2020]	620 (9.83)	716 (11.37)	219 (3.48)	334 (5.30)	900 (14.29)	1,974 (31.33)	368 (5.84)	1,169 (18.56)	6,302
S. Leone [2019]	868 (11.85)	616 (8.41)	1,072 (14.64)	1,555 (21.22)	480 (6.55)	562 (7.67)	615 (8.40)	1,558 (21.26)	7,326
T. Leste [2016]	96 (1.92)	504 (10.08)	50 (0.99)	704 (14.08)	81 (1.63)	887 (17.73)	81 (1.61)	2,598 (51.96)	5,000
Uganda [2016]	267 (2.63)	710 (6.99)	192 (1.89)	786 (7.74)	466 (4.59)	2,417 (23.80)	418 (4.11)	4,898 (48.24)	10,152
Zambia [2019]	288 (3.94)	1,005 (13.72)	242 (3.30)	920 (12.57)	392 (5.35)	1,506 (20.56)	358 (4.89)	2,613 (35.67)	7,325
Total	24,207 (8.16)	18,714 (6.31)	31,194 (10.52)	43,877 (14.79)	14,751 (4.97)	24,832 (8.37)	25,204 (8.50)	113,803 (38.37)	296,581

Research Integrity for Students

Certificate of Completion

This is to certify that

Melese Girmaye Negero

has successfully completed

Module 1: Research Integrity and Code of Conduct

Professor Lori Lockyer,
Dean, Graduate Research School

University of Technology Sydney

Date: *12/02/2020*

Research Integrity for Students

Certificate of Completion

This is to certify that

Melese Girmaye Negero

has successfully completed

Module 2: Plagiarism and Misconduct
Module 3: Risk Assessment
Module 4: Risk Management and Health & Safety
Module 5: Project Management

Professor Lori Lockyer,
Dean, Graduate Research School

University of Technology Sydney

Date: 14/02/2020

Project Name: Women's Use of Quality Maternal Healthcare Services Across The Continuum in Low-and lower-middle-income Countries, With A Focus On Ethiopia.

Activity	Mar-21	Apr-21	May-	Jun-21	Jul-21	Aug-21	Sep-21	Oct-21	Nov-21	Dec-21	Jan-22	Feb-22	Mar-22	Apr-22	May-	Jun-22	Jul-22	Aug-22	Sep-22	Oct-22	Nov-22	Dec-22
Reviewing remaining papers under consideration for publication																	X	X	X			
Dissertation writing																	X	X	X			
Submission of dissertation thesis																			X			
Graduation																				X		