COLLEGE OF HEALTH SCIENCE

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INEQUALITIES IN USE OF QUALITY ANTENATAL CARE AND ITS DRIVERS: FURTHER ANALYSIS OF THE 2016 ETHIOPIA DEMOGRAPHIC AND HEALTH SURVEY DATA

A THESIS SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES OF ADDIS ABABA UNIVERSITY SCHOOL OF PUBLIC HEALTH IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTERS IN PUBLIC HEALTH WITH SPECIALTY IN REPRODUCTIVE, FAMILY AND POPULATION HEALTH

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Inequalities in the use quality antenatal care and its drivers: Further analysis of the 2016 Ethiopia demographic and health survey data

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Addis Ababa, Ethiopia

DECLARATION

I, the undersigned, declare that this thesis is my original work, has not been presented for a degree in this or another university and that all sources of materials used for this thesis have been fully acknowledged.

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ABRIVATIONS AND ACRONYMS

AA ……..…..... Addis Ababa

AAU……. …… Addis Ababa University

ANC ……...Antenatal care

CI……Confidence interval

CCI……. Corrected concentration index

CSPro …… Census and Survey Processing System

CSA ……Central Statistical Agency

DHS……. Demographic and Health Survey

EDHS……. Ethiopian Demographic and Health Survey

FMOH……. Federal ministry of health

HSTP……...Health sector transformation plan

ICF……. Inner City Fund

LMIC……...Low and middle income countries

MCH……...Maternal and child health

SDG……Sustainable Development Goals

SES……. Socio-economic status

UNFPA……...United Nations Population Fund

USAID……United States Agency for International Development

WHO……. World Health Organization

ABSTRACT

Background: There is a growing body of evidence on the inequality in the use of maternal health care services. However, there is little evidence in the literature describing the status of inequality in use of quality of healthcare service. Particularly, there is a paucity of high-quality evidence on whether quality antenatal care (ANC) is being fairly distributed across the various subgroups of population in Ethiopia. This study aimed to examine the extent of inequalities in quality antenatal care and its drivers in Ethiopia using data from the most recent standard Ethiopia Demographic and Heath Survey.

Methods: Cross sectional survey data from 2016 Ethiopia Demographic and Health Survey (EDHS) were used. The EDHS samples were selected through a stratified, two stage clustered sampling technique. To examine inequalities quality ANC was measured by using six WHO recommended ANC service elements. The inequality was assessed with respect to the selected equity stratifiers namely, region, place of residence, wealth quintile, maternal age and maternal education. We employed both the simple (ratio and difference) and complex (concentration index) measures of inequality. Further, wealth based inequality was decomposed to understand drivers under pinning the observed inequality.

Result: The simple summary measure of inequality for the region showed high disparity across region with highest ANC quality (Addis Ababa region) and lowest (Afar region), difference (D)= 0.0690, 95% CI (0.0086, 0.1294) and the ratio ®=1.3844 with 95% CI (1.0227, 1.8946). Also showed maternal age based inequality with D=0.0864, 95% CI (0.0077, 0.1652) and R=1.4728, 95% CI (1.0328, 2.1004) value indicated that women aged above 20 while giving birth were more likely to have quality of ANC service. However, insignificant disparity was observed for place of residence difference (D) = 0.0298, 95% CI (-0.0368, 0.0964) and ratio (R)=1.1368, 95% CI (0.8589, 1.5046). Concentration index for wealth and education based inequality was 0.15 and 0.21 respectively, indicating pro-rich and pro-educated scenario of the use of quality ANC. The decomposition analysis indicated that the main contributors of the wealth based inequality were region, wealth status, education, frequency of ANC visit, type of ANC facility and provider.

Conclusion and recommendation: There were glaring inequalities in the receipt of quality ANC in Ethiopia. It needs high impact target interventions focused on region, wealth and frequencies of ANC were the main contributors together accounted for nearly three-fourth of the wealth driven inequality.

Key words: quality, antenatal care, inequality, decomposition, DHS, Ethiopia

1. INTRODUCTION

1.1 Background

Antenatal care is one of the targeted global core interventions given for women during pregnancy which is important for the health of the mother and the development of the unborn baby by promoting healthy behaviors and parenting skills (1). Globally, 86% of pregnant mothers currently access antenatal care with skilled providers at least once during their pregnancy (2).In many low-income countries, the proportion of women who receive antenatal care services is increasing. However, quality ANC was lagged behind ANC service coverage in most low and middle income countries (3, 4). In Ethiopia, from 2000 to 2016 ANC coverage increased from 26.7% to 62.4% (5). According to Ethiopia's five year Health Sector Transformation Plan, the government of Ethiopia aims to increase the proportion of pregnant ladies obtaining at least four ANC visits to 95% by 2020(6).

The World Health Organization (WHO) envisions ''every pregnant woman and newborn to receive quality care throughout the pregnancy, childbirth and postnatal period'' and released new recommendations on routine ANC for pregnant women in November 2016 (7). In addition to increasing the recommended number of ANC contacts from a minimum of four to eight, this recommendation highlighted the importance of quality of care received by women during pregnancy. Following this recommendation, global attention has been shifting from predominantly measuring utilization (coverage) of ANC to additional considerations of equity and quality of this care in order to tackle remaining preventable morbidity and mortality among women and their babies (3, 8-11). The Sustainable Development Goals also call for an equal distribution of health gains (12). Health care inequality implies the existence of systematic observable disparities in health or major determinants of health between different groups within a population such as regions, place of residence, social, economic, cultural or religious groups, or by age or gender (13).

One of the main objectives of Ethiopia's five year Plan is to ensure universal primary health coverage and improve health services quality and close equity gap in the country(6). The importance of quality was stated in different ways where one of these stated as "Quality should not be the purview of the elite or an aspiration for some distant future; it should be the DNA of all health systems" (11). Furthermore, " the human right to health is meaningless without good quality

care because health systems cannot improve health without it"(11).Having good quality antenatal care is critical for the prevention and detection of potential causes of maternal obstetric complications and to avert newborn deaths and stillbirths (7, 14). In addition to its direct effect on health, higher quality antenatal care has also been linked to a higher promising of retention in care and of giving birth in a health facility, which might further improve maternal and newborn outcomes (15, 16). In Ethiopia, different studies have shown that certain population groups are consistently less likely to have access to and use health services (17-21). Despite increased efforts to expand health service coverage across the country, the health system continues to face poor quality of care and unequal utilization of healthcare resulting in disparities in health outcomes among different segments of the population (18-20, 22). This study aims to examine the extent of inequalities in the use of quality ANC services and factors that can be explain the observed inequalities.

1.2. Statement of the problem

Globally, every year an estimated 295,000 women die from preventable causes related to childbirth and pregnancy, 99% of whom live in low and middle income countries (LMICs) and two thirds of all maternal deaths now occur in sub-Saharan Africa which bears the largest share (23, 24). In Ethiopia maternal mortality ratio remains one of the places with the highest rate of mortalities in the world (25). According to 2016 DHS maternal mortality ratio is 412 mothers per 100 000 live births mothers still die due to preventable conditions associated with pregnancy, child birth and the postnatal period (5). This is primarily due to poor quality of services (26, 27). While achieving a significant reduction in mortality it requires further expansion of health service coverage to improve accessibility. At the same time, it is equally important to improve the quality of care provided (22, 28).

In provision of service many LMICs have increased in antenatal care coverage but quality had much lower and unequal among women (3). In Ethiopia, few studies have measured technical quality of care (16, 29, 30) and examined effective coverage of ANC (22). Ensuring an equal distribution of good quality care was one of the key targets of the HSTP where "the quality of care provided does not differ by any personal characteristics including age, gender, socioeconomic status or place of residence" (6). But differences in the quality ANC received have not been systematically examined.

One study analyzed socioeconomic differences in the quality antenatal services across 91 LMIC including Ethiopia, has shown unequal levels of low-quality care. However, the study describe ANC quality based on receipt of only three services namely urine and blood testing and blood pressure monitoring and did not provide within country specific results other than poverty status (3). Measuring inequality by different equity stratifies and identify factors contributing for observed inequalities have particular importance in populous countries like Ethiopia; to contribute to the effort towards addressing quality ANC to all. To our knowledge, no decomposition study has so far attempted to investigate the effect of different sets of explanatory factors over the influence channeled through wealth, as there is limited evidence on the issue under caption. This study aimed to measure inequalities in the use of quality antenatal care and to scrutinize the

individual contribution of various sets of explanatory variables on quality of ANC using the recent 2016 Ethiopian Demographic and Health Survey data.

1.3 Rationale and Significance of the study

The sustainable development goals (SDGs) have helped retrain the spotlight on one of the most critical issues of our time – reducing inequality (12). Although health systems will look different in different settings, all people should be able to count on receiving high-quality care that will improve their health and earn their trust on the system (11). Understanding the level of disparities in quality of care among different geographic and socioeconomic groups will help to identify women who are least likely to receive quality ANC. This help the public health system to monitor and understand the progress of improved maternal and child health outcomes, set better target service improvement initiatives, supporting the effort to work out the HSTP targets, apply "leaving no one behind" agenda of SDGs (12).

On the other hand, to promote nationwide inclusive social development and improve evidence based targeted intervention, health gains need to be given away equally across all regions and socioeconomic groups, therefore, producing evidence to support government and development agencies to address the constraints is an important step. Analyzing and understanding disparities in health gain enable the unmasking disparities across regions and other socioeconomic strata thereby enabling deeper understanding of both the severity of disparities and inequality in provision of quality health services. Especial important is identifying inequality in quality antenatal care service, as the mere existence of antenatal care service does not have any guarantee for equal provision of quality service between the poor and the rich women. To reduce the health consequences attributable to unequal distribution of quality ANC service improvements in quality gaps between the poor and rich is critical.

Additionally, findings of the study will serve as an input for other related studies in the future and inform the launch of different strategies to help end the unfair within country inequality in the provision of quality services during ANC. This study is expected to show evidence important for policy makers.

2. LITERATURE REVIEW

2.1 Quality of antenatal care

Antenatal care is one of the "four pillars" of safe motherhood, as formulated by the Maternal Health and Safe Motherhood Program (WHO 1994)(31). WHO defines it is care provided by skilled health-care professionals to pregnant mothers and juvenile young ladies in order to secure the best health conditions for both mother and baby during pregnancy(7). Quality is defined in various manners by different organizations. Measuring quality is difficult because it has multiple dimensions but Donabedian identified three dimensions of quality of care: (1) structure: the physical and human resources to give care; (2) process: the technical and interpersonal aspects of delivering care; and (3) outcomes: the effects of care (32).

Provider qualifications and the number and recurrence of ANC visits is a premises of quality ANC. Antenatal care quality can also be monitored through the content of services received and the sorts of information given to women during their visits. These services bring issues to light of the peril signs during pregnancy, delivery, and the postnatal period. They also improve the health-seeking behavior of the client, orient the client to birth preparedness issues, and give essential preventive and therapeutic care. Provision of quality ANC service requires the presence of relevant infrastructure, adequately trained health workers, infection control facilities, diagnostic equipment, supplies and essential drugs. Furthermore, the ANC process requires the utilization of guidelines that health providers ought to follow while offering care to guarantee prevention, diagnosis and treatment of complications (5, 33).

Antenatal care service quality is basic to guarantee the expected advantage for both the mother and the baby otherwise the entire process loses its value. It lessens the occurrence of maternal and child morbidity as well as mortality during pregnancy, delivery and the postnatal time. By 2030 sustainable development goal plan to accomplish global MMR to <70/100,000 live birth but these cannot be achieved without quality antenatal care arrangement and (34, 35) and also Poor antenatal care is viewed as the second most significant preventable factor for maternal death after unsatisfactory obstetric care (36).

Globally, proceeding to accomplish universal ANC coverage is checked by following two indicators: 1) First ANC which means the proportion of women of reproductive age who report at least one ANC visit with a skilled health provider during the most recent live birth and 2) ANC 4+ which is the proportion of women of reproductive age who report at least four ANC visits during the most recent live birth (37). These two indicators evaluate the figure of contacts or visits pregnant mothers had but having contact with the health system doesn't ensure the receipt to lose or any of the crucial ANC interventions(38).

A cross country study has shown that antenatal care coverage was high, 89·7% (95% CI 88·0–91·4) of women went to first ANC visit. However, just 72·9% (69·1–76·8) of these women revealed getting their blood pressure checked and their urine and blood taken at any time during their pregnancy going from simply 6% in Burundi to nearly 100% in Armenia, Belarus, Kazakhstan, and Ukraine. In most low-income countries 86·6% (95% CI 83·4–89·7) of women accessed antenatal care which shows the coverage is still high but only 53·8% (44·3–63·3) of women announced getting quality ANC which was measured in terms three essential component of care so, this figure mentioned numerous LMICs had much lower and unequal levels of quality despite elevated levels of antenatal care coverage (3).

Different studies indicate that, even though women had adequate contact with healthcare providers through improved access to care, the majority of them did not receive high-quality care. Age, level of education, household wealth, parity and experiencing complications were associated with having adequate contact and receiving high quality care. Discrepancy observed in the frequency of contact and qualities of care were influenced by the residential cluster effect (39-42).

In Ethiopian, various studies indicated that the quality of ANC is low in all regions although the performances slightly differ across the regions of Ethiopia and women are likely not to obtain important clinical actions, such as asking about danger signs, iron supplementation, or counseling on the importance of delivering with a skilled attendant(22).Lack of adherence to the guidelines for ANC decreases the potential health gains for women who endeavor ANC(43).

Similarly, another study in Ethiopia has demonstrated that the community level quality of received ANC, 54.3% women lived in a community with a low level quality of received ANC, while 45.7%

lived in a community with high community level quality of received ANC. Besides, 45.9% of women living in a community with high quality of received ANC completed four or more ANC visits, though just 25.6% of those in a community with low quality of received ANC completed the four or more ANC visits(44)

2.2 Inequalities in quality of antenatal care service

Among the total 17 SDGs goals 1, 5 and 10 directly plan to handle inequality, while the third goal on health, set priority on universal health coverage, constructs a solid agenda for diminishing disparities in health and guaranteeing health and prosperity for all. Moreover, SDG 17, managing fortifying the means of implementation and rejuvenating global partnerships, makes explicit notice of the significance of limit working to build the accessibility of disaggregated data, which thus empowers nonstop observing of health inequalities within countries(12, 45). .

Literature has shown inequalities are produced when underlying causes linked with various factors such as individual characteristics like wealth status, age, educational level, living in different region and residence also the distribution of income, the gap between the rich and the poor and the focuses of decision making power concentrated in the advantaged group, perceived need for service, access and quality of service are among factors for variation in service utilization contribute to considerable inequalities(46, 47)

Around the world, in excess of 8 million individuals for every year in LMICs die from conditions that should be treatable by the health system. In 2015 alone, these deaths brought about US$6 trillion in financial misfortunes. Poor quality care is presently a greater obstruction to lessening mortality than inadequate access. 60% of deaths from conditions liable to health care are because of poor quality care, whereas the remaining deaths result from non-utilization of the health system and quality of care is worst for vulnerable groups, including the poor, the less educated and adolescents (11).

Study conducted in 2018 in 91 LMICs which measured inequalities in ANC quality based on women's self-report the content of ANC consultations have shown that getting good quality of antenatal care was correlated with gross domestic product per capita and upper-middle-income countries had 40 percentage points high compared with low-income countries. Within countries,

after adjustment for sub-national region, maternal age, urban residence, education and frequency of antenatal care visits poor women were four times less likely to report good quality care than wealthiest women. These inequities were largest in low-income countries, having good quality of care were reported nearly ten times more likely by wealthiest women compared to their counterparts. In Ethiopia the poorest women were substantially less likely to report having their blood pressure checked and their urine and blood analyzed during ANC consultations compared to the richest (3). Similarly, another study conducted in 59 low and middle-income countries (LMICs) to analysis the socioeconomic differences in the quality of antenatal services have shown that socioeconomic status differences are noted in content of ANC provided(4).

Studies in three African Countries Kenya, Malawi, and Nigeria focused on women who gave birth during the five years preceding the survey and who reported accessed skilled antenatal care during their most recent pregnancy shows that many women of them do not receive all the essential components of care. The findings further showed in the quality of antenatal care received was considerable observed in educational inequalities (48).

Different studies in Kenya, India, Brazil and Ghana have shown that population access to a minimum standard of quality maternal care was both low and inequitable, antenatal quality varied by poverty level: at the facility level, all quality metrics were lowest for the most impoverished areas and increased significantly with greater wealth(40, 49, 50).

Study conducted in Egypt to describe the changes over time (1991–2014) in the use of ANC in Egypt, focusing on sector of provision (public versus private), and the content and equity of this care, have shown that despite improvements in ANC coverage, changes failed to translate into adequate ANC. Less than a third of women received, at least once during pregnancy, the seven essential ANC components that is have been weighed, had a blood sample taken, had a urine sample taken, receiving information on signs of possible complications during pregnancy, receiving or buying iron tablets or syrup, had their blood pressure measured, and receiving tetanus shots measured by DHS. Furthermore, women from poorer households and those in rural regions reported receiving fewer components than their wealthier counterparts and living in urban regions(51).

In Ethiopia study conducted in AA shows that majority of slum residents did not have adequate antenatal care services with only 50.3, 20.2 and 11.0 % of the slum resident women initiated antenatal care early, received adequate antenatal care service contents and had overall adequate antenatal care services respectively. Educational status and place of ANC visits were important determinant factors for adequacy of ANC in the study area. Women with highest educational status were nearly three times more likely to receive overall adequate care compared to those with no formal education. Similarly, clients of private healthcare facilities were two times respectively more likely to receive overall adequate antenatal care compared to those clients of public healthcare facilities (52).

2.3 Conceptual framework

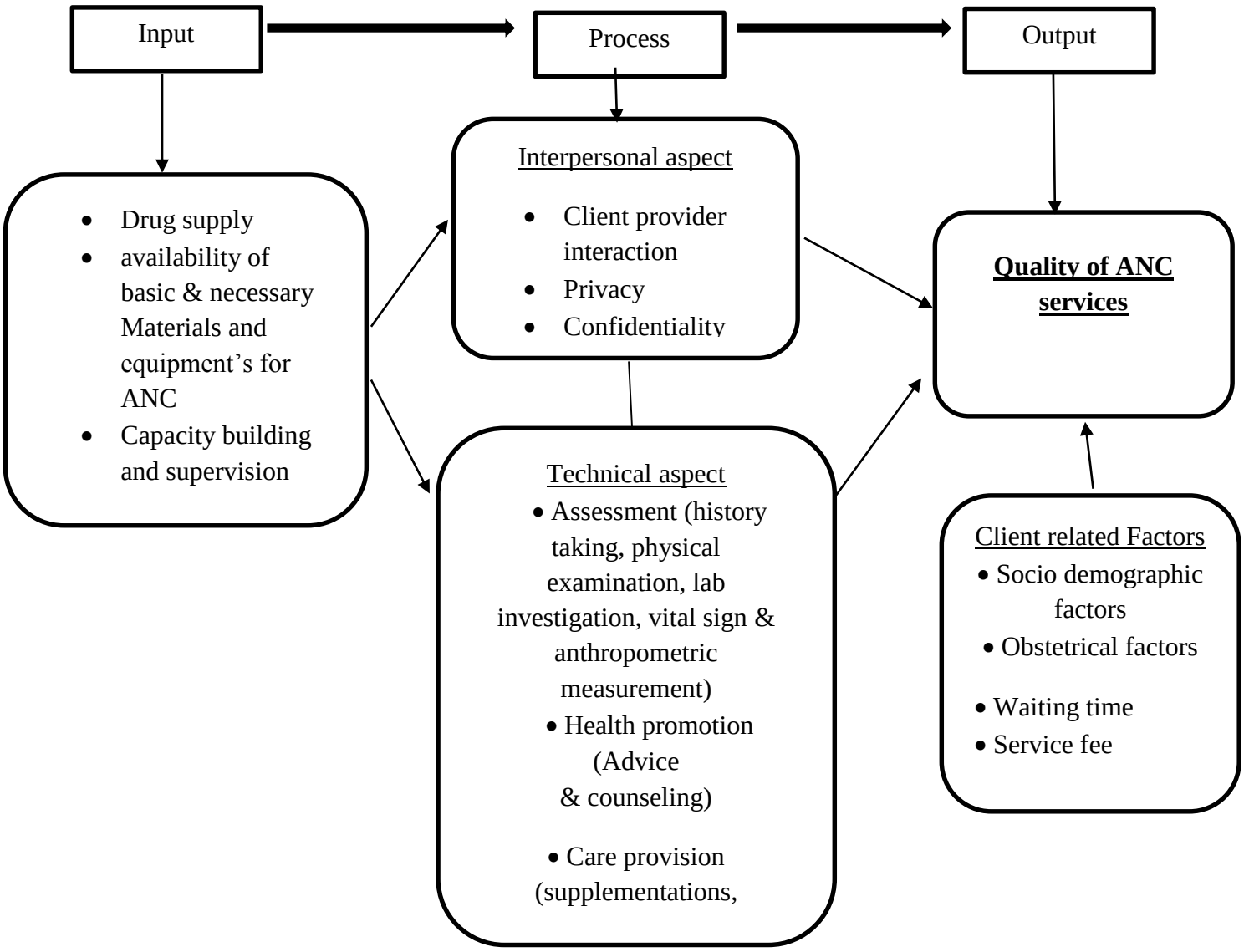

Figure-1 Donabedian Model adapted for quality ANC service (32)

2.4 Research question

- What is the magnitude of inequalities in quality antenatal care service by selected equity stratifies?
- What are the factors that could explain the observed inequalities in the quality ANC service?

3. OBJECTIVES

3.1 GENERAL OBJECTIVES

To determine inequalities in the use quality of antenatal care and its drivers among women aged 15–49 years who had ANC from skilled provider in the past 5 years in Ethiopia using data from the recent 2016 Ethiopia Demographic and Heath Survey.

3.2 SPECIFIC OBJECTIVES

1. To measure inequalities in the use of quality antenatal care by region, place of residence, education, wealth status and maternal age using simple and complex summary measures
2. To identify factors contributing to the observed wealth associated inequalities in the use of quality ANC through decomposition analysis.

4. METHODS

4.1 Study area and setting

Ethiopia makes up the horn of East Africa and is known to be the cradle of mankind and is lately being promoted as the "Land of Origins". Ethiopia is home for various ethnic groups and cultural diversity, with its population speaking more than 80 different languages(53). The country is comprised of nine Regional States and two City Administrations. Each of the 11 geographic regions in Ethiopia is divided into zones and each zone is divided into Woreda. Each Woreda is then further subdivided into the lowest administrative unit which is called Kebele in the administrative structure of the country(5).

General health service in Ethiopia has improved markedly since 2000; there has been encouraging improvements in the coverage and utilization of health services. As a result of its robust health policy and innovative strategies, the country has made huge progresses in increasing universal access to health services and improvements in health outcomes(6). The proportion of women age 15-49 in Ethiopia who received antenatal care from a skilled provider has increased from 27% in 2000 to 34% in 2011 and 62% in 2016. Thirty-two percent of women had at least four ANC visits during their last pregnancy (5).Despite this; Ethiopia is still one of the countries with a very high morbidity and mortality from preventable conditions associated with pregnancy (6). Maternal, child and reproductive health service coverage were also unevenly distributed and the coverage for the key maternal health indicator was unequal according to different dimension of equality (19).

The Ethiopia DHS survey is undertaken approximately every five years since 2000, collecting socioeconomic, demographic and health data from households and individuals for every survey. These survey implemented by the Central Statistical Agency (CSA) and ORC Macro for2000, 2005 and 2011 and for 2016 CSA with the financial and technical assistance by Inner City Fund (ICF) through USAID funded at the request of the Ministry of Health. This study uses the fourth and the most recent survey which is 2016 EDHS.

4.2 Study design and period

This study used cross-sectional design which was analyzed from 2016 EDHS survey data that was conducted across the nation that covered all regions in the country. The study was used EDHS data to measure inequality in quality ANC and identify factors explained by inequalities from January to December, 2020.

4.3 Population

4.3.1. Source population

All women of reproductive age group (15–49 years) who had most recent live birth in the past 5 years preceding the survey

4.3.2. Study population

The study population comprised number of women in Ethiopia aged 15 to 49 years with a birth in the past five years who received skilled antenatal care for their most recent live birth

4.4 Sample Size determination and Sampling Procedure

The sampling frame used for the 2016 EDHS is the frame of the Population and Housing Census (PHC) conducted in Ethiopia in 2007 and provided by the Central Statistical Agency (CSA). The sampling was a two-stage stratified cluster process; each region was stratified into urban and rural strata. Samples of Enumeration areas (EAs) were selected independently in each stratum with probability proportion to size allocation and EAs were the sampling unit for the first stage, followed by a systematic random sampling to select households in these EAs. From listed households in enumeration areas fixed number of households from each cluster selected with probability systematic selection (5).

In EDHS 2016 sample includes a total of 645 Enumeration areas (EAs) (202 in urban areas and 443 in rural areas) and representative sample of 18008 households selected and of this households 16650 were successfully interviewed from which 16583 eligible women identified and full interview were conducted for 15683 women age 15-49 yielding the response rate of 95%(5)

The sample for survey designed to provide estimates for reproductive, maternal, new born, child and adolescent health indicators for the country as a whole, for each of the nine regions and the

two administrative cities and for urban and rural areas separately. And since it is conducted for fourth round it provides valuable information on of key health indicator.

For the purpose of this analysis women in reproductive age 15 to 49 years and gave live birth in the last 5 years preceding the survey and who had skilled ANC during last pregnancy were included in the sample.

Table 1 Sample number of study participants to measure the magnitude of inequality in quality of ANC and its drivers in Ethiopia based on 2016 DHS data

	EDHS 2016
	Weighted sample
All respondent women age 15-49	16000
Number of women with alive birth in the past 5 years	7,590
Number of women who received skilled ANC for their most recent birth	4,734
Response rate	95%
Approximate time frame covered	2011-2015

4.5 Variables and Measurements

4.5.1. **Dependent variable:** Quality of antenatal care

In this study, quality of ANC was defined as receipt of all the six components of ANC services for the most recent birth during antenatal care was the outcome variable. The construction of outcome variables was guided by the World Health Organization's antenatal care guidelines (7, 32). We created an overall measure to ascertain if the women received all the six essential components of ANC. EDHS asked on women's self-report on the components of ANC consultations. These components were (1) blood pressure measurement, (2) blood test, (3) urine test, (4) informed on possible complications during pregnancy (5) counseling on nutrition (6) received advice on birth preparedness plan. Each question has a binary response (1 = Yes; and 0 = No). For quality of ANC

which was the overall measure of utilization of essential components of ANC, women were coded with a '1' if they had received all six essential ANC components and '0' otherwise.

4.5.2. Equity stratifers

Monitors of health inequality should reflect the relevant social conditions depending on the characteristics of the population and the health measure in question(13). To assess inequality from different dimension selection of appropriate equality stratifiers is important (13). Based world health organization (WHO) health inequality monitoring: with a special focus on low- and middle-income countries, review from national perspective variable that are widely used or proposed to study inequality was used in order to measure inequality in quality ANC. Therefore, for this study education, place of residence, wealth status, region and maternal age were the main equity stratifiers and these variables were categorized according to EDHS

Table 2 Equity stratifers description and measurements to determine inequalities in quality of ANC and its drivers in Ethiopia based on 2016 DHS data

Equity stratifers	Descriptions	Measurements
Maternal education level	Level of education attained by the respondent	Categorized in to four categories including, no education, primary, secondary and higher education.
Place of residence	The usual place of residence where the woman lives	Urban / rural
Wealth index	Households are given scores based on sets of household possessions and assets such as TV, radio, sanitation facilities and water supply. The wealth index was computed by principal component analysis	Ranked in to five (quintile) categories as poorest, poorer, middle, richer and richest

Region	The region where the woman lives	categorized as nine regional states (Tigray, Afar, Amhara, Oromiya, Somali, Benishangul-Gumuz, SNNP, Gambela and Harari) and two city administrations (Addis Ababa and Dire Dawa)
Maternal age at birth	Age of the women at birth during the recent birth	categorized in three-year age group interval as <20 years, 20-34years and 35-49 years

4.5.3. Exposure variables

To produce results that are net of confounding effect, we attempted to include other factors that have been shown in the literature to affect the quality of ANC (22, 50, 54). These include the frequency of ANC visits, the type of ANC facility, the type of ANC provider, parity (number of children), marital status, religion, current working status and experience of terminated pregnancy. Women who start ANC in the first trimester and attend the recommended four or more times are more likely to receive all the essential components of ANC services, because contact with the health system begins earlier and is more frequent (50). For the analysis, the frequency of ANC visits was dichotomized to 'one to three' and 'four or more visits,' based on the number of ANC visit recommended by the World Health Organization (55).

The variable 'type of ANC facility' specified the highest place where the women got ANC and originally had 12 categories which were reduced to 8. The two responses 'respondent's home' and 'Other's home' were merged to form one category 'Home'. 'Governmental hospital' 'health center' health post' 'private hospital' 'private clinic' 'NGO' and the four others 'other public' other private' 'other NGO' and 'other' were merged into one response 'other'.

In addition, the quality of antenatal care received may differ depending on whether the provider is a doctor, nurse/midwife, or other provider, because of different skill levels. According to EDHS if a respondent received ANC from more than one type of provider, the most highly trained provider

was used. Variable 'Type of provider' had 7 categories reduced to five (Doctor, Nurse, Midwife, Health officer and Health extension workers). The two additional categories in the survey: 'Traditional Birth Attendant' and 'Other' were excluded as there were not mentioned as skilled providers (5). And variable marital status originally had 6 categories which were reduced to 3. Never married, the two responses 'married' and 'living together' were merged to form one category 'married/living together' and the three responses 'widowed', divorced' and no longer living together/separated were merged to form one category widowed/divorced/separated'

Other factors like religion (Orthodox, Muslim, Protestant, Catholic, Traditional and other), parity (number of births categorized as one child, one to three and four plus children), experience of terminated pregnancy (Yes, No) and currently working status (yes, No) may influence quality of ANC were included in our analysis.

4.6 Operational definition

Quality of ANC: receipt of all essential component of ANC services such as blood pressure measurement, blood test, urine test, informed on possible complications, counseling on nutrition and advice on birth preparedness plan during pregnancy (3, 50)

Inequality in quality of ANC: It is an avoidable disparity in the use of ANC quality across women who received skilled ANC services during last pregnancy (13)

4.7 Source of data and data collection procedure

The data for this study was accessed from the DHS program official database, after permission was granted through an online request explaining the objective of study. The survey is usually conducted at five-year intervals in a country. Ethiopia has undertaken four consecutive DHS surveys, in 2000, 2005, 2011 and 2016.

The study used data from the recent rounds of Ethiopian Demographic and Health Survey (EDHS) which was conducted by central statistical agency from January 18, to June 27, 2016 in order to measure inequalities in quality of ANC and its drivers.

Study instruments used in the EDHS 2016 were a set of standardized questionnaires, namely the Household Questionnaire, the Woman's Questionnaire, Man's Questionnaire, the Biomarker Questionnaire and the Health Facility Questionnaire. These questionnaires were adapted from model survey instruments developed for the MEASURE DHS project to reflect the population and health issues relevant to Ethiopia and questionnaires were translated into five major languages

Amharigna, Oromiffa, Tigrigna, Somaligna, and Afarigna. Issues were identified at a series of meetings with the various stakeholders

All women in reproductive age (15-49) who were in the selected household the night before the interview neither of their usual residents in the household were interviewed using the Women's Questionnaire. The Women's Questionnaire was used to collect respondent's individual characteristics including age, marital status, occupation, residence as well as other information on topics including, reproductive history, contraceptive knowledge and use, antenatal care and its components, delivery and postnatal care, marriage, attitudes about family planning etc.

4.8 Data quality and management

In EDHS to maintain data quality CSA recruited and trained team supervisors, field editors, interviewers, secondary editors, and reserve interviewers. The Ethiopia DHS used different questionnaires: which were based on model survey instruments developed for the international MEASURE DHS+ project. The model questionnaires were then adapted to local conditions. These questionnaires were developed in the English language and translated into the five principal languages in use in the country. They were then independently translated back to English and appropriate changes were made in the translation of questions in which the back-translated version did not compare well with the original English version and then Pretests were conducted in place that was not included in the survey. During data collection electronic data files were transferred to the CSA central office in Addis Ababa every few days via the secured IFSS. Data processing was done through office editing, coding of open-ended questions, data entry, and editing computer-identified errors. Data entry and editing were accomplished using the CSPro software. For this analysis after the EDHS data set were downloaded, the variables appropriate for study were identified and their completeness assessed by running frequencies to check the missing values. If there are "Don't know" and missing values managed according to DHS statistical guideline. For example, if there are "Don't know" and missing values on components of antenatal care, assuming that they did not receive the care component(56)

4.9 Data analysis plan

After officially registered on the measuredhs.com website the EDHS datasets were downloaded in STATA format. Analysis was performed using the women's file (IR) and based on sample derived from all women aged 15–49 with a live birth in the surveys' five-year recall period (2011–2016).

We examined women's self-report in the components of antenatal care for the pregnancy leading to the most recent live birth from skilled provider. The variables appropriate for this study were identified and their completeness assessed by running frequencies to check the missing values and then recoding and generation of essential variable was conducted according to DHS statistical guide. Descriptive statistics namely frequencies and percentages of socio demographic characteristics and outcome variable were done and presented using tables and graphs. Analyses were performed in STATA software version 15 and R software version 3.6.2. The DHS stratification and the unequal sampling weights as well as household clustering effects were taken into account and 95% CI is reported as a measure of magnitude of significance in the analysis.

Inequality analysis

The World Health Organization recommends inequality in health or health care is disaggregated by a chosen equity stratifiers before presenting the inequality with higher level of analysis. In this study, the inequality in the receipt of quality ANC was disaggregated by the five dimensions of inequality, namely region, place of residence, maternal age, wealth status and maternal education.

Summary measures of inequality

Equity literature stresses the importance of examining both absolute and relative measures of inequalities which are complementary and together reveal the full picture of disparities (57) Absolute inequality highlights the actual coverage gap that exists between extreme groups and the corresponding efforts that are required to close it. Relative inequality shows the degree of unfairness between the subgroups. In this study both simple (ratio and difference) and complex (concentration index) measures of inequalities were used. Simple measures are useful for conveying messages to the non-technical audience (e.g policy makers in Ethiopia), whereas Complex measures use the full data distribution between subgroups and thus more accurately show the magnitude of metrics (13, 58).

We computed concentration index for wealth and education based inequalities in the quality of ANC since these stratifers are ordinal and concentration index requires data to be distributed across a raking variable. The index quantifies magnitude of inequality across all wealth quintile and education level and becoming the standard tool for measurement and concentration curves were used to illustrate how one variable is distributed across the population ranked by another variable

(59-61). Twice the area between the concentration curve and the line of equality is called concentration index. The index assumes values between -1 and +1. A negative value of the concentration index denotes quality of ANC is concentrated to the lower socio-economic status. On the other hand, a positive concentration index implies that quality of ANC favors women who are wealthier or more educated. When the value of the concentration index is zero, there are no inequalities in the receipts of ANC quality. Concentration index was calculated using the conindex command in STATA

The related tool is concentration curve which plots the cumulative percentage of quality ANC on the vertical axis against the cumulative percentage of women ranked by their socioeconomic status (wealth and education in this study) on the horizontal axis, beginning with the lowest and ending with the highest. The equality line runs diagonally across the figure when women, irrespective of socioeconomic status have the same quality of ANC, that is, all values on the x-axis equals all values on the y-axis. A curve that lies below the equality line indicates quality of ANC concentrated among high socioeconomic status whereas, the curve lies above the line of equality implies the presence of inequality, that is, quality of ANC is concentrated among lower end of the SES. The concentration curve overlaps with the 45-degree line with no inequality (59-61).

Literature shows that none of the inequality measures available are perfect (61). While different variants of concentration index are available in the literature, in this study we chose to use the Erreygers corrected concentration index (CCI), as it corrects for several problems inherent in the standard concentration index. (61). For instance, when the outcome variable of interest is binary, which is often the case in health care, the values of the standard concentration index may not lie between -1 and +1, and this problem can be overcome by adopting the CCI.

For the variable of interest “y” the, Erreygers CCI was calculated as:

CCI (y) = 8cov (yiRi)…………………………….…(1)

Where: yi is the outcome of interest (dependent variable) of the individual i

Ri is fractional rank of an individual in the wealth distribution

The simple summary measures of inequalities used in the study were ratio and difference.

Difference (D) is an expression of the absolute inequality that exists between two subgroups; D is calculated as the difference between two subgroups; that is, the mean value of a health indicator in one subgroup subtracted from the mean value of that health indicator in another subgroup. For dimensions with more than two subgroups with a natural ordering such as education and wealth $ymax$ refers to the most advantaged subgroup and $ymin$ refers to the most disadvantaged subgroup. In cases of dimensions of inequality with more than two subgroups that have no natural ordering, such as region and maternal age, D is calculated as highest estimate subtracted from the lowest estimate

$$D = ymax - ymin \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

Ratio is an expression of the relative inequality that exists between two subgroups; that is, the mean value of a health indicator in one subgroup divided by the mean value of that health indicator in another subgroup. For dimensions of inequality with more than two subgroups that have a natural ordering, such as education and wealth ymax is most advantaged subgroup, whereas, ymin the most disadvantaged subgroup. In cases of dimensions of inequality with more than two subgroups that have no natural ordering, such as region and maternal age, R is calculated as highest estimate divided by the lowest estimate.

$$R = ymax / ymin \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3)$$

If there is no inequality D takes a value of 0 and R takes a value of 1. Greater absolute values indicate higher levels of inequality. For R, it takes only positive values (larger or smaller than 1). The further the value of R from 1 the higher the level of inequality(62, 63).

After multivariable logistic regression model was fitted, ratio and difference were calculated using adjrr command in Stata.

Decomposition Analysis

To explain the underlying drivers of the wealth based inequality in the use of quality ANC service, we decomposed the measured wealth based inequality. A decomposition analysis allows one to

estimate how determinants proportionally contribute to inequality (for instance the gap between poor and rich) in a health variable (64). The concentration index of a health variable decomposed into the contributions of individual factors to its inequality, where each contribution is the product of the sensitivity of the health variable with respect to that factor and the degree of inequality in that factor. The concentration index of the health variable of interest can be expressed as the sum of the contributions of the various determinants of that variable, together with unexplained residual component. In order to identify the individual contribution of wealth to inequality in quality of ANC decomposition analysis for the concentration index was done using the "decomp" package in R studio. In decomposing the CCI of ANC quality the following step was followed (65, 66)

(i) Regress the health variable against its determinants through an appropriate model. This results in finding the coefficients of the explanatory variables. (ii) Calculate the means of the health variable and each of its determinants (iii) calculate the concentration indices for the health variable and for the determinants. The overall concentration index for the predicted outcome variables is computed as follows (61, 65)

$$(y) = 4\ \{\sum(\beta kxk)\ CIk + GC\varepsilon\ \} \quad \ldots\ldots(4)$$

Where: xk is the mean of dependent variable (Quality of ANC),

CIk: is the CI of the dependent variable (xk), and

GCϵ: is the generalized CI of the error term (e).

CI is then equal to a weighted sum of the CIs of the k regressors. The residual expresses the inequality that cannot be explained due to systematic variation in the regressors included in the analysis. The closer the residual goes towards 0, the better the fit of the model (65).

In order to regressing the health variable against its determinant since our response variable quality of ANC was binary, we used the survey weighted generalized linear model (GLM) with binomial family of logit link. The goodness of fit a model were used to measures how well the model describes the response variable (67). In statistics there are different methods of testing the model fitness. Based on assumption for this study we choose Hosmer–Lameshow(H-L) test and its value was calculated in R studio version 3.6.2 using the "**Resource Selection"** package. In Hosmer-

Lameshow goodness-of-fit test if p-value greater than 0.05 implies that the model estimates are adequate to fit the data at an acceptable level.

4.10. Ethical consideration

This study was used secondary data from the Ethiopian Demographic and Health Survey. As the DHS data set is available to the public domain we registered to the DHS website and agreement was assessed from (www.measuredhs.com). All respondents who participated in the EDHS survey were requested to give informed consent prior to the interview then got ethical approval from ethical committee. In addition, for this study ethical clearance was enquired and secured from Ethical Review Committee of School of Public Health College of Health Sciences Addis Ababa University.

4.11. Dissemination plan

The final document will be submitted and defended as Master's thesis at Addis Ababa University College of health Science School of public health. After defense the final result will be communicated to policy, programs and decision makers who are working on quality and equity of health care issues at each level and presented on conferences, Symposia, or Workshops. Finally, it will be published in an international peer reviewed journal.

5. RESULTS

5.1 Distribution of quality of ANC across socio-demographic characteristics

About 15,683 women of reproductive age group who were taken from the nine regions and two administrative states, (Addis Ababa city administration and Dire Dawa city council) were included in the 2016 EDHS. Out of them, 4734 women (weighted) had antenatal care from skilled provider for most recent live birth in the five years preceding the survey and were included in this study. Majority of women 81.5% (3861) resided in the rural part of the country. Most of the respondents were from the Oromia region (33.5%) and were followed by the SNNP and Amhara regions (23.4% and 23%) respectively. About 94 % (4446) were married, 68% (3234) were not currently working, 54% (2553) were not educated and 16.6% (985) were from the poorest wealth quintile. When we see the proportion of the women by their religion, Orthodox Christian (42.4%) were more than those of Muslim (32.9%) and others (25%) in the study population.

Figure 2 presents the receipt of essential ANC components among women who had skilled ANC. Three in four 75.6% (95% CI 73.2%–77.9%) of women reported their blood pressure had checked. About 72.6% (95% CI 69.8%–75.4%) and 66.2% (95% CI 63.3%–69.1%) of women blood and urine samples were taken respectively, three in five (66.3%, 95% CI 63.9%–68.7%) women reported counseled on nutrition during pregnancy, while fewer than half received information on pregnancy complication (45%) (95% CI 42.4%–47.6%) and 56.1% (95% CI 53.4%–58.7%) were told about birth preparedness plan. Only one in five women (22.5%, 95% CI 20.3%–24.6%) received all six components of ANC during pregnancy.

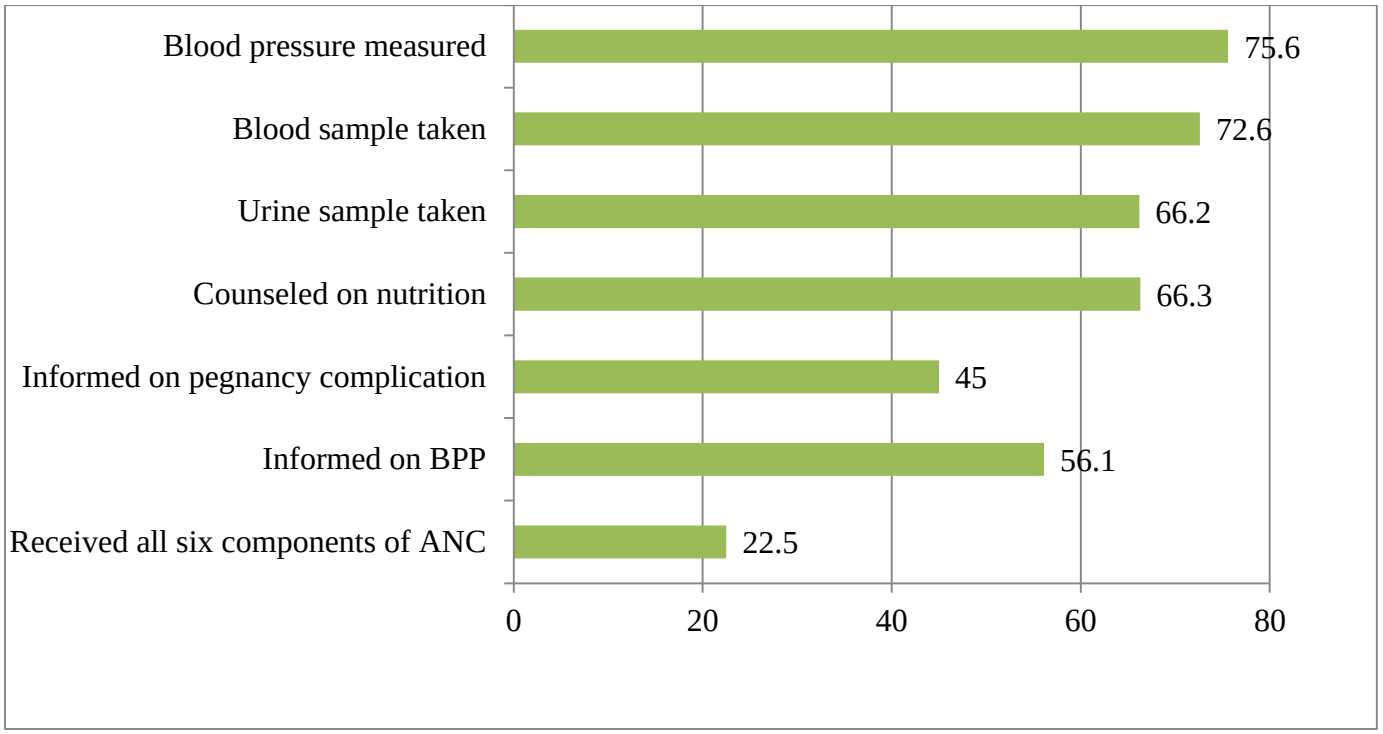

Figure 1 Utilization of essential ANC components among women age 15-49 who had skilled ANC with a live birth in the 5 years before the survey

This study found quality of ANC which was calculated in terms of receiving all the six components of services among women who had skilled ANC service was 22.5% with 95% CI (20.3%–24.6%). The result showed differences in ANC quality by region, place of residence, maternal age, education and wealth. Among regions, quality of ANC is highest in Addis Ababa region (49%) and lowest in Afar region (8.6%). Those women who reside in urban areas receive 39% ANC quality compared to those women who reside in rural areas that was 18%. Women in higher education level were received more quality ANC service (48%) than women with no education (17%); 16% among maternal age at birth less than 20 years compared to 23% women's older than 20 years and 13.2% among the poorest compared to 40% among the richest (Table 3).

Table 3 Weighted distribution of ANC quality in Ethiopia disaggregated by region, residence, education, maternal age and economic status of 2016 DHS

Characteristics	Category	N (%)
Region	Tigray	174 (36)
	Afar	3 (8.6)
	Amhara	267 (24.3)
	Oromia	271 (17)
	Somali	21 (17.5)
	Benishangul	11 (19)
	SNNP	211 (19)
	Gambela	2 (13)
	Harari	6 (44.2)
	Addis Ababa	95 (49.2)
	Dire Dawa	6 (20)
Place of residence	Urban	343 (39.2)
	Rural	722 (18.7)
Level of maternal education	No education	435 (17)
	Primary	355 (22.6)
	Secondary	166 (42.7)
	Higher	109 (48.3)
Maternal age at birth	<20 years	93 (16.6)
	20-34	809 (23.2)
	35-49	163 (23.3
wealth status	Poorest	104 (13.2)
	Poorer	131 (14.2)
	Middle	175 (17.6)
	Richer	224 (23.4)
	Richest	431 (40.1)

5.2 Inequality in quality of ANC through the summary measures of inequality

5.2.1 Quality of ANC using simple summary measures of inequalities

In most cases, absolute and relative inequality should be reported together as complementary measures of inequality. In this study, we calculated ratio and difference adjusted for potential confounding variables so that it could not correspond to the unadjusted findings presented in the Table 3. The level of inequality in the receipt of the quality of ANC was quantified using two commonly used measures: the difference and ratio. See Table 4 for the detail.

5.2.1.1 Absolute and relative measures of inequalities for Region

The ratio and difference inequality summary measure indicated that there was inequality in quality ANC across the region. Based on the difference value for region based absolute inequality quality of ANC was 0.0690 with 95% CI (0.0086, 0.1294) (Table 3). These estimates show that women lived in Addis Ababa region, on average had ANC quality 6.9 percentage points high compared to Afar region, holding all else constant. Similarly, ratio value based relative inequality we found that women lived in Addis Ababa region were 38% more likely to experience quality ANC as compared to women in Afar region (R=1.3844 with 95% CI (1.0227, 1.8946)).

5.2.1.2 Absolute and relative measures of inequalities for place of residence

According to the simple measure of inequality result shows that there was variation in ANC quality in urban and rural place of residence. An absolute gap between urban and rural areas of 2.9 percentage points with 95% CI (-0.0368, 0.0964) and women came from urban areas more likely to had ANC quality than rural areas with a relative ratio of 13.6. This was statistically not significant since the 95% CI includes 0.

5.2.1.3 Absolute and relative measures of inequalities for education level

Interpreting absolute difference value, we found that women in higher educational level had ANC quality 18.45 percentage points more than non-educated one (D=0.1845 with 95% CI: 0.0898, 0.2793). In terms of ratio value based relative inequality, women with higher education were about two times more likely (R: 1.9950; 95% CI: 1.4711, 2.7055) to had ANC quality compared to women with no education.

5.2.1.4 Absolute and relative measures of inequalities for wealth index

Findings suggest enormous wealth based inequalities in ANC quality. Based on the difference value for wealth based absolute inequality in quality of ANC was 0.1732 with 95% CI (0.1049, 0.2416) showing women from the richest house hold on average, had ANC quality 17.32 percentage points more often than the poorest women. Alternatively, women belong to the richest households three times more likely (29.13% more likely) to had ANC quality when compared to the poorest.

5.2.1.5 Absolute and relative measures of inequalities for maternal age

Judging from the simple measures of inequality presented in Table 4, maternal age -based absolute inequality in quality of ANC was 0.0864 with 95% CI (0.0077, 0.1652). This value indicates women whose age older than 20 years had 9 percentage points higher quality of ANC than younger than 20 years. Similarly, ratio value based relative inequality shows those women age older than 20 years were 1.47 times more likely (R =1.4728 with 95% CI (1.0328, 2.1004) to have quality of ANC service than the women in younger age groups.

Table 4 Absolute and relative level of inequalities in quality of ANC by equity stratifies

Simple summary measure of inequality	Value with 95% (CI)
Region	
Difference (Highest-lowest)	0.0690 (0.0086, 0.1294)*
Ratio (Highest/lowest)	1.3844 (1.0227, 1.8946)*
Place of residence	
Difference (urban-rural)	0.0298 (-0.0368, 0.0964)
Ratio (urban/ rural)	1.1368 (0.8589, 1.5046)
Educational level	
Difference (Higher-no education)	0.1845 (0.0898, 0.2793)*
Ratio (Higher/no education)	1.9950 (1.4711, 2.7055)*
Wealth Index	
Difference (Richest-Poorest)	0.1732 (0.1049, 0.2416)*
Ratio (Richest/Poorest))	2.2913 (1.6156, 3.2495)*
Maternal age	
Difference (Highest-lowest)	0.0864 (0.0077, 0.1652)*
Ratio (Highest/lowest)	1.4728 (1.0328, 2.1004)*

*p-value < 0.05

5.2.2 Quality of ANC using complex summary measures of inequalities

5.2.2.1 The concentration index for wealth status and maternal education of the women

The concentration index for both wealth and education related inequalities had positive values which indicating higher concentration of the quality of ANC service among the most advantaged subgroups (Table 5).

For wealth status the concentration index was (0.21) with a statistical significance of p-value less than 0.001, which implies that women among the better-off groups were more advantageous in receiving quality of ANC than the women among the most disadvantaged subgroups. Similarly, the concentration curve lies below the line of equality indicating that, quality of ANC service

utilization was concentrated among the better-off women than the most disadvantaged women (Figure 2). Similarly, more educated women tended to utilize the service more frequently than their non-educated counterparts (Figure 3). Interestingly, both the index and the curve supported our findings that the receipt of quality ANC was mainly dominated by women from well to do family and women who are more educated.

Table 5 Result of concentration index for wealth status and level of maternal education in 2016 EDHS data

Index	No. of obs.	Index value	Robust std. error	p-value
Erreygers norm.CI for **Educational status**	4684	.15647667	.02001275	< 0.001
Erreygers norm.CI for **Wealth status**	4684	.211035	.01972665	< 0.001

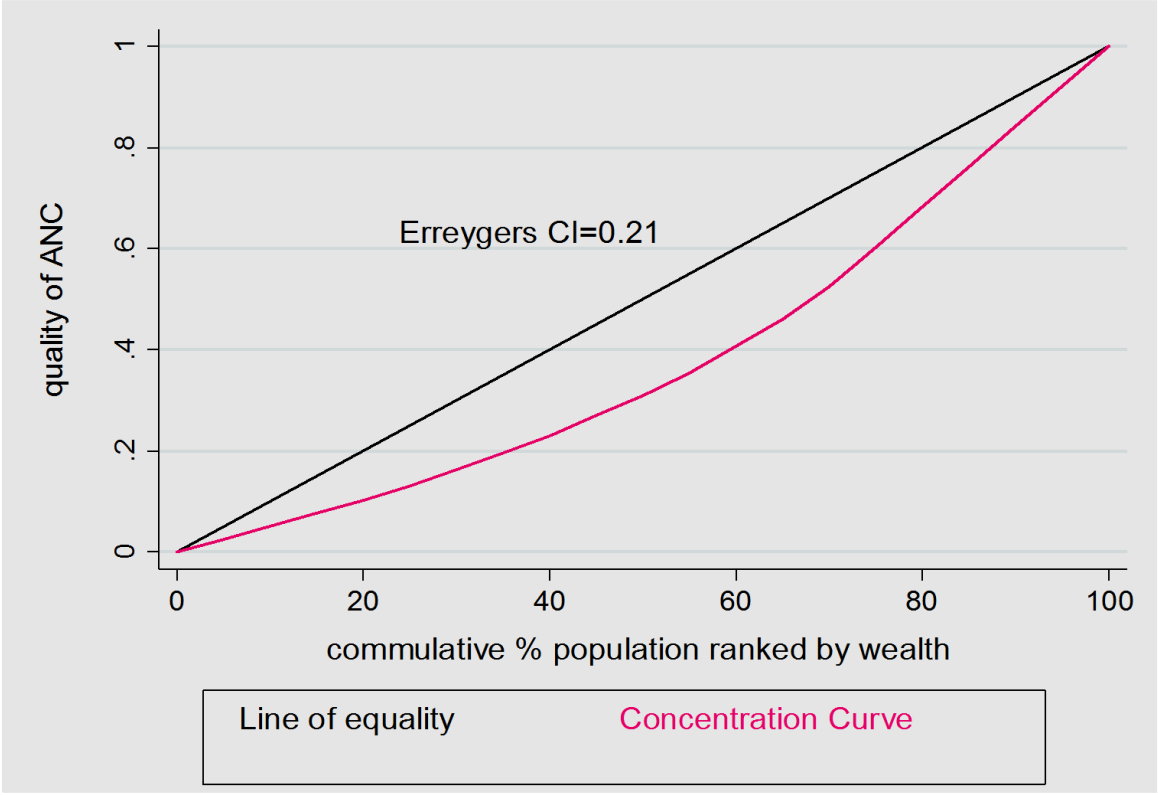

Figure 2 Concentration curve for wealth based inequality in quality of ANC in Ethiopia, DHS 2016

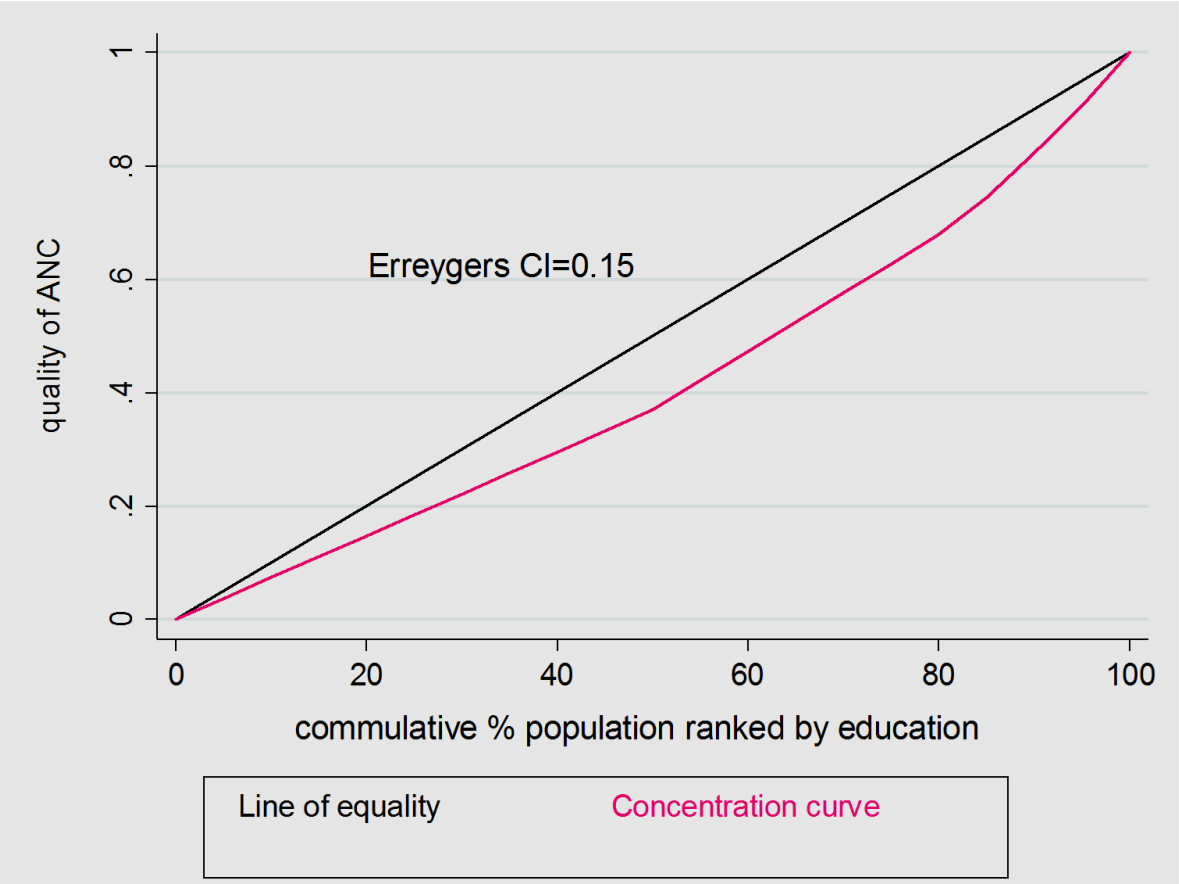

Figure 3 Concentration curve for level of maternal education based inequality in quality of ANC in Ethiopia, DHS 2016

5.3 Decomposition of the wealth based inequality

Figure 4 shows decomposition analysis result of selected explanatory factors contribution to the observed wealth-based inequality in quality of ANC service. Table 6 describe percentage contribution, regression coefficient and the concentration index of each factor for quality of ANC with 95% Confidence interval.

Explanatory variables namely mother's primary/secondary or above level of education, region (being Harari/Addis Ababa/Dire Dawa), maternal age (being 20-34 years), experience of

terminated pregnancy, type of provider (being midwife), type of facility (being hospital/private clinic/NGO), women had four or more ANC visits, had occupation and women whose marital status fall in the category of widowed/ divorced/separated all had positive concentration index i.e., they are more concentrated among the better off people. In contrast, other variables in this study had negative concentration indices (means more concentrated among the lower end of wealth status).

Different categories of wealth status by itself had different concentration indices. For instance, the 'poorer' and 'middle' categories had negative concentration index indicating that women in this category were economically low, whereas the richer and richest sub-group had positive concentration index meaning that people in this category were relatively better off. Over all, wealth helped the inequality in ANC quality widened the gap by 18% (sum of contributions made by all categories of wealth status).

Overall result of decomposition showed that the leading contributors to wealth based inequality in ANC quality were living in Gambella and Afar region (19% or 14.9%, respectively), had four or more antenatal care visit (15.3%), women from richest wealth division (13.3%), had ANC from health post or health center (12% or 7.8%, respectively) followed by ANC by midwifes (6.3%), higher education level (3.8%) and place of residence (2.7%). This positive value of contributions means that the variables contribute to pro-rich inequality, that is, richer individuals had ANC quality than the poor. Variable like women had experience of terminated pregnancy, living in Dire Dawa and Oromia region, ANC was given by nurse providers, ANC from governmental and private hospital, had four or more children and being married had negative contribution which indicating that the effect of predictors for inequality worked by lowering inequality, that is, they tended to shrink/narrow the wealth-based inequality.

The decomposition residual regression error for the inequality in quality of ANC was found to be nearly 0. This indicates that the determinant factor included in the decomposition analysis explained most of the inequality (Table 6).

Table 6 Contributions to the wealth based ANC quality inequality, 2016 Ethiopia DHS

		Coefficient	P-value	Contribution (%)	Concentration Index	95% confidence interval	
Variables	**Residual**			**< 0.001**			
Wealth Index	Poorest [Ref]						
	Poorer	0.03	0.83	3.05	-0.28	-0.30	-0.26
	Middle	0.30	0.03*	-0.15	-0.06	-0.08	-0.03
	Richer	0.56	0.001*	1.76	0.13	0.10	0.16
	Richest	0.84	0.001*	13.33	0.61	0.60	0.63
	Total			**17.99**			
Maternal education level	No education [Ref]						
	Primary	0.19	0.03*	0.80	0.05	0.03	0.07
	Secondary	0.48	0.001*	1.76	0.16	0.12	0.2
	Higher	0.63	0.001*	3.87	0.45	0.41	0.48
	Total			**6.43**			
Region	Tigray [Ref]						
	Afar	-1.23	0.001*	14.93	-0.5	-0.55	-0.46
	Amhara	-0.35	0.01*	0.02	-0.04	-0.54	0.45
	Oromia	-0.67	0.001*	-0.01	0.01	-0.65	0.68
	Somali	-0.53	0.01*	1.21	-0.16	-0.25	-0.06
	Benishangul	-0.59	0.001*	2.6	-0.16	-0.2	-0.13
	SNNP	-0.53	0.01*	0.12	-0.07	-0.39	0.25
	Gambela	-1.26	0.001*	18.93	-0.21	-0.23	-0.18
	Harari	0.28	0.11	8.56	0.34	0.32	0.36
	Addis Ababa	-0.06	0.70	0.23	0.58	0.51	0.65
	Dire Dawa	-0.81	0.001*	-6.06	0.25	0.23	0.28
	Total			**40.5**			
Place of residence	Urban [Ref]						
	Rural	0.15	0.28	2.74	-0.29	-0.31	-0.27
	Total			**2.74**			
Maternal age at birth	< 20 [Ref]						

	20-34	0.25	0.05	2.91	0.02	0.01	0.03
	35-49	0.45	0.01*	-1.13	-0.05	-0.10	-0.01
	Total			**1.78**			
Previous history of terminated pregnancy	**No** [Ref]						
	Yes	-0.02	0.83	-0.01	0.03	-0.02	0.08
	Total						
Type of ANC provider	**Doctor** [Ref]						
	Nurse	0.12	0.37	-1.55	-0.1	-0.12	-0.07
	Midwife	0.31	0.03*	6.38	0.16	0.15	0.17
	Health officer	0.09	0.69	0.89	-0.16	-0.28	-0.04
	HEWs	0.03	0.85	1.05	-0.26	-0.32	-0.21
	Total			**6.77**			
Place of ANC	Home [Ref]						
	Government hospital	0.77	0.12	-3.52	0.24	0.21	0.26
	health center	0.01	0.21	7.86	-0.07	-0.09	-0.05
	health post	0.38	0.44	12.24	-0.28	-0.32	-0.25
	private hospital	0.63	0.23	-2.04	0.53	0.49	0.57
	private clinic	0.69	0.19	-2.99	0.27	0.21	0.34
	NGO health facility	0.85	0.11	-0.56	0.19	0.14	0.24
	others	-0.43	0.62	-0.05	0.56	0.03	1.1
	Total			**10.94**			
Parity	1 child [Ref]						
	2-3 children	0.02	0.32	0.56	0.03	0.01	0.06
	4+ children	0.01	0.86	-2.2	-0.04	-0.05	-0.04
	Total			**-1.64**			
Number of ANC visit	Less than four [Ref]						
	4 or more	0.70	0.001*	15.36	0.11	0.10	0.13
	Total			**15.36**			
Marital status	Never married [Ref]						
	Married/living together	0.53	0.17	-0.74	-0.008	-0.01	-0.002

	Widowed/divorced/separated	0.44	0.27	0.61	0.09	0.04	0.14
	Total			**-0.13**			
Occupation	No [Ref]						
	Yes	0.01	0.98	0.87	0.09	0.06	0.11
	Total			**0.87**			
Religion	Orthodox [Ref]						
	Catholic	0.01	0.98	0.05	0.32	-0.01	0.66
	Protestant	-0.11	0.42	-2.74	-0.26	-0.29	-0.22
	Muslim	-0.08	0.43	-0.21	0.01		
	Traditional	-0.45	0.66	1.27	-0.46	-0.62	-0.31
	Others	-0.02	0.96	0.56	-0.3	-0.42	-0.17
	Total			**-1.07**			

Note: * Variables with non-zero coefficients at < 0.05 p-value; Ref=reference

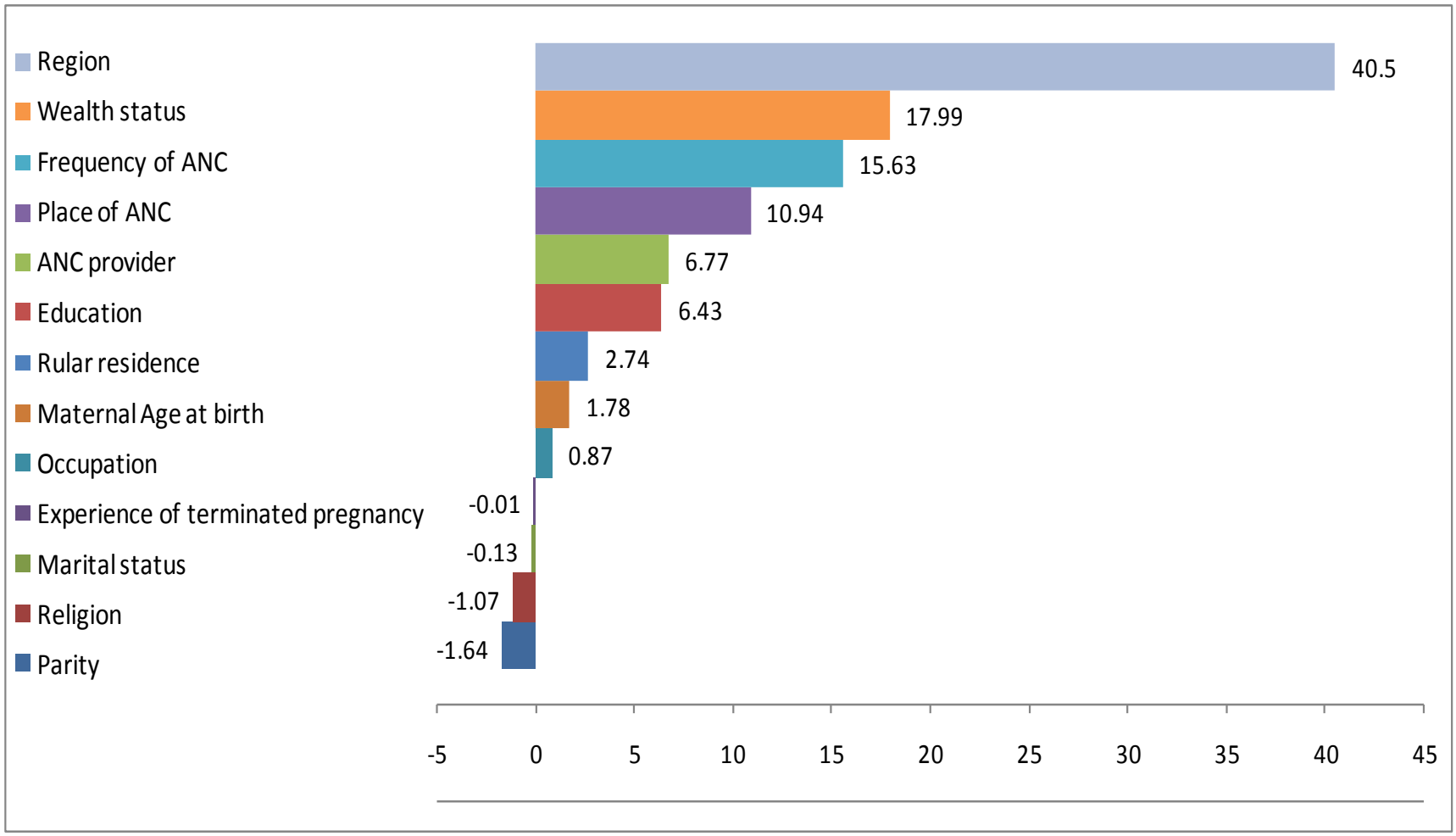

Figure 4 Decomposition share of the inequalities in the determinants of quality of ANC, in Ethiopia, DHS 2016

6. DISCUSSION

we conducted secondary analysis on Ethiopia Demographic and Heath Survey data to examine the extent of inequalities and drivers of inequality in use of quality ANC service. ANC quality was calculated using women who had antenatal care from skilled provider and reported receiving all the six essential components of antenatal care. We employed complex and simple as well as absolute and relative summary measures of inequality using data drawn from the fourth round of the Ethiopia demographic and health survey.

Overall quality of ANC service provided for pregnant women was 22.5% (95% CI 20%, 24%). Absolute and relative measures of inequalities for region, place of residence, education, wealth and maternal age showed that there was clear inequality in ANC quality. After an adjustment of a confounder concentration index for ANC quality computed for wealth was 0.12, with a 95%CI (0.11, 0.13). The concentration index being positive proves that this care was more likely to be received by wealthier women. The pro-rich nature of the use of quality ANC in this study was consistent with finding of other study (3). In decomposition analysis, more than 90% of wealth based inequalities in quality of ANC were explained by region, wealth, education, frequency of ANC visit, place of residence, type of facility and provider of ANC.

A significant difference and ratio based inequalities in ANC quality across regions suggest that ANC quality services disproportionately concentrated among the advantaged region (Addis Ababa, Dire dawa and Harari region). This is consistent with study done in Ethiopia using Service Provision Assessment Plus Survey (SPA+) data which computed effective coverage of ANC have shown that quality of ANC vary across the regions and very low across disadvantaged regions (22). As indicated in other studies this could indicated that the variation resulted from health workers' performance in resource limited settings affected by gaps in training, motivational factors like salaries, benefits, working environment with limited opportunities for supervision, mentoring and feedback and disproportional of volume of clients with staff numbers that leads to staff burnout (7, 19, 68).

In receiving essential components of antenatal care simple summary measures of inequality (ratio and difference) for place of residence revealed that there was a gap in urban rural distribution. Insignificant difference of this gap showed that quality of ANC was in favor of the urban place of residence. This was in line with findings of other studies (50, 54). This might be due to urban areas has more access to health

care services and health information than in rural areas (19, 69). It also might be linked with quality of ANC is expected to be lower in rural areas related with less developed health infrastructure and presence of fewer well trained health workers (29, 54). Thus, rural areas are often under resourced in health workers (68). Moreover, women in rural places are less educated and less independent than women in urban areas to try to find quality of health care (70).

The results showed the presence of inequality based on education-level. Receiving ANC quality was highest for educated women and increased with increasing education level. Similar findings other studies in African countries were reported the same (48-50, 69). Educated mothers are more likely to request the services because of enhanced access and understanding to relevant healthcare information (48, 49, 71). In addition, educated mothers tend to have better communication skills which facilitate interactions with health workers (48, 72). Another possible explanation of the observed inequality may be that service providers tend to discriminate against with little education by not providing them with comprehensive information about pregnancy care and not performing all the required tests (48, 73). At the same time, uneducated women are frequently unemployed, poor decision-making capacity and lack of awareness about the importance of getting recommended components of antenatal care.(48)

We found substantial heterogeneity in quality of ANC by wealth status. The result revealed that receiving at least six essential components of ANC was largely concentrated among pregnant women from higher economic status. This finding was consistent with evidence from study in 91 LMICs national household surveys analysis that indicate socioeconomic inequalities in antenatal care quality (3, 4, 15, 40, 49, 50). Quality of care disparity by economic status include wealthier women live in areas where quality of care is generally higher, afford high quality care, better access to health information (48). Studies have shown that poorer women tend to access care locally or at nearby facilities and tend to live next to facilities with poorer structural quality where the basic amenities and equipment needed to provide services was not available (40). Similarly, much has been written about how implicit bias by healthcare provider links to disparities in access to and quality of care (74); discriminatory treatment from health workers could also explain why women in the lower end of economic status get worse quality of care than their richest counterparts. Studies have revealed that there was different treatment among disadvantaged women during childbirth including inadequate, disrespectful and abusive care (75, 76), these women might also be differentially treated during ANC and might not be offered the same quality of care as wealthier women.

The result of regression-based decomposition analysis showed economic status, region, frequency of ANC, ANC place and provider, education, and place of residence have the biggest shares to observed wealth based inequality in ANC quality. As, the analysis showed that pregnant women living in Gambela, Afar and Benishangul region were provided the largest positive contribution to inequality in ANC quality. This 36% share was mainly the product of a high concentration of poor women in these region (negative CI) indicated that widening of inequality by preventing the poor from receiving ANC quality. The study showed ANC quality was concentrated among advantaged region, if mother who lives in the disadvantaged region start to be on the same economic level with the mother in advantaged region inequality in ANC quality were reduced.

Based on the findings wealth by itself was substantial contributor for widening wealth based inequalities in ANC quality to the disadvantage of the poor (positive CI). This indicated that eliminating the current levels of wealth inequality will reduce economic inequality in ANC quality by 18%. Educational status of the woman and having four or more ANC visit were concentrated among women from better economic status (positive CI) and also had a positive contribution (6% and 15%) respectively. This implied that these variables operate by helping the wealthier people receive quality of ANC services, this resulted in raised inequality to the favor of the rich. Since no study were recognize the individual contribution of these important variables on the disparity in the use of ANC quality but these variables were mentioned an important factors for receiving ANC quality (3, 48).

The type of health worker providing ANC services and the place where ANC provided also had a large contribution which accounted for a total share of 17.7% (6.7% and 10.9%, respectively) of wealth based inequality in ANC quality. Women receiving ANC from health post and by health extension workers had positive contribution with negative concentration index. This implied that both variables being more prevalent among women in the lower end of economic status (negative CI) and widened the inequality by preventing the poor from getting the quality ANC service. In Ethiopia health extension program was launched in 2003 mainly for the purpose of health promotion and disease prevention for rural population and underprivileged society. The program brings an improvement in the uptake of maternal health services (21, 77, 78).The observed widening inequalities in ANC quality favoring the rich in this study might be the implemented health programs have not adequately addressed the issue of quality.

Other important contributors to the observed wealth associated disparity were place of residence, maternal age, occupation, parity, marital status and previous history of terminated pregnancy. Explanatory variables that had positive contribution widened the observed poor-rich inequality in quality of ANC. Therefore, different effort has to be made in addressing these positive contributors of inequality in quality of ANC in order to close the inequality. On the other hand, other variables which had negative contribution narrow the disparity. Women who live in rural place of residence had negative Concentration index means they were found to be poor but contributed positively to the inequality. This implies that the rural people being poor it prevented them not to have the ANC quality service. This differential influence on the place of residence of wealth status led to the increased wealth based inequality in ANC quality.

Generally, the above scenario clearly showed that if the variable by itself is unequally distributed across wealth status it contributes for inequality either through widening or narrowing the gap (19, 21, 79). Overall, earlier studies on inequalities in quality of ANC service utilization shows the disadvantages of the population with lowest end of economic level (3, 15, 40, 49). As long as these financial status differentials may potentially not emerge from a systematic avoidance of the poor (49), they speak the case that the poor struggle for a double burden of poor quality services as well as disparity for care.

6.1. Strength and Limitation of the Study

Strength of the Study

- Using the most recent EDHS data which have standardized data collection procedures with good response rate and which is nationally representative
- Study was based on the WHO recommended methods of inequality measurement which is methods mix of simple and complex as well as absolute and relative summary measures to improve quality of the evidence.

Limitation of the Study

In spite of the afore- mentioned strength this study had some limitations

- Even if we use the most recent live birth in the past 5 years before the survey for calculation of quality of ANC there might be a recall bias
- Information from mothers that had dead birth was not collected (under estimate)

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7. CONCLUSION AND POLICY IMPLICATIONS

We assessed inequalities in technical quality ANC in terms of receipts of six essential components of ANC were reported in 2016 EDHS. This study concludes there were significant inequalities in receipts of ANC quality disproportionately favors the advantageous subgroup in Ethiopia namely wealthier and more educated women, women residing in urban setting and some advantageous regions such as Addis Ababa, Dire Dawa and Harari. Rich women enjoy relatively more ANC quality services compared to the poor. Factors such as region, wealth, frequency of ANC, education, place of residence, type of ANC facility and type of provider significantly explained the observed wealth based inequalities.

Although the sustainable development goal and health sector transformation plan envisaged giving quality and equity health service by this time, this study has shown that quality of ANC service provided for pregnant women was low and there was a significant inequality in this care. So, the performances are still far from the expected. Despite the possible significant role of the health system in decreasing inequality in ANC quality, new policies and interventions need to fixate not only on the health system but also on social initiatives with an equity lens to handle the causes hidden these factors and their disparities. Using intentional endeavors to tackling inequalities in ANC quality which has a contribution to have an access of quality health care service and bring "no one left behind". Moreover, this study shows clear insight into the use of decomposition in dealing with inequality in ANC quality it can uphold prioritization of interventions and hence can lead to effective and efficient use of the limited resources available in any society.

8. RECOMMENDATIONS

Based on the finding of the study, the following recommendations are given below for the concerning bodies.

Policy makers

- Emphasis needs to be given on improving drivers of the wealth driven inequalities by increasing maternal wealth and education, targeting the poor and by increasing household wealth and income of women in poor regions (with negative index)
- Inter-sectoral collaboration (MOH, ministry of agriculture, Education) were needed to alleviate inequalities.

Ministry of health

- To increase Antenatal care quality in Ethiopia due consideration should be turned in encouraging pregnant women rising the uptake of four or more ANC because frequency ANC was one of the major contributors.
- Quality improvement effort should also focus on health post which is an entry point where clients formally contact health care providers for the first time before going to the next higher level of health care.
- The government should focus on health workforce especially those working in disadvantageous region and rural areas at ensuring the availability of adequate number and mix of quality health workforce that are competent, motivated and compassionate to provide quality health service as settled in HSTP II

Researchers

- we recommended research to understand the trend of inequality in ANC quality and could examine changes in factors that explained by wealth based inequalities in ANC quality

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