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Social Determinants and Maternal Health Care Utilization in Ethiopia: Risk and Protective Factors

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Dedication

To the memory of my mother Nuriya Ahmed, who passed away on October, 2021. She will always live in my heart. I will miss you. Allah the Almighty rest your soul in Jenneha.

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Acknowledgment

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Summary

Background: The Sustainable Development Goals (SDGs) stress the importance of reducing maternal mortality. Maternal health care service utilization is important for the improvement of both maternal and child health. This is a major public health challenge in Ethiopia. Socio-economic inequalities within the country are greatly reducing the use of maternal health care services despite government policy reforms to improve access to maternal health care services and interventions. This reflects how Social determinants of health (SDH) impacts population health and individual health care utilization. The SDH include income and social status; social support networks; education; employment/working conditions; social environments; physical environments; personal health practices and coping skills; healthy child development; gender; and culture. The actions we take to prevent ourselves from becoming ill are influenced by social determinants of health. The same is true for a pregnant woman who wants to make sure that her unborn child and herself are healthy during the course of the pregnancy and childbirth, and beyond. Whether she attends antenatal care and/or delivers at a health facility or not is dependent on a host of determinants at the individual and community level, and within a socioeconomic and political context. Available studies in Ethiopia have not sufficiently explored the impact of local social determinants of maternal health care utilization. Additional evidence is helpful to policy makers and program managers to address the prevailing problems in maternal health care utilization, and narrow the equity gap between different social classes.

Aim of the study: This thesis aims to study the impact of various social determinants and intimate partner violence on the utilization of maternal healthcare services. It also explores the characteristics of women identified as a positive deviant in relation to use of maternal health care services.

Methods: The study is based on data from repeated cross-sectional surveys carried out by Measure Demographic and Health Survey and Central Statistical Authority of Ethiopia. Study I used data from 2005, 2011 and 2016 surveys, covered a representative sample of 22, 799 and study II was based on the 2016 data which included 2836 currently married women with one live birth in the five years preceding the survey and who participated in the domestic violence sub-study. While study III used data from the 2011 and 2016 surveys with 15, 492 women in the reproductive age (15 – 49 years), reporting at least one birth in the last 5 years preceding the survey. All these available data were pooled and compiled.

Descriptive analysis were carried out to assess the characteristics of study women in relation to the outcome of interest. Analyses of trends in proportions over time were done. Taking into account the nested structure of the data, multilevel logistic regression analyses were conducted to explore factors influencing the utilization of maternal healthcare services, and to explore the characteristics of women considered positive deviant for uptake of skilled maternal healthcare. All analyses were performed using STATA MP 15 and 16.1 Statistical Software. Sampling weights were also applied in all the analyses.

Results: The study demonstrated that the proportion of women who received at least one ANC visit use increased significantly from 28.5% in 2005 to 62.8% in 2016. Despite these improvements, only 32% of the Ethiopian women met the current Ethiopian policy recommendation of four ANC visits for the index pregnancy. Significant disparities in ANC uptake between urban and rural areas, across regions and by socio-economic status were detected. In addition, health facility deliveries for women living in rural areas increased substantially from 5.0% in 2011 to 24.1% in 2016. Likewise, facility delivery among urban women increased from 53.0% in 2011 to 84% in 2016.

Multilevel analyses showed that there are several risk and protective factors with a significant impact on the utilization of maternal healthcare services. The risk factors include younger maternal age, second or above birth order, women with no education, residing in low wealth index households, living in rural and pastoralist region, far distance to health facility, and intimate partner violence. Furthermore, the following were identified as potential protective factors: living with husband who have primary or above education, employed women and having employed partner, exposure to media, women's participation in household at least in one decision-making, and living in the urban, or agrarian regions. Moreover, positive deviant mothers had the following characteristics compared to their non-deviant counterparts for uptake of skilled maternal healthcare: more likely to be involved in at least one decision-making, exposed for mass media, had husband with primary or above education, employed, or were less likely to perceive a far distance to a health facility. There were rural/urban difference as well.

Conclusion: The study illustrates that social determinants affect utilization of maternal health care services, and IPV has a negative impact on women's health. This calls for a thorough assessment of the Ethiopian actions related to intimate partner violence. From a policy perspective, the positive deviant approach provides a means for local policy makers and

program managers to identify factors facilitating improved health behaviours, and ultimately, better health outcomes, despite an acknowledged adverse risk profile. Addressing the identified risk and protective factors will be important in order to better understand the social process related to skilled maternal healthcare services utilization and design appropriate strategies and policies. There should be an integrated approach implementing high-impact context-specific interventions focusing on resilience building coupled with a tailor-made development package that addresses the SDH and poor health outcome faced by these populations. Actions at multiple intersecting levels might provide women with the important health services they need if Ethiopia desires to progress towards the SDGs set for maternal health.

Sammendrag

Bakgrunn: Bærekraftsmålene løfter opp betydningen av å redusere mødredødeligheten globalt. Bruk av svangerskapskontroller og det å ha tilgang på kvalifisert hjelp under fødsel, er viktig for optimal mor barn helse. Dette er en folkehelseutfordring i Etiopia. Sosioøkonomiske ulikheter innen landet påvirker bruk av mødrehelsetilbudene på tross av statelige tiltak og reformer. Sosiale helsedeterminanter (SHDer) inkluderer, inntekt, sosial status, sosialt nettverk, utdanning, arbeid, nærmiljø, kultur og politiske forhold. Alle disse, i tillegg til risiko adferd og evne til å takle utfordringer, påvirker individuell helseatferd. Det er ingen tilgjengelige etiopiske studier som på en helhetlig måte har vurdert hvordan SHDer kan påvirke bruk av mødrehelsetilbud på regionalt nivå. Slik forskning vil være nyttig for politikere og myndigheters arbeid med å løse utfordringene i landet og redusere regionale ulikheter i mor barn helse.

Formål med studien: Dette doktorgradsarbeidet ønsker å vurdere betydningen av ulike SHDer samt partner vold og bruk av mødrehelsetilbud. Studien vil også se hva som kjennetegner kvinner som på tross av høy risikoprofil bruker tilbudet. Disse defineres som positive avvikere i sin helseatferd.

Metoder: Studien benytter sekundær data fra tre runder (2005, 2011 and 2016) av den Etiopiske demografi og helseundersøkelsen. Studie I benytter data fra alle tre, tilsammen totalt 22799 kvinner. Studie II er basert på 2016 data og inkluderer 2836 gifte kvinner, med ett levende født barn i løpet av femårsperioden før studien, som deltok i understudien om partnervold. I studie III brukes data fra undersøkelsene i 2011 og 2016, hvor totalt 15492 kvinner mellom (15 – 49 år) rapporterte en fødsel de siste fem årene. Deskriptive analyser identifiserte relasjonen mellom kvinnenes karakteristika og bruk av mødrehelsetilbud. Multinivå logistisk regresjon ble brukt for å analysere betydningen av de ulike faktorene for bruk av helsetilbud, samt å identifisere de kvinnene som var positive avviker i bruk innen de med høy risiko for ikke bruk av mødrehelsetjenestene. Vi utførte også tidstrend analyser og tok høyde for datainnsamlingsstrategien i analysene. Alle analyser ble utført ved hjelp av STATA MP 15 and 16.1 Statistical Software.

Resultater: Denne studien viser at andelen av kvinner som hadde minst en svangerskapskontroll økte signifikant fra 28.5% i 2005 til 62.8% i 2016. På tross av denne økningen var det kun 32% av kvinnene som oppfylte den nåværende etiopiske anbefalingen om fire svangerskapskontroller. Vi identifiserte ulikheter i bruk av svangerskapskontroll

tilbudet relater til sosioøkonomisk status, mellom by og land, og region. Andelen fødsler i sykehus økte betydelig fra 5.0% i 2011 til 24.1% i 2016 for kvinner på landsbygda, og fra 53.0% i 2011 til 84.0% i 2016 i urbane strøk. Multinivå analyser identifiserte ung alder, tidligere barn, ingen skolegang, lav inntekt, bosatt i ruralt område eller i nomaderegion, lang avstand til helsetjeneste, samt partnervold som risikofaktorer for ingen bruk av mødrehelsetilbud. Bruk at tilbudene var forbundet med, partner med noe skolegang, arbeid eller partner i arbeid, tilgang til media, deltagelse i beslutninger i husholdningen, bosatt urbant eller i en jordbruksregion. En positivt avvikende bruker av mødrehelsetjenesten var i større grad involver i avgjørelse i husholdningen, hadde en mann med noe skolegang, var eksponert for media og anga uproblematisk avstand til helsetilbudet.

Konklusjon: Denne studien viser at SHDer påvirker bruk av mødrehelsetjeneste. Fasiliterende og begrensende faktorer er viktig for å forstå sosiale prosesser relatert til bruk av tilbudet. Sosiale og regionale ulikheter i bruk helsetjenestene må vurderes når Etiopia utvikler og iverksetter politiske tiltak. Partnervold har en negative påvirkning på kvinners bruk av mødrehelsetjeneste tilbud. Den nåværende håndtering og strategi relater til partnervold bør systematisk gjennomgås. Fra et forebyggingsperspektiv så er konseptet relatert til positiv avvikende bruker av mødrehelsetjeneste tilbudene svært interessant. En integrert strategisk tilnærming som fokuserer på ulike SHDer kan være en mulighet for Etiopia å øke bruk av helsetjeneste tilbudene i de mest utfordrede regionene og nærme seg bærekraftsmålene de har satt seg.

List of acronyms and abbreviation

aIRR: Adjusted Incident Rates Ratios

AOR: Adjusted Odds Ratios

ANC: Antenatal Care

CSA: Central Statistical Agency

CI: Confidence Intervals

EDHS: Ethiopian Demographic and Health Surveys

EPHI: Ethiopian Public Health Institute

FDRE: Federal Democratic Republic of Ethiopia

FMoH: Federal Ministry of Health of Ethiopia

FANC: Focused Antenatal care

GBV: Gender Based Violence

GDP: General Domestic Product

HEW: Health Extension Worker

HSTP: Health Sector Transformation Plan

HIV/AIDS: Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome

HDI: Human Development Index

ICF: Inner City Fund

IDSR: Integrated Disease Surveillance and Response

IPV: Intimate Partner Violence

ICC: Intra-Cluster Correlation

LMICs: Low and Middle Income Countries

MDSR: Maternal Death Surveillance and Response

MMR: Maternal Mortality Ratio

MDGs: Millennium Development Goals

MPI: Multi-Dimensional Poverty Index

NB: Negative Binomial

NB RE: Negative Binomial Random effects

NORHED: Norwegian Programme for Capacity Development in Higher Education and Research for Development.

NRSGH: Norwegian Research School of Global Health

PD: Positive Deviance

PSU: Primary Sampling Unit

PCA: Principal Component Analyses

RE: Random Effects

REML: Restricted Maximum Likelihood Method

SACCADE: Strategic AND Collaborative Capacity Development in Ethiopia and Africa
SBA: Skilled Birth Attendants

SPHMMC: St Paul's Hospital Millennium Medical College
SDH: Social Determinants of Health

SNNPR: Southern Nation Nationalities People Region

SSA: Sub-Saharan Africa

SDGs: Sustainable Developmental Goals

STATA: Statistical Software Package
TBAs: Traditional Birth Attendants

TB: Tuberculosis

UiO: University of Oslo
VA: Verbal Autopsy

WHO: World Health Organization

ZINB: Zero Inflated Negative Binomial

ZIP: Zero Inflated Poisson

List of papers

The thesis is based on the following papers:

S.No	Title	Journal	Status	Author & Co-authors
1	**Social determinants of antenatal care service use in Ethiopia: Changes over a 15-year span**	Front. Public Health 2019; 7:161. doi: 10.3389/fpubh.2019.00161	Published	Ousman SK, Mdala I, Thorsen VC, Sundby J and Magnus JH
2	**Maternal exposure to intimate partner violence and uptake of maternal healthcare services in Ethiopia: Evidence from a national survey**	PLoS ONE	In review	Seman Kedir Ousman, Mekdes K Gebremariam, Johanne Sundby, Jeanette H. Magnus
3	**Uptake of Skilled Maternal Healthcare in Ethiopia: A Positive Deviance Approach**	Int. J. Environ. Res. Public Health **2020**, 17, 1712; doi:10.3390/ijerph17051712	Published	Seman K. Ousman, Jeanette H. Magnus, Johanne Sundby and Mekdes K. Gebremariam

The original papers printed in thesis with permission from the respective journals and are referred to in the text by their Roman numerals (Appendix1). Permission letters are attached in the appendix 4.

Chapter I: Introduction

Maternal health refers to the health of women during pregnancy, delivery, and the postpartum period [1]. Maternal health outcomes are key indicators of women's health and status. One of the most prominent is maternal mortality. Reducing maternal mortality has long been a global health priority particularly for developing countries. The World Health Organization (WHO) estimates that about 295, 000 women of reproductive age (15 – 49 years) died in 2017 from pregnancy-related complications. There are huge differences in the levels of maternal mortality ratio (MMR) in various parts of the world (Figure 1). The Sustainable Developmental Goals (SDGs) for 2030 continue the focus on maternal health, pushing beyond the targets set by the Millennium Development Goals (MDGs) for 2015. This goal also highlights the immense disparities between developing and developed regions in their contributions to the global MMR [1].

The MMR in Sub-Saharan Africa (SSA) is one of the highest in the world, reaching 542 per 100,000 live births [1]. Three countries had extremely high MMR in 2017: South Sudan with 1150, Chad 1140 and Sierra Leone 1120 maternal deaths per 100,000 live births, whereas Belarus and Norway recorded 2 maternal deaths per 100,000 live births, in the same year [1].

Figure 4.1. Maternal mortality ratio (MMR, maternal deaths per 100 000 live births), 2017
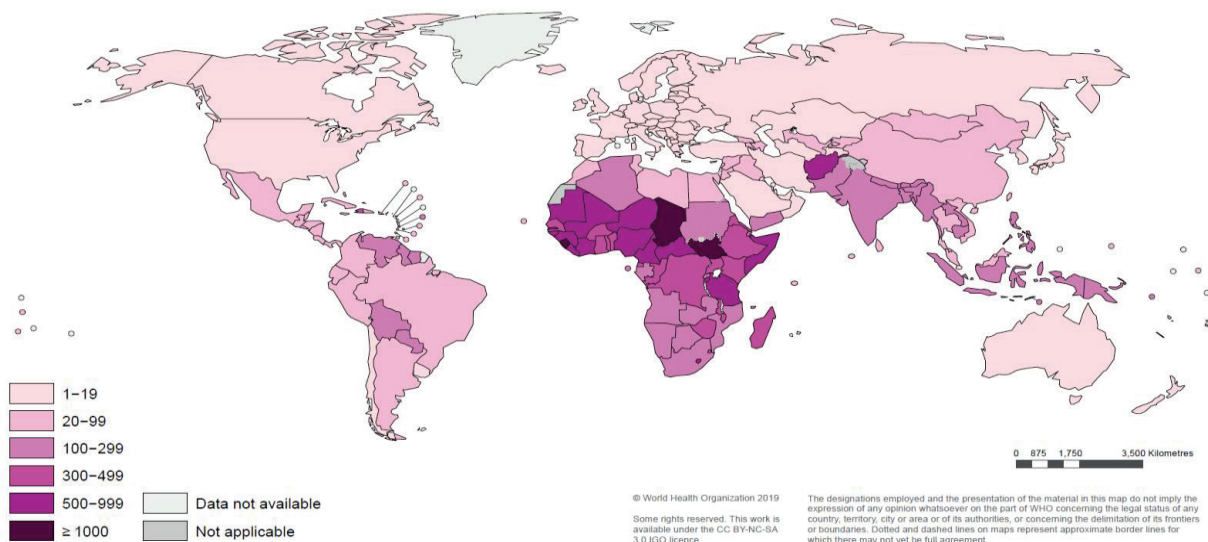
Figure 1. Map of the world showing categories of countries according to their maternal mortality ratio (MMR, maternal deaths per 100 000 live births), in 2017.

Source: [1]. Granted permission for copyrighted figure from WHO attached in the appendix 4.

High MMR are attributed primarily to blood loss, infection, high blood pressure, unsafe abortion, and obstructed labour, as well as indirect causes such as anemia, malaria, and chronic diseases [1]. In addition, inadequate access to antenatal care (ANC), as well as intrapartum, and postnatal health care services are related to high maternal and child morbidity and mortality in SSA [2]. Access to quality services during pregnancy, delivery, and the postnatal period impact survival and death for both mother and baby [3].

Women are the mainstays of families, the key educators of children, care providers to young and old alike, farmers, traders, and often the main, if not the sole, breadwinners in SSA [4]. Families without mothers are often at increased risk of infant mortality, children not attending school and/or living or working on the street [5]. A society deprived of their contribution might experience social and economic decline, impoverished culture, and its potential for development severely limited [6]. Reduction of maternal mortality and improved maternal healthcare are imperative to the societal advancement in SSA.

Maternal mortality in Ethiopia

The Ethiopian MMR is very high compared to countries in the Eastern Africa Region (Table. 1).

Table 1. Estimates of Maternal mortality ratio for Eastern African countries', 2016 - 2017

Year	Country	Number of maternal deaths	MMR with 95% CI
2017	Rwanda	960	248 (184, 347)
2017	Djibouti	51	248 (116, 527)
2017	Sudan	3900	295 (207, 408)
2017	Kenya	5000	342 (253, 476)
2017	Uganda	6000	375 (278, 523)
2016	Ethiopia	12,000	412 (273, 551)
2017	Eritrea	510	480 (327, 718)
2017	Tanzania	11,000	524 (399, 712)
2017	South-Sudan	4500	1150 (789, 1710)

Source: Computed using results from the 2016 EDHS and 2017 WHO, UNICEF, UNFPA, World Bank Group and the United Nations Population Division [1,10].

Ethiopia showed remarkable reduction of 53% in MMR between 2000 and 2016, as illustrated in Figure 2 [7 - 10]. Significant efforts are needed in Ethiopia to reach the targeted reduction to 199/100.000 live births [11], and the political goal of an MMR of less than 70 deaths per 100,000 live births by 2030 [12].

TRENDS IN MATERNAL MORTALITY RATIO

━━ MMR/100,000 LBs
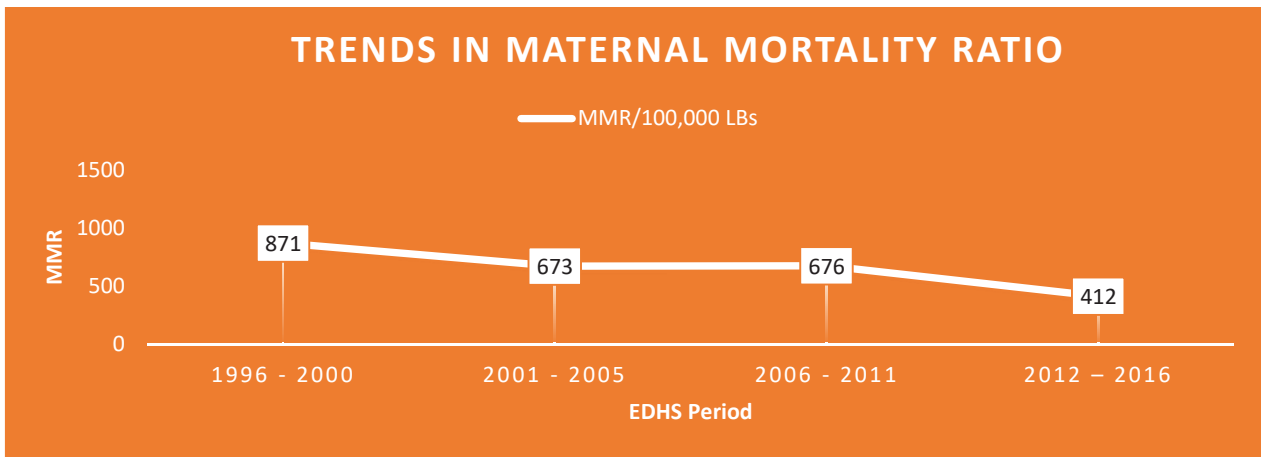
Figure 2. Trends in MMR in Ethiopia (pregnancy-related deaths per 100,000 live births, 7 years before each survey). Source: Constructed using results from EDHS 2000, 2005, 2011 and 2016.

The Federal Ministry of Health of Ethiopia (FMoH) launched the national maternal death surveillance and response (MDSR) system in May 2013 as a tool to improve the quality of maternal healthcare, particularly during pregnancy, childbirth and the postpartum periods. MDSR is a system implemented in the entire country to ensure that every maternal death (at home or in health institution) is identified, audited and responded to. The reporting of maternal death are incorporated within Integrated Disease Surveillance and Response (IDSR) in order to deepen the initiative's reach the community level. There are two major sources of information for maternal deaths: Communities and facilities. In the community, the Health Extension Worker (HEW) will establish a link to the nearby health centre, who will arrange the Verbal Autopsy (VA), with all possible sources of information for identifying deceased women of reproductive age. In the facility, the head of the any ward where a suspected maternal death occurs is responsible for notifying the head of the health facility/the medical director.

The Ethiopian Public Health Institute (EPHI) indicates that about 85% of these deaths are directly attributable to postpartum haemorrhage (41.3%), hypertensive disorders in pregnancy (Preeclampsia/Eclampsia, 18.6%), obstructed/ruptured uterus (9.7%) and sepsis (9.3%), other direct

causes (7.3%) as well as to indirect causes, anemia (17.5%), and other indirect causes (malaria, cardiac, HIV and TB, 8.0%); (Figure 3). When looking at reasons for the deaths, the report classified these as a 3 –Delay Model. Delay 1 refers to delay in **deciding to seek assistance**. Delay 2 relates to delay in **reaching a facility**, and Delay 3 captures delays in receiving **appropriate care after arrival at a facility**. The EPHI reported that Delay 1 was cited in 66.8%, delay 2 in 37.7% and Delay 3 in 48.6% of 1547 reviewed **maternal deaths**. This underscores that delay in deciding to seek assistance as critical related to maternal death in Ethiopian context [13].

Figure 3. Direct and indirect causes of maternal deaths in Ethiopia (%), 2017
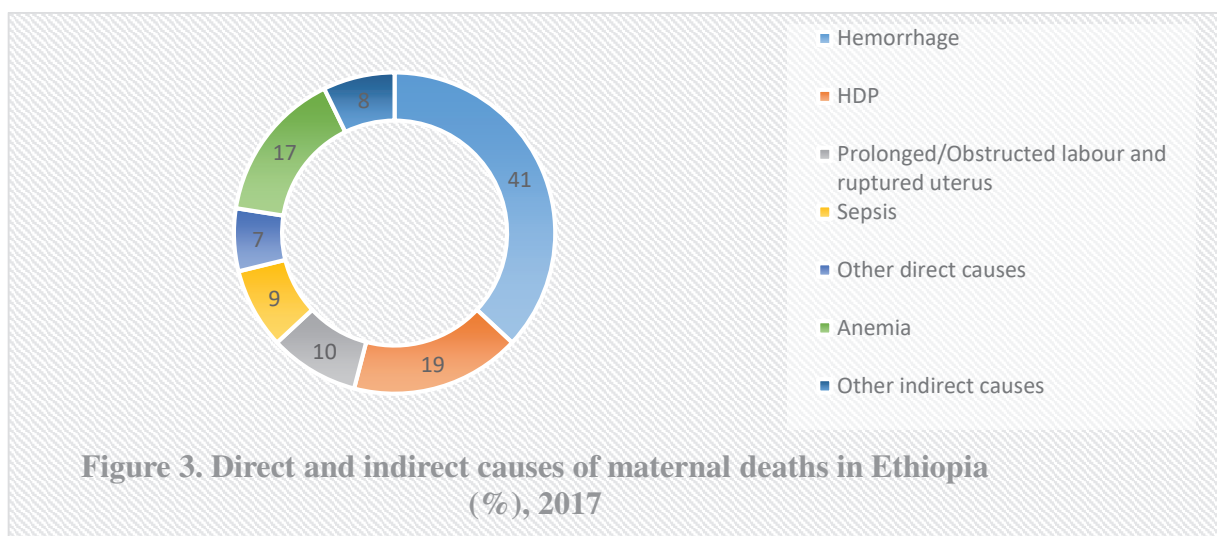
Source: Constructed using result from the National Maternal Death Surveillance and Response (MDSR) System Annual Report, 2017/18 [13].

Moreover, in Ethiopia the high number of maternal mortality is compounded by a low degree of maternal healthcare utilization. For instance, a low utilization of ANC (74%) is related to a low rate of delivery at health care facilities (48%) and limited post-partum care (34%), all providing additive reasons for a sustained high maternal mortality [14].

II. Background

In the following section, literature related to access and utilization of maternal and healthcare services in SSA and Ethiopia will be presented. We will include studies published prior to 2017 as that represent the state of knowledge at the time this research projected started. The search terms and searching strategies

employed are described in the appendix 2. New studies published from 2017 onwards are included in the discussion section.

2.1 Access to Maternal Health Care

Accessibility to services comprises three components: infrastructure, availability of health personnel and quality of services [15]. Access to healthcare services is an important requirement to create willingness among the people to use the maternal health services [16]. Globally, the effects of inequitable access to health care are quite apparent as the extent of morbidities and deaths emanating from resource-poor countries are significantly higher than those in resource-rich nations [17]. The disparity in access to health is even more visible when analysed within each country, especially in the resource constrained countries [18]. The steepness of this disparity calls for the need to assess the notion of equitable access to health care that governments uniformly claim to be implementing [19]. Generally, there is sufficient evidence on the link between inequitable access to health care and inequitable distribution of illness [20]. Diminishing the wide gap in important health care services use between different population groups would increase health equity and improve the overall health of a nation.

2.1.1 Access to Maternal Health Care in SSA

The challenge in low-income countries is to deliver both high coverage and high-quality care, reducing financial and geographical barriers to access to maternal and perinatal health services. Improving access to maternal and newborn quality care does not guarantee a positive effect on maternal and newborn health outcomes but is reasonably considered as a contributing action to this goal, along with education and socioeconomic development. A number of women die every year during pregnancy and childbirth due to the lack of access to skilled birth attendants (SBA) in low and middle income countries [21]. Sub-Saharan Africa has some of the greatest wealth inequality gaps in the world for access to skilled care [22].

Inadequate access to quality maternal healthcare is generally recognized as one of the major challenges to reducing maternal mortality and morbidity in Sub-Saharan Africa [23 -24]. In many countries, shortages of skilled health workers, facilities, and unequal distribution of health resources, create barriers to access care for large segments of the population [25 -26]. Access can be further restricted by cultural, social, and economic factors that influence the perceived benefits of seeking care and the ability to obtain care. These include health-related knowledge and attitudes, women's autonomy within the household, and the economic status of households [27 -28]. In Sub-Saharan Africa, where poverty is widespread, the cost to households of seeking care, including user fees, transportation and lost labour time, is a significant factor

in health care decisions for poor families [29 -31]. There are inequalities in both access to general health care and specifically to maternal health services where poverty has been identified as a major cause for exclusion from ANC and SBA which is linked to higher maternal mortality [32]. Various health system barriers to access to obstetric care have been fairly well documented in SSA [33].

2.1.2 Access to Maternal Health Care in Ethiopia

The national health policy of Ethiopia gives strong emphasis to fulfilling the needs of the rural residents, which constitute 84% of the Ethiopian population [34]. Ensuring universal access to health care is one of the main targets of the National Health Sector Transformation Plan in Ethiopia [11]. An accelerated expansion of primary health care facilities (composed of health centers and health posts) has been undertaken since 2003. In a decade, the number of health posts and health centers in Ethiopia grew by six fold to reach 3724 health centers and 17,187 health posts by 2016. Each health posts has two health extension workers and a total of 39,878 health extension workers were trained and deployed nationally [35]. The expansion is envisaged as the key strategy to deliver maternal, neonatal and child health interventions especially to the rural and impoverished segments of the population. According to the 5th National Health Accounts in Ethiopia, 34% of the total health expenditure was household out-of-pocket spending [36].

Moreover, with geographical and socio-demographic variations about 70% of women stated health care access problems in 2016 a significant reduction from 96% in 2005 [8, 10]. Ethiopia has adopted several of the World Health Organization recommendations in order to improving maternal health outcome [37]. Various studies have repeatedly stressed the need for ANC and availability of and access to SBAs for women during labour and delivery [38 - 39]. Because of this, Ethiopia has given special consideration to access to ANC and SBAs the last two decades [11]. Strategic multifaceted interventions including health facility expansion, providing maternal services free of charge, increasing health insurance enrollment, implementation of the health extension programs, women education and empowerment are some of the contributing factors for the reduction of health care access challenges among women [40 -42].

In Ethiopia, the government facilities structure consists of a primary district hospital (serving 60,000 – 100,000 people), health centers (1 per 15,000 – 25,000 people) and Health Posts staffed by health extension workers (1 per 3000 – 5000 people). This is supplemented by non-government organizations and profit-based facilities [11]. The 2015-16 Health Sector Transformation Plan, highlight maternal and newborn health as priorities for the Government of Ethiopia, which was the first phase (2015 – 2020) of a 20-year

plan, and also is part of the second growth and transformation plan II. The key components are delivery at a health facility, with skilled medical attention and hygienic conditions; reduction in complications and infections during labour and delivery; timely postnatal care that treats complications from delivery; and education of the mother on care for herself and her infant.

2.2 Utilization of Maternal Health Care

Utilization of maternal healthcare defined as attendance of ANC, delivery by SBA and postnatal care are critical in reducing pregnancy-related morbidities, decreasing maternal mortality and improving birth outcomes [43]. Maternal health care utilization is not simply a matter of access, choice, or needs; rather, it can be shaped by individual and cultural-level expectations, constraints, and contexts [44 -47]. The utilization of maternal health care can be driven by multilevel factors, such as those operating at the individual, community and policy levels [48 -51].

Previous empirical studies have found that the use of maternal health services is related to demographic, cultural, and socio-economic factors, such as age of women, birth order, size of household, education, ethnicity, place of residence, religious background, marital status, employment, income level and accessibility. According to a systematic review of 28 studies [52] and other SSA study [25], the most commonly identified factors affecting antenatal care uptake are: maternal education, husband's education, marital status, availability, cost, household income, women's employment, media exposure and having a history of obstetric complications. Cultural beliefs and ideas about pregnancy also had an influence on antenatal care use. Parity had a statistically significant negative effect on adequate attendance. Whilst women of higher parity tend to use antenatal care less, there is interaction with women's age and religion. Only one study examined the effect of the quality of antenatal services on utilization. None identified an association between the utilization of such services and satisfaction with them. This large systematic review has shown that determinants of ANC utilization are complex and multifactorial. They vary not only by region of the world but also by and within religions, ethnicities, and social circles. Studies in Nigeria have revealed that the perceived quality of care, religion, ethnicity, income-yielding occupations and saturation of mass media were also significantly related to the use of antenatal care [53 – 55].

Maternal health care utilization is not only related to individual choice or characteristics but also to a large extent depends on the socio-cultural arrangements of communities [56]. Cultural norms within the community or district, for example, can hinder a woman from seeking or receiving health care. These

cultural norms can either facilitate or impede the process of seeking care [47 – 49]. Understanding the role of community factors in studies of maternal health care service utilization is important because decisions to seek health care can be related to the characteristics of the community in which a woman lives [57]. Moreover, social ecological perspectives emphasized the contribution of multiple relations of physical socio-cultural and environmental conditions to health behavior [58].

It is reasonable to assume that utilization of maternal health services depends also on factors operating at the policy level. The review of existing literature however shows that very few studies have gone beyond individual, including household, and community factors to consider factors at higher levels. The implication of this omission could be that some determinants are inadvertently missed, leaving a serious research and programmatic lacuna. Secondly, failure to consider the role of factors operating beyond the first two levels in service utilization may result in serious bias in the estimates. Individuals are nested within families, which are in turn nested within communities which are in turn influenced by policies and other factors. Methodologically, it is important to take this nested structure into account. This demands the use of multilevel modelling, which would calculate the standard errors more accurately and reduce the chance of misestimating the significance of variables, as some of the assumptions inherent in traditional regression methods are not valid for nested data [59]. Therefore, identifying the specific social determinants of maternal health and understanding these complex inter-relations of maternal health service utilization require targeting of these underlying individual/household, community and health facility level factors in order to know their relative roles.

2.2.1 Utilization of Maternal Health Care in SSA

More than half of all births in SSA still take place without the assistance of skilled birth attendance [60 - 62]. The situation is worse in the Eastern Africa region (where Ethiopia lies) with only 34% of births assisted by SBAs compared to 41% in Western Africa. Likewise, 74% of received ANC in Eastern Africa compared to 98% in Western Africa, while 34% received PNC in Eastern vs. 88% in Western Africa [60, 63].

While seeking to understand the barriers to health care services utilization by SSA women, many studies have focused on individual, household, community, and health system-level barriers [64 -67]. The supply side factors include lack of accessibility, availability, quality, continuity, and comprehensiveness of health services [68 -69]. The demand-side factors are mainly social, economic, or cultural. Among various socioeconomic factors, maternal education level and economic status-measured as a composite wealth

index- are considered as most important determinants of utilization of health services [70 - 71]. Although there are several supply and demand-side initiatives provide by the government and non-governmental organizations and donors, utilization of maternal care services remains well below the desired level.

2.2.2 Utilization of Maternal Health Care in Ethiopian context

Ethiopia endorsed the Sustainable Development Goals with a spotlight on the unfinished agenda of ending preventable maternal, newborn and child deaths [72]. This is however, compounded by a very unequal geographical distribution of health services [73]. The health care system in Ethiopia is among the least developed in SSA, and is not, at present, able to effectively cope with the significant health problems the country is facing.

2.2.2.1 Ethiopian Strategies to improve Maternal Health Care Service Utilization

In Ethiopia, key factors affecting utilization of maternal healthcare services are, maternal age, education status (both women and husband), household wealth status, access to media, order of the last birth, women's decision making autonomy, place of residence, and distance or lack of transportation [74 - 76]. Over the years the Ethiopian Government has taken steps to resolve some of the barriers women face related to maternal healthcare services. These initiatives include a rapid expansion of availability of health services, routine evaluation using a scorecard to determine the effectiveness, increased education and training of midwives, physicians, public health officers and nurses, deployment of health extension workers in the community, as well as inclusion of ANC, delivery and postnatal care on the list of free services.

Furthermore, emphasized interventions include an accelerated training of midwives, and improving the capacity of health extension workers. The accelerated training of midwives comprised of two parts: Many who join regional health science colleges for three-year midwifery diploma training, and others who join universities for a four-year midwifery education. In addition, recognizing the skill gap of the health extension workers for antenatal care, the Ministry of Health began to upgrade health extension workers to diploma level, with additional one-year training in midwifery, which started in 2011. To respond to human resource shortages, two new programmes have been started: 1) Specialty training in emergency surgery including cesarean section for non-physician clinicians who are health professionals with a bachelor's degree before joining the programme for three years 2) Increased number of four-year accelerated training of health professionals with bachelor's degree as medical doctors. In addition, there is an increased

specialization of medical doctors. This will require a great commitment from the government and its partners with community effort.

Antenatal Care

Antenatal care (ANC) is according to WHO one of the four pillars of safe motherhood and is usually the first entry point of contact with the formal healthcare system [37]. One objective of ANC is to educate and inform women about where to give birth and signs and symptoms of obstetric complications. Antenatal care can help reduce the numbers and severity of pregnancy-related complications by careful monitoring and early treatment of diseases aggravated during pregnancy, e.g. malaria and anemia.

The scientific and medical discourse about the core purpose and effectiveness engendered the streamlining of ANC into a new goal-oriented model off four-focused visits (focused antenatal care) [77]. The Focus ANC model has now been superseded by the 2016 WHO model; where a minimum of eight ANC contacts is recommended. The term 'visit' in the previous model has now changed to 'contact' to indicate an active interaction between the pregnant woman and her health-care provider [78]. This new ANC models with a minimum of eight contacts recommendation are not yet full practiced in Ethiopia.

In Ethiopia, the rates of women using ANC at least once increased from 27% to 74% from 2000 to 2019 (figure 4), [7 -10, 14]. In the same period, receiving four or more ANC visits increased from 10% to 43%.
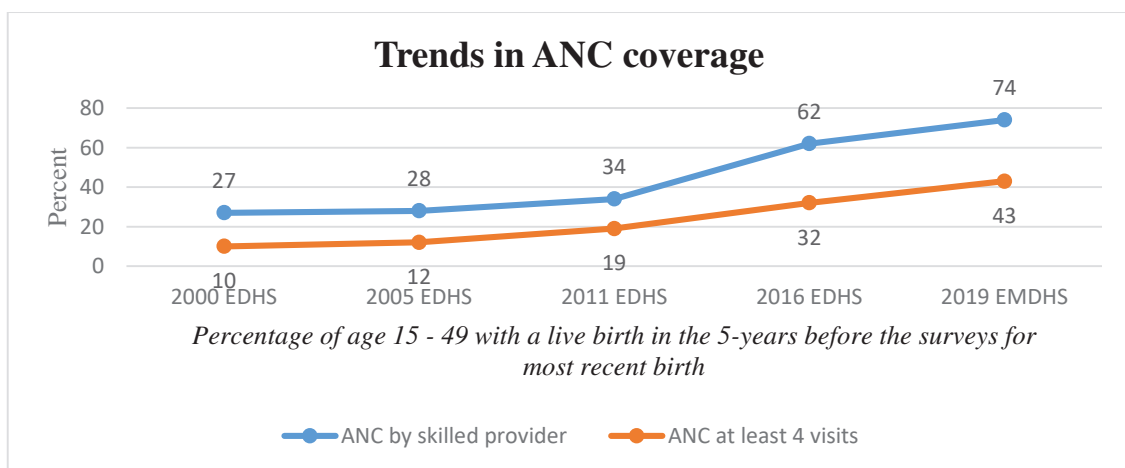
Figure 4. Trends in antenatal care coverage. Source: Constructed using results from EDHS 2000, 2005, 2011, 2016 and 2019.

Skilled Birth Attendance

Even with the best possible antenatal screening, any delivery can become a complicated one requiring emergency intervention. Therefore, SBA is essential and the single most critical intervention for ensuring safe motherhood. SBA hastens the timely delivery of emergency obstetric when life-threatening complications arise [79]. SBA denotes the presence of midwives and others with midwifery skills who are trained to recognize problems early, when the situation can still be controlled, to intervene and manage the complication, or to stabilize the condition and refer the patient to a higher level of care [80]. A Study in Ethiopia indicated that midwife-led continuity of care increased women's satisfaction with maternity care for women at low risk of medical complications [81]. Lastly, it requires an effective referral system that facilitates the desired efficient movement from delivery care for normal labor at the primary level of care to basic and comprehensive emergency obstetric care for women with obstetric complications at the secondary and tertiary levels of care [82].

Emergency obstetric care includes the administration of parenteral antibiotics, oxytocic drugs and anticonvulsants, as well as manual removal of placenta, removal of retained products, assisted vaginal delivery, ability to perform surgery (cesarean sections) and provide blood transfusions [83]. Such facilities provide vitally needed backup for skilled attendants working at the most peripheral level of the health care system in resource-poor settings [84 - 85]. Increasing institutional deliveries is important for reducing maternal and neonatal mortality. However, access to health facilities in rural areas is more difficult than in urban areas because of distance, inaccessibility, and the lack of appropriate facilities. Although institutional delivery has been promoted in Ethiopia, home delivery is still common primarily in hard-to-reach areas. Forty-eight percent of live births in the 5 years before the survey were delivered in a health facility, (Figure 5).

Percent of livr births in the 5-year period before the survey
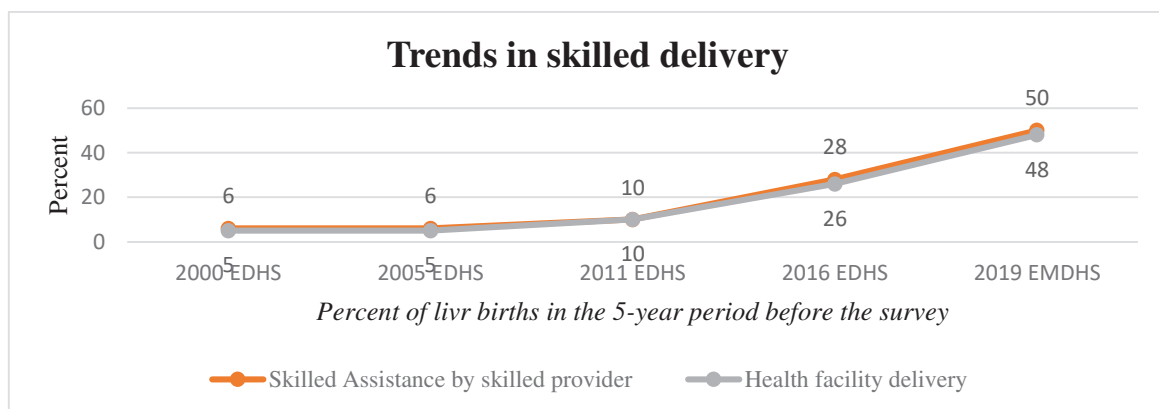
Figure 5. Trends in delivery care coverage.   Source: Constructed using results from EDHS 2000, 2005, 2011, 2016 and 2019.

Studies conducted in different parts of Ethiopia revealed different determinants on place of delivery. Some of these factors are similar for different study areas while some of them are specific for specific study areas. Among the identified factors are: lack of access to health facility, education status of the expectant women, place of residence, parity, birth order, counselling service obtained during ANC visit, maternal age, absence of previous obstetric complications, number of ANC visits, health care providers' behaviour, quality of ANC service, decision maker on place of deliver and cultural barriers [86- 90].

2.3 Social Determinants of Health

Determinants are any factor, whether event, characteristic, or other definable entity, that brings about a change in a health condition or other defined characteristic; they influence the occurrence of disease and other health-related events [91]. More specifically, the concept of social determinants of health focuses on social factors that shape people's health. Health is an outcome of a web of social influences. This web can be seen to constitute "the social determinants of health". Simply put, social determinants of health (SDH) are the "causes behind the causes" [92]. The upstream social and economic factors that largely but insidiously dictate the health - *and disease* - of individuals and populations. They are critical to explaining the distribution of illness, i.e. why some people are healthy and others are not due to the unfair and avoidable differences in health status seen within and between populations. They also explain why the consequences of illness or disability have a more serious impact on the lives of the vulnerable than those of the wealthy [93]. The notion recognizes that the conditions in which we live, work, learn and play all heavily influence the health we can achieve.

The WHO stated that "the enjoyment of the highest attainable standard of health is one of the fundamental rights of every human being without distinction of race, religion, political belief, economic or social condition". To attain this aim, the WHO promotes to work on the social determinants of health to minimize inequities and injustice due to the social backgrounds of individuals. The WHO further explains that these social and economic conditions, and their effects on people's lives, determine our risk of illness; the actions we can take to prevent ourselves becoming ill; and our ability to treat illness when it occurs. One should think of social determinants as the root-causes of health and disease. Social determinants of health include income and social status; social support networks; education; employment/working conditions; social

environments; physical environments; personal health practices and coping skills; healthy child development; gender; and culture [94].

2.3.1 Theoretical/Conceptual framework
Conceptual framework on Social Determinants of Health (CSDH)

The WHO's commission on Social Determinants of Health developed a framework that provides not only an overview of major categories of determinants, but also pictures how these categories could interconnect (Figure. 6) [95]. The commission firmly views health and disease as products of social processes and defines the risk and the impact of ill health as the outcomes of inequalities in the distribution of SDH within or across populations underlying social determinants are a major cause for inequities in health.
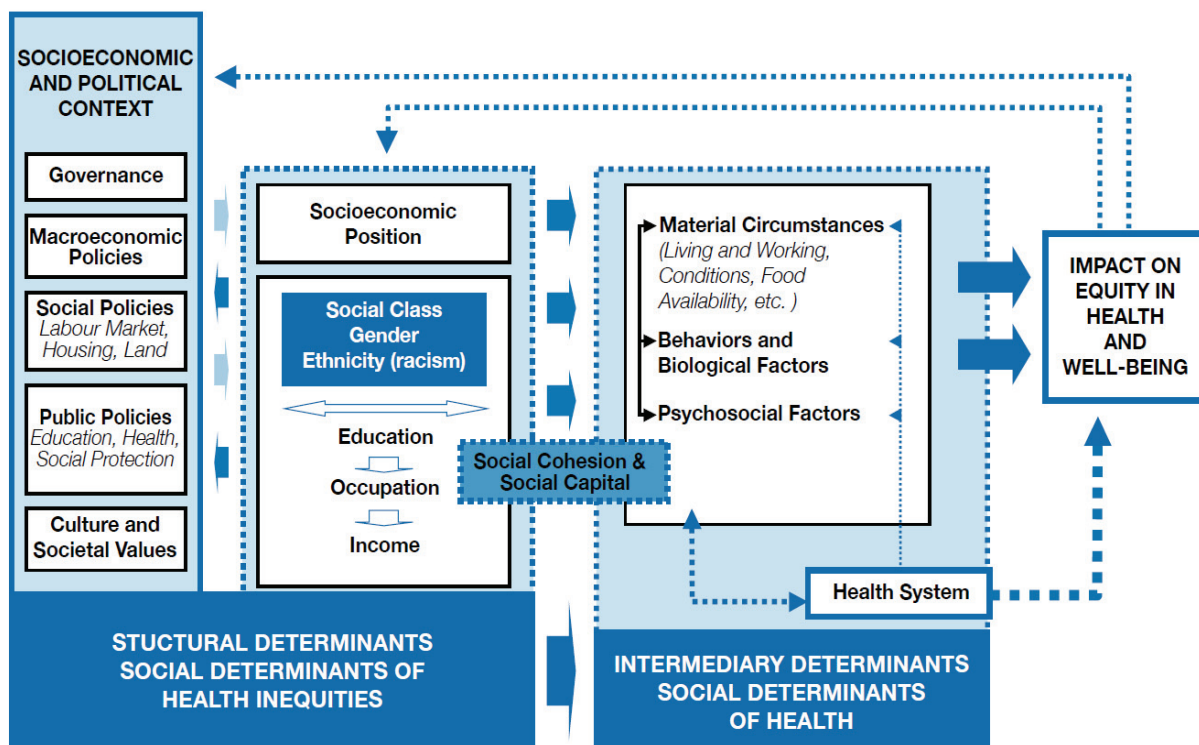
Fig. 6. Conceptual framework of SDH taken from WHO.

Source: [95]. Granted permission for copyrighted figure from WHO attached in the appendix 4.

This framework distinguishes 'structural determinants' all social and political mechanisms (governance, macro-economic policy, social policy, public policy as well as social and cultural values) which generate, configure and maintain socioeconomic position (social class, gender or ethnicity); from the 'intermediary

determinants', not only working and living conditions, but also behavioural, psychosocial and biological factors and the health care system. Interactions identified between structural and intermediary SDH determine differentiations (inequities) in health and well-being. Through depicting the many potential impacts on health by social determinants of health, the framework serves as a starting point and guide for policy, strategy and action. Therefore, the choice of SDH as a theoretical base for this study allows us to consider socio-economic and political context that determine maternal healthcare services utilization.

Social determinants of health, has been studied in high income countries [96], but in contrast, it has not been a popular theme in the health agenda of low and middle income countries. Hence, understanding the social determinants on maternal health care in Ethiopia context will be helpful for identifying which segment of the population needs to be addressed with interventions to improve maternal health outcomes in the country.

2.3.2 Social determinants of maternal health

Studies on strategies aimed at improving maternal health should not be limited to medical aspects; it is also important to consider the contribution of social determinants influencing health outcomes at the individual, community and health system level and their potential effect on the continuum of care when improving maternal health [97 - 99]. Social factors are significant when they have a direct bearing on the woman's health as well as on the health of the fetus. As mentioned earlier, the actions we take to prevent ourselves from becoming ill are influenced by social determinants of health. The same is true for a pregnant woman who wants to make sure that she and her unborn child are healthy during the course of the pregnancy, childbirth, and beyond. Whether she attends antenatal care and/or delivers at a health facility or not is dependent on a host of determinants at the individual and community level, and within a socioeconomic and political context (as depicted earlier in the SDH framework).

Maternal health outcome is impacted by various social determinants of health that include: poverty, education, employment, health status and gender inequality [56, 100 - 101]. The link between poverty and maternal health is well established as the poor and disadvantaged are more likely to die when compared to the affluent [102 - 104]. Education is linked to improved health outcomes through its association with employment, income and living conditions. Educated women seek antenatal care; skilled birth attendant, have income through employment; have better nutritional status; are able to identify danger signs during pregnancy; bear fewer children with larger gaps between children; and are more likely to marry later [105-107]. Women in developing countries are more likely than men to be employed in insecure low paying

jobs, which in turn are significantly associated with low use of antenatal care and skilled birth attendance [108]. Health status of a woman prior to and during pregnancy influences her chances of developing a pregnancy related complication and her ability to survive the complication [109]. Pre-existing health conditions such as malaria, hepatitis, anaemia, tuberculosis, malnutrition and HIV/AIDS contribute maternal deaths, however information on the specific contributions is limited [110]. Addressing the gender inequities that shape maternal health critical to achieving equitable health outcomes [111].

In addition, some social determinants such as insurance status [112], availability of social-support in the form of childcare [113], adequate housing [114], good neighbourhood [115], and transportation access [71], play some role in ANC service and SBA utilization. However, little is known regarding the specific impacts of these social determinants on maternal health outcomes. Based on the literature, and informed by existing models, we propose a pathway by which social determinants interact with skilled maternal health service utilization to impact maternal health outcomes such as maternal morbidity, and pregnancy-related death, as shown in the Figure 7.
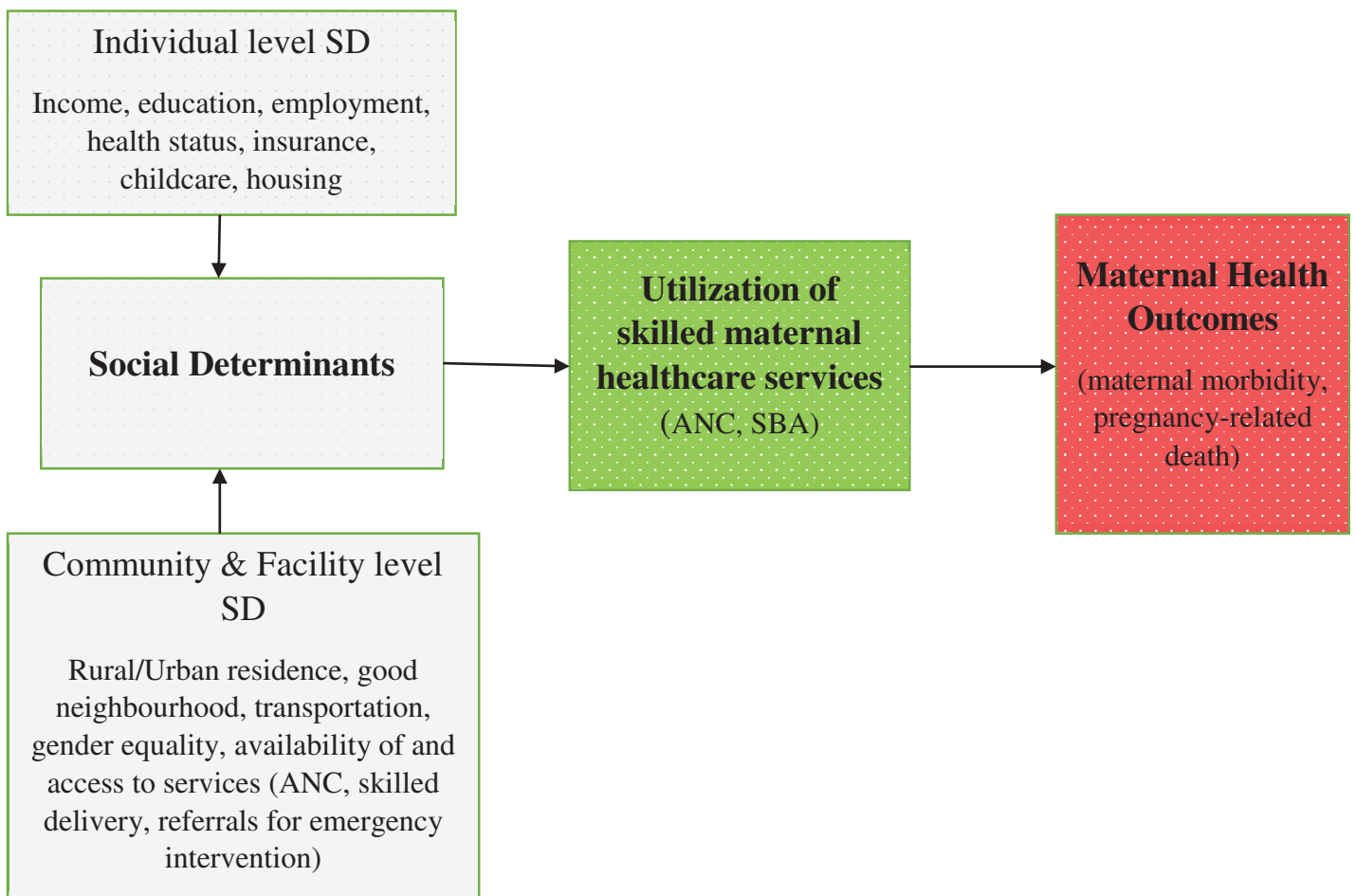
Figure 7. The relationship between individual and community level social determinants of health, and maternal health outcomes.

2.4 Social Ecological Model

Socio-ecological frameworks have been widely adapted with the recognition that no single factor can explain or predict a particular phenomenon [116]. The model was adapted to explain factors constraining utilization of maternal health care service by women in the reproductive age [117]. The model recognizes multiple interacting layers of environmental, social and communal factors that influence human behaviour. At the core of the model is the individual whose behaviour is influenced by personal knowledge, beliefs and attitudes. The second layer of the framework signifies interpersonal factors such as formal and informal social networks and social support systems including family support and relationship with health workers. The next shows community-level factors such as relationships between organizations, institutions and resources that embody likely sources of communication and support. The fourth layer represents organizational systems, institutional/health systems, characterises and norms, and rules and regulations that constrain individual behaviour, while the outermost layer signifies, local, state and national policies, strategies and guidelines [116]. The use of this model in this thesis adequately facilitated the exploration of pregnant mother's experiences, the influences of their families, institutional/health system, community and policy level contexts that all work on different levels to influence maternal healthcare seeking behaviours (Fig 8).

Interpersonal/network
- Family size
- Marrital relationship
- Family decision making

Individual
- Age
- Parity
- Education
- Occupation
- Household wealth
- Media exposure
- Religion

Policy/national

Government Health finance & infrastructure, national health policy, laws (gender equality, anti-violence), reproductive health & rights.

Institutional/health system

Availability of relevant services (ANC, SBA, referrals & emergency interventions), staff skills & technical competence, acceptability to the community, fees & related costs.

Community

Rural/urban residence, Geographical region, social position (ethnicity), distance to facilities, community based financing or health insurance, community traditions related to care of pregnancy & childbirth (preference to home birth & TBAs).

Diagram circles (outer to inner): Policy level, Institutional/health system, Community, Interpersonal/network, Individual

Fig 8. Socio-ecological model influencing utilization of maternal health care services

Sources: the model is based on the information obtained in literatures [48, 56, 58, 116-117]

The complexity of maternal healthcare service utilization in an Ethiopian setting warrants several studies and approaches. The mapping of the interaction between the various levels on utilization is core. Furthermore, as women are exposed to harmful experiences in their relationships the impact of intimate partner violence on health care utilization during pregnancy is important to access.

2.5 Association between IPV and Utilization of maternal healthcare services

Intimate partner violence (IPV) refers to behaviour by an intimate partner or ex-partner that causes physical, sexual or psychological harm, including physical aggression, sexual coercion, psychological abuse and controlling behaviours [118] is considered to be one of the main risk factors that might influence use of maternal health services [119]. A recent study by the WHO showed that globally 1 in 3 (30%) women experience physical and/or sexual violence in their lifetime, mostly by an intimate partner [120].

Within and outside of SSA increasing evidence has shown a linkage between IPV and various maternal health outcomes such as ANC [121], facility delivery [122], postnatal health care services [123], and other studies have looked at the relationship between IPV and maternal and child health care services [124]. Therefore, it is important to continue to investigate factors that can affect utilization, particularly in regions with high incidents of IPV and low utilization of maternal health service. Understanding the relationship between IPV and maternal health care service utilization, including the influence of various factors within the ecological model that are organized according to the individual, interpersonal, community and societal levels of the ecological model shown in Figure 8, is critical to mitigating the impacts of IPV and to optimizing maternal healthcare utilization in Ethiopia.

A substantial body of research also has documented the magnitude and forms of violence across a range of settings, in low, middle, and high-income countries [125 -126]. The fundamental link between violence and the continued subordinate status of women in society is also well recognized [127]. The findings send a powerful message that IPV is not a small problem that only occurs in some pocket of society, but rather is a global public health problem of epidemic proportions, requiring urgent action. There has been a rapid growth in the body of research evidence available on IPV and its health effects. This is, in part, a result of a growing consensus on how best to measure women's exposure to IPV through household survey like the Demographic and Health Surveys, while taking precautions to put women's safety first and to ensure that respondents requesting assistance can be referred to services if needed [128].

2.5.1 Violence Against Women in Ethiopia

Freedom from domestic abuse is basic to women's empowerment. In Ethiopia, violence against women and girls continues to be a major challenge and a threat to women's empowerment. Women and girls face physical, emotional and sexual abuses that undermine their health and ability to earn a living; disrupt their social systems and relationships; and rob them of their childhood and education.

Ethiopia has put in place appropriate and effective legal and policy provisions to promote the rights of women and girls. These rights are enshrined in the constitution. Ethiopia has also ratified many of the international and continental agreements that promote and protect women's rights, including the Convention on the Elimination of Discrimination against Women in 1979, and the Protocol to the African Charter on the Rights of Women in Africa. In addition, Ethiopia has established specific legal measures and actions to address violence, including the National policy on Ethiopian Women (1993), the 1995 FDRE constitution, the Revised Family law in 2000, and the Revised Criminal code in 2005, which criminalizing acts of Gender Based Violence, and the revised Federal Civil Servants Proclamation (2007) which supports the creation of violence-free working environment.

The government has also put in place the requisite institutional mechanisms at federal and regional levels, including the establishment of (1) The Ministry of Women, Children and Youth Affairs Offices, (2) Child and Women Protection Units within the various police units, and (3) a special Bench for violence against women cases within the federal criminal court. Currently this ministry established special anti-violence police task force that monitors violence against women and children. In addition to legal penalties, sex offenders will start being registered on national sex offender registry which creates an environment where the perpetrators are restricted from accessing social services so that they learn how the act is shameful and ugly and that the country will not tolerate [129]. Moreover, Ethiopian Ministry of Health has developed a standard operating procedure for the response and prevention of sexual violence in Ethiopia in 2016 [130]. Taking into account these initiatives, the 2016 Ethiopian Demographic and Health Surveys (EDHS) was tasked with providing up-to-date, reliable and concrete data on violence against women. This data should allow targeting in a specific, measurable way and enable informed intervention programs.

2.6 Positive Deviance Approach

Positive Deviance (PD) is a concept based on the observation that in every community or organization, there are a few individual's or small groups whose uncommon behaviours and strategies enable them to find better solutions to problems than their peers, despite having access to the same resources and facing similar or worse challenges [131]. The PD approach seeks out "positive deviants" in the community and uses their solutions to bring about sustainable behavioural and social change [132]. The concept of PD entered the public health field in the 1970's in the area of child nutrition. Wishik and Van Der Vynckt [133] were among the first researchers to suggest that the PD approach could be used to find solutions to childhood malnutrition by identifying mothers whose children were well nourished, despite living in

poverty. Vietnam, Bangladesh, and Haiti were the first countries where the positive deviance approach was used to develop interventions aimed at malnourished children, and with success. The approach has been used in developed countries, but to a lesser extent than in developing countries.

Since then, the PD approach has been studied in a range of different contexts and including both qualitatively and quantitatively, such as smoking cessation [134], nurse-patient communication [135], methods Methicillin-resistant Staphylococcus Aureus (MRSA) prevention [136 - 137], hospital management [138] and to develop nurses' leadership skill in school community [139]. While some studies have used positive deviance to study nutrition related behaviours such as diabetes care [140], and weight control [141]. Others study including to curb girls' trafficking [142], anemia control program [143], to assess population health outcomes [144], in acute myocardial infarction (AMI) patients [145], and to practice safer sex in young adults in the context of HIV/AIDS [146] also have been documented. Research adopting a PD strategy when exploring factors influencing the use of maternal health services, is however still in its infancy [147 - 149], as existing literature in general focuses on all women in the reproductive age [150 -155].

In Ethiopia the PD approach has been used to study childhood malnutrition and the impact of health systems strengthening in primary health care units [156– 157]. To the best of our knowledge, we have not come across any published literature on the PD approach related to uptake of maternal healthcare utilization in Ethiopia. Hence, identifying Ethiopian mothers with positive health behaviours despite an adverse risk profile and exploring their characteristics could help policy implementation, enable program managers to optimize public health initiative's performance, and ultimately improve population health.

Chapter II: The rationale of the current study

Maternal health care service utilization is important for the improvement of both maternal and child health. Addressing health system factors and socioeconomic barriers is imperative for increasing women's overall utilization of health services. This thesis aims to study the effect of various social determinants and intimate partner violence on women's utilization of maternal health services. It also explores the characteristics of women identified a positive deviant in relation to the uptake of skilled maternal healthcare services.

As we in Ethiopia have four consecutive demographic and health surveys, we have an opportunity to explore change over time and potential associations of why, despite many interventions and on some

improvement in reduction of maternal mortality, the country are not in line to meet its maternal health outcomes targets. For renewed commitment by the Ministry of Health and the government to improve access to maternal and child health services, it is important to have adequate research results. Ethiopia is ethnically and socially diverse, and there are variations in health outcomes across the different communities in the country.

This might identify individual and community level factors that can be targeted in interventions to improve maternal health. Available studies in Ethiopia have not sufficiently explored the impact of local social determinants, neither the protective nor the risk factors to pregnant women. Understanding these aspects of maternal health care is helpful to narrow the gap between different social classes. Therefore, we aim to use data from the Ethiopian Demographic and Health Surveys to fill gaps of knowledge related to utilization of ANC and SBA employing multilevel-multivariate analysis.

Research Questions and Objectives

Major Research question

How do the social determinants of health impact maternal healthcare utilization in Ethiopia?

Specific research questions

1. What are the social determinants of health affecting the use of maternal healthcare services and do change over time?
2. Does intimate partner violence exposure impact utilization of maternal healthcare services?
3. What characterized women with positive deviant behaviours for the uptake of maternal healthcare services?

Objectives

General Objective

To increase knowledge of Ethiopian women's utilization of maternal healthcare services, the risk and protective social determinants of health factors, identify any change over time facilitating evidence based interventions aimed at reduction of maternal mortality in Ethiopia.

Specific Objectives

In this thesis, the research results are presented as three specific studies:

1. To explore the social determinants of health that influence the antenatal care utilization (**Paper I**)
2. To explore the association between Intimate Partner Violence and maternal healthcare services and to assess if women's educational attainment and wealth status moderate this association **(Paper II)**
3. To identify positive deviant mothers for the uptake of skilled maternal services and to explore their characteristics **(Paper III)**

Chapter III: Methods and Materials

3.1 Country profile

Ethiopia is an ancient country, Paleontological studies identify as one of the cradles of mankind with the ancient civilizations situated in the horn of Africa, and is the oldest independent country in Africa having great geographic diversity with a projected population size of 105 million in 2022 [158], which is the second largest population, after Nigeria. Ethiopia is a large landlocked country and it shares borders with Sudan, South-Sudan, Kenya, Somalia, Djibouti, and Eritrea in East Africa, (Figure 9). It encompasses about 1.1 million Km^2 area of land and the terrain is geographically diverse, ranging from mountainous highlands (from high peaks of 4,550m above sea level to a low depression of 110m below the sea level) to tropical forests.

It is a mainly rural country with only 20% of the population living in urban areas. Christianity and Islam are the main religions, and there are more than 80 ethnic groups and 90 languages. Economically, more than 70% of Ethiopia's population is still employed in the agricultural sector, but services have surpassed agriculture as the principal source of GDP. Currently, there are pushes for diversifying the economy into manufacturing, textiles, and hydropower energy [159]. In recent years, the country has achieved a fast economic growth. However, according to the 2020 reports of the Human Development Index (HDI) [160] and the 2021 Multi-Dimensional Poverty Index (MPI) [161], Ethiopia remains among the poorest countries in the world even after substantial improvements in all MPI indicators between 2011 and 2016.
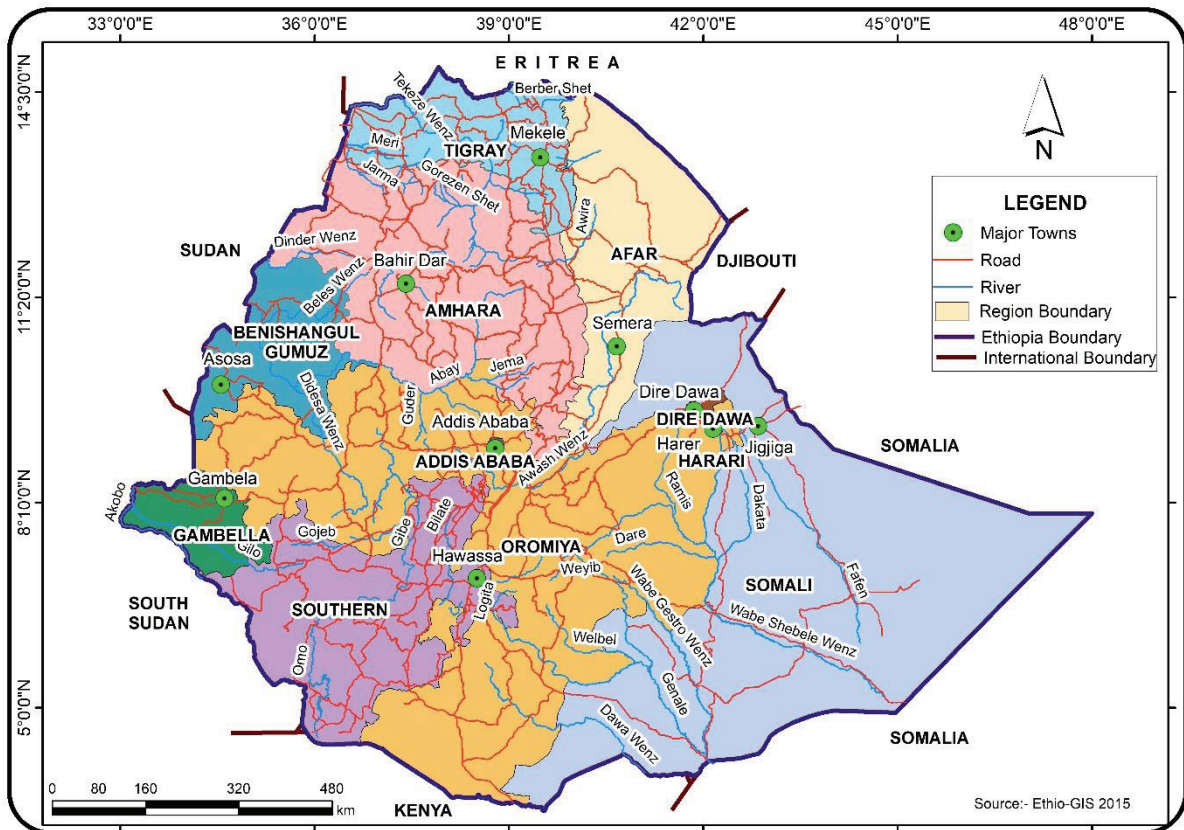
Figure 9. Map of Ethiopia showing regional states, city administration and neighbouring countries.
Produced by: Bamlak Amente – GIS expert at Addis Ababa University, Ethiopia.

The population of Ethiopia has increased steadily over the last three decades and it is estimated that by 2050, the population will double into 208 million [162]. Ethiopia is also going through a demographic transition from high fertility, high mortality to a low fertility and mortality scenario. Though the country has entered the transition phase, all the regions are not the same transition phase. This would imply that the future changes in fertility would also not be uniform across the regions. The pyramidal age structure of the population has remained predominantly young. While the male-female sex ratio is almost equal, women in the reproductive age (15-49 years) make up 24% of the total population [158]. Overall, 41% of currently married women are using modern method of family planning and 1% are using traditional methods [14].

3.2 Data sources and Data Collection Procedure

The three studies in this thesis are based on data from Ethiopian Demographic and Health Surveys of 2005, 2011, and 2016, particularly data on individual women. The EDHS is representative nationally, regionally,

and by urban – rural residence. The recoded data were accessed at www.dhsprogram.com [163] and Central Statistical Agency (CSA) after the acceptance of the research proposal submitted by the author. These surveys were conducted by the Ethiopian Central Statistical Agency, in collaboration with the Federal Ministry of Health and Ethiopian Public Health Institute with technical assistance from Inner City Fund international, USA. The Demographic and Health Surveys Program is one of the principal sources of international data on fertility, family planning, maternal and child health, nutrition, mortality, environmental health, HIV/AIDS, malaria, and provision of health services that are implemented in most developing countries including Ethiopia [164]. The target group for the surveys are women in the reproductive ages (15 – 49 years) and the members of their households.

3.3 Study Population: The study subjects were women in reproductive age between 15 to 49 years who had at least a live birth in the last five years preceding the actual surveys, and who participated in one of the three surveys from all regions of the country.

3.4 Study Design: A retrospective quantitative cross-sectional study design has been used. These community–based surveys encompassed all administrative regions of Ethiopia, and included both urban and rural areas.

3.5 Sample size of the Surveys

The EDHS sample design considers different parameters for the indicators to estimate the final sample size. Accordingly, 14,070 in 2005, 16,515 in 2011 and 15,683 during 2016 women were interviewed and presumed to represent the Ethiopian population with respect to the selected indicators for the three study periods with a response rates ranged from 95% in 2016 to 96% in 2005. However, for Study I we covered a representative sample of 22, 799 (from the three surveys) and study II based on the 2016 data included 2836 who participated in the domestic violence sub-study. While study III used the 2011 and 2016 with 15, 492 women.

3.6 Sampling procedure

Administratively, regions in Ethiopia are divided into zones, and zones, into administrative units called Woredas. Each Woredas is further subdivided into administrative units called Kebele. During the 2007 population and housing census each Kebele was also subdivided into census enumeration areas, which were convenient for the implementation of the census. Enumeration area is a geographic area covering on average 181 households. As mentioned above we used recoded data from EDHS, particularly data on individual women. The EDHS used a stratified two-stage cluster sampling design with rural-urban and regions as strata to identify the representative samples. Enumeration areas were the sampling units for the

first stage. A sample of 540 from the 1994 Population and Housing Census in 2005 EDHS, 624 from the 2007 Population and Housing Census in 2011 and 645 in 2016 EDHS; clusters or enumeration areas were drawn by the Ethiopian CSA from its master sampling frame of the census, using probability to proportional size method. Households comprised the second stage of sampling. Then, a fixed number of households were selected from each cluster. Accordingly, 13,721 in 2005, 16,702 in 2011, and 16,650 in 2016 were systematically selected using systematic random selection, respectively (Figure in the data extraction procedure at appendix 5). All women of reproductive age (15 – 49) whose last birth was within five years preceding the survey and who were either usual members of the selected households or who slept in the household the night before the survey were eligible for interview. This sampling design enables the data to represent Ethiopia as a whole, for urban and rural areas separately, and for each of the eleven regions as a result the study can be generalized to the Ethiopian population.

3.7 Data Collection Procedure

A structured and pre-tested questionnaire was used as a tool for data collection. The questionnaire was developed in English and then translated into three different local languages (Oromiffa, Amharic, and Tigrigna). The questionnaire was developed based on standard DHS survey questionnaires. Structured interview schedules were performed by trained interviewers. In order to maintain the quality of data to be collected, interviewers were trained, a pretest was performed before the actual data collection, frequent supervision was performed during data collection and interviews were performed using local languages. For all surveys separate structured questionnaires were administered: for the household, women, and men. The main focus is a number of specific questions asked women about their most recent pregnancy and live birth in the five years preceding the survey. Women were asked 1) whether they were checked by a trained health professional (doctors, midwife/nurses) at least once during pregnancy, i.e. antenatal care (ANC); and 2) whether they were attended by a health professional during their delivery. The surveys were conducted all the nine regions and two City Administrative Councils of Ethiopia.

Methods of data collection for the EDHS involves a stratified two-stage cluster sampling techniques. The first stage involves selection of clusters (urban and rural clusters) otherwise known as the primary sampling units. In the second stage, lists of households are selected from each cluster. Information is then collected using face-to-face interview in selected households including all women age 15 – 49 and in close confidentiality. The survey is usually conducted at five-year intervals in a country. Ethiopia so far has

undertaken four consecutive DHS surveys and a more detailed description of the methodology has been provided elsewhere [7 -10, 165 - 166].

Studies I, II and III

The data for studies I, II and III were derived from the 2005, 2011, and 2016 EDHS. A pooled database file system was constructed for analysis using these dataset, which employed standard DHS questionnaire and techniques for data collection [166]. Eligible participants were interviewed with the Women's Questionnaire ages 15 to 49 who were present in a selected household the night before the interview, whether or not they were usual residents in the household. The Women's Questionnaire was used to collect information on the following topics: respondent's background characteristics; marriage and sexual activity; reproductive history; family planning use; maternal and child health; infant, child and neonatal mortality levels; child nutrition, breastfeeding practices, and other health issues relevant to the achievement of the Sustainable Development Goals. Study I analysed the SDH that influence the ANC utilization which included 7306 women in 2005; 7908 in 2011; and data from 7585 women in 2016. Study II analysed the association between intimate partner violence and utilization of maternal health care which covers 2836 women using the 2016 dataset with similar eligibility criteria and study III analysed positive deviant mothers for the uptake of skilled maternal services that included 7584 women in 2016 and 7908 in 2011.

3.8 Variable Description and Measures

Outcome Measurements

Two indicators of the use of maternal health services were used in this analysis: use of antenatal care during pregnancy and health institutional deliveries conducted by trained health professional. As part of maternal health care services, ANC provided by a doctor, nurses/midwives, health officers, and health extension workers comprises of a thorough physical examination, blood tests for infection screening and anaemia, a urine test, tetanus toxoid injections, iron and folate supplements, and deworming medications. This was based on women's responses to two questions regarding their last birth: "Did you see anyone for antenatal care for this pregnancy?" and "Who did you see?". In these study, delivery in the health facility includes public, private, and NGOs health facilities. To examine delivery by an SBA, information on the

delivery of women who reported that this birth was attended by health professionals, based on women's response to the question: "Where did you give birth to (NAME)?".

Study I

The analysis in this paper were assessed in terms of: (1) The total number of ANC visits each participant had in the index pregnancy; and (2) whether women had had four or more visits during the course of the pregnancy or not.

Study II and III

The analysis of these papers addressed two maternity healthcare binary outcomes: (1) antenatal care (ANC) use, categorized into four or more visits and less than four visits; and (2) place of delivery, either home or birth at a health facility. For women with multiple birth experiences, the index birth experiences was analyzed in the study. The following subparagraph describe the independent variables used in this thesis:

Independent variables

The following subparagraph describe the potential individual and community-level independent variables used in the thesis that influence women's decision on the use of ANC visits and health institution delivery based on the information obtained in different literatures.

Mother's Age at last Birth: it is the self - reported age of the women at the time of birth and was categorized into three groups < 20 Years, 20 – 34 Years, and 35 – 49 Years for study I; for study II and III the following categorization was used: 15 – 24 Years, 25 – 34 Years, and 35 – 49 Years.

Current marital status: We recoded the current marital status of women at the time of the surveys into two categories (Studies I & III): a) living with partner (merging women formally married and women living with partner); and b) Not living with partner (by merging widowed, divorced, no longer living together/separated, never in union).

Religion: Religious affiliation of the women during the interview and in the survey was categorized as: Orthodox, Catholic, Protestant, Muslim, traditional, and other religions. In this study the variable was recoded into: Christianity (Orthodox, Catholic, Protestant); Islam (Muslim) and Others (traditional, and other religions), for study I. The latter groups were merged due to a low number of women in this category.

Women's and their Partners' Educational level (Studies I & III) was reported as: No Education, Primary Education, Secondary Education and Higher level that a woman/partner attained. However, for this study the categories secondary and higher education were merged together with the assumption mothers/partners who attained secondary and above may not differ significantly in the both decision as to the number of ANC visit and place of delivery. For study II, Women's Educational grouped as Primary or No education vs. Secondary and above.

Women's and partners' employment status: The EDHS collected data on women and partner's employment as 'no job' or as a list of different jobs. The sorts of jobs collected for both women and husbands ranged from unskilled manual to professional. In this thesis, the responses were coded into a) 'not employed/not working' (by merging the categories- not working, household and domestic, unskilled manual, other) or b) 'employed/working' (merged as professional/technical/managerial, clerical, sales, agricultural – employee, agricultural - self-employed, services, skilled manual) regardless of the type of job. The 'no job' category does not mean that women do not perform any activities; rather, women are limited to household activities for Studies I and III.

Women's empowerment Index (Studies I and III): Decision-making can be a complex process, and the ability of women to make decisions that affect the circumstances of their own lives an essential aspect of women empowerment. We focused on person who usually make decisions about three attributes from the data to describe women as empowered, or not empowered. These are: (i) Person who usually decides on women's health care; (ii) Person who usually decides on large household purchases; and (iii) Person who usually decides on visits to family or relatives. The categories of women's empowerment variable were based on the number of these decisions, in which women participate, or not. In these studies, a woman was considered to be empowered if the decision on any of the above items were made by the woman alone or together with her partner. Therefore, the variable was categorized into four categories: a) Not involved at all in decision making; b) involved in at least one decision; c) involved in two decisions; and d) involved in at all the three decision issues for both Paper I and III. But for paper II, re-categorization was done into: low autonomy (no participation in any decision making), medium autonomy (participation in 1 or 2) and high autonomy (participation in all decision making).

Household wealth index: is a composite measure of a household's cumulative living standard and calculated using easy-to-collect data on a household's ownership of selected assets, such as televisions and bicycles; materials used for housing construction; types of water access and sanitation facilities. The household wealth index classification was measured in quintiles in the EDHS as a composite variable: poorest, poor, middle, rich and richest. These were computed using principal component analyses (PCA) [167]. However, for study I it was categorized into three groups by assigning the same values as that of the original variable. The three categories were: a) wealthiest (rich and richest), b) middle, and c) poorest (poorest and poor). For Study II & III, it was re-categorized into two groups: a) Low household wealth status (poor, poorest, and middle), and High household wealth status (rich and richest).

Exposure to Media (Studies I to III): This variable was based on whether women have had any exposure to listen radio or watch television. We categorized it into three parts: a) no exposure to either media channel; b) exposure to either one of the two channels; and c) exposure to both. These studies excluded exposure to magazines and newspapers, since the proportion of uneducated women in Ethiopia is high and assumed that there is little exposure to print media.

Order of the last birth: This was the birth order of the child during the survey. The variable was categorized into 3 categories: a) first order birth, b) Second or third birth order, and c) Fourth or higher birth order (Study I to III). Indirectly, it points out the parity of the mothers.

Perceived distance to a health facility to get medical help. The survey question asked women if distance was a problem for them to get any medical help from health institutions, not limited to ANC and/or health facility delivery. The responses were coded as 'yes big problem'; or 'not big problem'. We used the same codes for Study III. The responses for this variable were neither quantities nor specific to the uptake of maternal healthcare services.

Number of currently married women, with one or more co-wives: describes whether the relationship status was in a polygynous union or not and categorized as: a) Yes (In a polygamous relationship) and b) No (not in a polygamous relationship) for studies I and III.

Sex of household Head: classified as female or male headed for Study I.

Ever had a terminated pregnancy: if a woman voluntarily ended a pregnancy or not and coded as Yes or No in study III.

Number of under 5 children: the variable was coded from a question that assessed the number of children 5 and under in household's woman had and were grouped as no child, one child, and two or more (Study III).

Currently breastfeeding: based on the whether the women were breastfeeding or not during the time of the surveys and coded as yes or no in study III.

Anaemia status during pregnancy: this variable was coded as anaemic or non-anaemic (Study I).

For paper II we also constructed three measure of intimate partner violence that includes emotional IPV, physical IPV, and sexual IPV using the 2016 dataset. This follows that the definitions of IPV used in single-country analyses to date of the association between IPV and maternal health care utilization [168]. IPV was defined as ever in committed partnership women who have ever experienced one or more of the specified acts of spousal physical violence or sexual violence or emotional violence by their current or most recent husbands/partners [164]. Intimate partner physical violence was defined as ever in committed partnership women who have experienced one or more of the specified acts of spousal physical violence by their current or most recent husbands/partners preceding the surveys. Likewise, intimate partner sexual violence and emotional violence were defined as ever experiencing one or more of the specified acts of spousal sexual or emotional violence by their current or most recent husbands/partners preceding the survey.

Attitude towards wife beating was also included. Respondents are asked if they agree that a husband is justified in hitting or beating his wife under each of the following five circumstances: she burns the food, she argues with him, she goes out without telling him, she neglects the children, and she refuses to have sex with him. If respondents answer 'yes' in at least one circumstances, they are considered to have attitudes that justify wife beating (Paper II).

Community level factors
Direct Community level independent variables
Place of Residence: where the woman was living at the time of the surveys. This variable in the EDHS can explain characteristics of the clusters directly. The two categories were: urban; and rural (Studies I to III).

Contextual region (Studies I to III): All health programmes under FMoH are organized within the Agrarian (Amhara, Oromia, SNNPR and Tigray), Pastoralist (Somali, Afar, Gambella, and Benishangul Gumuz regions) and City dwellers (Addis Ababa, Dire Dawa, and Harar) to provide communities with client-oriented services. So, we followed the same categorization that may have a strong relationship with health-seeking behaviour of the respondents, particularly on maternal health care utilization.

3.9 Statistical methods and analysis

The different characteristics of the women and the communities were described using descriptive statistics. Taking into account the nested structure of the data, multilevel logistic regression were employed. All analysis in this thesis were performed using Stata 15.0 and 16 Statistical Software. We also applied sampling weights in all the analyses to enable us to generalize the results to the population. The sample weight variable (V005), is the pre-existing individual sampling weight in the DHS datasets [164].

Study I

In study I, descriptive analysis was carried out to show the characteristics of female survey participants in the 2005, 2011, and 2016, Ethiopian DHS. Chi-squared test for trend in proportions were performed on each variables and survey periods to determine how these changes were significant over time. The prevalence of all the variables in this study was also measured within the sample population. The number of antenatal visits that each woman had treated as discrete observations (counts) in the analysis and the available data contained significant number of zero counts due to the high number of women not attending ANC at all.

These data, collected at three different time points (2005, 2011, and 2016) are nested within the women, who are in turn nested within households, which are nested within regions. Therefore, any analysis method that assumes independence of the responses is rendered inappropriate. The Poisson model is the basic model for modeling counts [169]. The Poisson model assumes that the mean and the variance are equal, a relationship called equi-dispersion. In many cases, data are usually over-dispersed, that is, the variance is greater than the mean. Depending on the reasons for over-dispersion, the Poisson model was extended by introducing individual, household and region random effects (RE) to account for data clustering. Possible extensions to the Poisson model included were: the Poisson RE model, Negative Binomial (NB) model, the NB RE model and if over-dispersion is due to excess zeros (zero antenatal visits), then either a zero

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inflated Poisson (ZIP) or zero inflated negative binomial (ZINB) were fitted to the data. Therefore, we considered a three-level model with random intercept and random effect of time on regions at level 3, random intercept for households at level 2 and the women at level 1. As shown on Fig. 10, the ZINB (yellow line) model found to be the best model since it handled the cluster effect of the data.
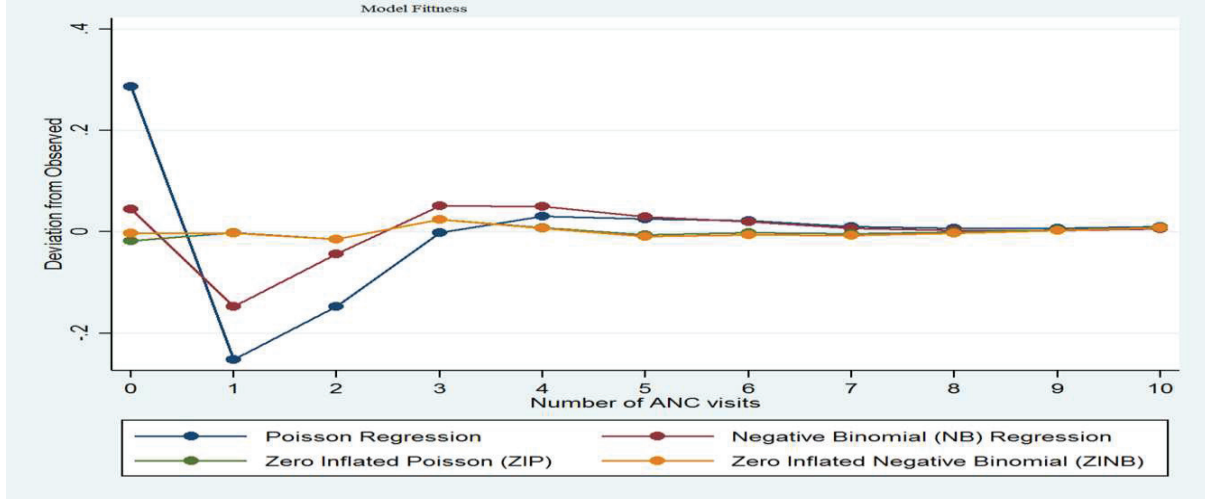
Figure 10: Observed vs Predicted Plots of the fits of four Poisson Model

Study II & III

In study II and III, multilevel logistic regression analysis was carried out to estimate the adjusted odds ratios (AOR) and 95% confidence intervals of facility delivery or not, and if she had at least four ANC visits or not. Such binary responses were modelled using a multilevel logistic regression model [170] given by:

$$Y_{tijk} \sim \text{Binomial}(1, p_{tijk})$$

$$\text{logit}(p_{tijk}) = \begin{cases} \beta_0 + \beta_1 \text{time}_t + \beta_2 x_{ijk} + \ldots + \beta_p x_{ijk} + & \text{(Fixed effects)} \\ \\ \alpha_{0k} + \alpha_{1k} \text{time}_t + \alpha_{0jk} + \alpha_{0ijk} + \varepsilon_{tijk} & \text{(Random effects)} \end{cases}$$

Y_{tijk} takes the values 1 if woman k (at time t) from household j that is nested in region i will deliver at the facility and 0 otherwise. The parameter estimates β_0 through to β_p represent the fixed effects associated with the intercept, time effects and other factors such as age of the mother. The random effects α_{0k} and

α_{1k} represent the individual random effect associated with the intercept and time slope respectively. α_{0jk} is the random effect of household j that is nested in region k while α_{0ijk} is the random effect of woman i belonging to household j that is nested in region k. ε_{tijk} is the random error that is assumed to have a mean 0 and variance δ^2.

For both responses, variance components models (models without fixed effects) was fitted first to the data. Estimates of Intra-Cluster Correlation (ICC) was obtained from the variance components models. These helped to explain the amount of variability in the outcome responses that can be attributed to differences between the data clustering levels. Since the data was obtained from surveys conducted at two different time points, interactions with time was performed to describe, for example changes in antenatal visits over time for paper III. Yet another clustering level is residence (rural/ urban). However, we treated this variable as a fixed effect in the multilevel models and compared the rural people from the urban folks. The model parameter estimates were obtained in the statistical software StataSE 15 and 16 using the restricted maximum likelihood method (REML). Logistic regression relies on maximum likelihood estimation rather than ordinary least squares; this is iterative approach where various solutions are estimated until the best solution of having the maximum likelihood is found [171]. Table 2 gives the thesis studies: aim, study subjects, sample size population, study design, and analytical methods.

Ethical Consideration

The study adhered to national and international ethical guidelines for biomedical research involving human subjects [172], including the Helsinki declaration. The study protocol was reviewed and approved by the Regional Committee for Medical and Health Research Ethics (Code number: 2016/967/REK sør-øst A) and the Norwegian Centre for Research Data (Code number: 48407) at the University of Oslo; (all ethical approvals are found in Appendix 3). Our team also requested permission and access to the data from the CSA in Ethiopia and Inner City Fund (ICF) international by registering online on the website www.dhsprogram.com [163] and submitting the study protocol by highlighting the objectives of the study as part of the online registration process. The ICF Macro Inc removed all information that could be used to identify the respondents; hence, anonymity of the data was maintained.

Table 2: Summary of methods used in the study based on objectives

Study	Objectives	Study subjects	Sample size utilized	Study design	Statistical analysis
I	To explore the social determinants of health (SDH) that influence the antenatal care (ANC) utilization in Ethiopia over time	Women in the reproductive ages 15–49 years, reporting at least one births in the last 5 years preceding the actual survey, and participating in one of the three surveys from any region in the country	We included total of 22, 799 weighted data from: 7306 women in 2005; 7908 women in 2011; and data from 7585 women in 2016		- Descriptive analysis (text, tables and graphs) - Zero inflated negative binomial (ZINB) model - Multilevel logistic regression analyses
II	To explore the association between intimate partner violence (IPV) and utilization of maternal healthcare services and if the women educational attainment or wealth status modified this association	Women in the reproductive age (15 – 49 years) who reported at least one birth during the five years preceding the actual survey (i.e., 2012–2016); and participated in the domestic violence sub-study from any region in the country	Weighted data from 2836 women in 2016	A retrospective quantitative cross-sectional study	- Descriptive analysis (text, tables and graphs) - Multilevel logistic regression analyses

| III | To identify positive deviant (PD) mothers for the uptake of skilled maternal services and to explore their characteristics | Women in the reproductive age (15 – 49 years) who reported at least one birth during the five years preceding the actual survey (i.e., 2006–2011 and 2012–2016); and participating in one of the two surveys from any region in the country | Weighted data from 7584 women in 2016 and 7908 in 2011; totalling of 15,492 | | - Descriptive analysis (text, tables and Graphs)

- Multilevel logistic regression analyses |

Chapter IV: Summary of findings

Paper one presents findings of the effect of social determinants on antenatal care service use. The relationship between maternal exposure to intimate partner violence and utilization of skilled maternal healthcare is described in paper II, and identification of positive deviant mothers and exploring their characteristics for the uptake of skilled maternal services is addressed in paper III.

Summary of results, Paper I

The aim of this study was to identify the SDH that influence the antenatal care utilization in Ethiopia over time using data from three Ethiopian Demographic and Health Surveys (2005, 2011, and 2016). This gave a total sample of 22,799 women in Ethiopia with a birth within five years prior to the survey. The majority were living in agrarian communities. Both the women and her partner's educational attainment increased between 2005 and 2016. Result also show that there were statistical difference between women employment and the employment status of her partner's characteristic between 2005 and 2016 ($p<0.01$). A significant improvement in participation in decision-making of the household was observed over the years, ($p<0.01$). Rural mothers used fewer ANC visits and services than urban women, but the overall percentage of women with at least one ANC visits increased ($p<0.01$).

Our estimates of the adjusted incident rates ratios (aIRR) obtained from negative binomial difference results showed that the uptake of antenatal care services, after adjusting for all other variables was affected by various social determinants. The difference of education attainment in the number of ANC visits pregnant women attended declined over the three surveys. Furthermore, women who were in employment reported a higher use of ANC services than unemployed women between 2011 and 2016 survey periods. Findings also indicated that the respondents with educated husband or from a middle of high wealth family background had more ANC visits. The reported IRR for media exposure indicated that mothers with media access were more likely to use ANC services (IRR = 1.80, 95% CI: 1.61, 2.02). Empowered women involved in at least one decision-making had a higher number of ANC visits (IRR = 2.10, 95% CI: 1.79, 2.45). A mother with second or higher birth order utilized less ANC services than the respondent with first birth in all survey periods. The number of ANC services attended was significantly higher among women who were city dweller's (IRR = 3.39, 95% CI: 2.15, 5.33) than women who reside in agrarian regions. Overall, the study revealed that the

ZINB model was fitted to identify social determinants associated with the number of ANC services utilizations in Ethiopia.

Summary of results, Paper II

The aim was to explore the association between intimate partner violence (IPV) and utilization of maternal healthcare services and if the women educational attainment or wealth status modified this association. A total of 2836 currently married women in reproductive age reporting any experience of spousal violence included. According to the findings, 23.4% of women had experienced physical, 23.1% emotional, while 9.4% experienced sexual IPV. The utilization of ANC services was significantly lower among women exposed to any IPV. There was no association between IPV and health care facility delivery.

In multivariate analyses, we examined each type of IPV and its association with maternal healthcare utilization and whether the inclusion of the women's educational attainment or wealth status moderate the IPV effects. After adjusting for potential confounding factors, the analysis documented that women who were exposed to emotional IPV during pregnancy were significantly less likely to have adequate use of ANC service (AOR = 0.77, (95% CI:0.61 - 0.98)). Furthermore, controlling for key covariates, exposure to sexual and physical IPV during pregnancy were not significantly association with ANC service utilization. We did not find a statistically significant moderation effect with either education (AOR = 1.55, (95% CI:0.68 - 3.53), $p = 0.299$) nor wealth status (AOR = 1.08, (95% CI:0.66 - 1.77), $p = 0.754$) on the relationships between maternal exposure to IPV and use of maternal healthcare service utilization.

However, we have observed two different marginal effects of emotional IPV between the two educational sub-groups on ANC: the effect of emotional IPV on ANC was significant among those with primary or none education in the negative direction. In those with secondary education and above, the direction appears to be positive, but the association was not statistically significant. The emotional IPV variable makes a difference in ANC probability of approximately 3% points increase in the secondary or higher education group, and about 5% points lower in the primary education group. On the other hand, the effect of exposure to IPV on ANC was borderline significant in the negative direction among low wealth index households. In those with high wealth sub-group, the direction appears to be negative, unlike before, the association was not statistically significant. Exposure to emotional IPV variable makes a difference in ANC probability of 3% points lower in the high wealth sub-group, and about 4% points lower in the low wealth sub-group.

Summary of results, Paper III

The aim of this study was to identify positive deviant (PD) mothers, mothers who reported no formal education, but had an adequate use of ANC visits and or institutional delivery services and explore their characteristics. The data for this analysis came from the two Ethiopia Demographic and Health Surveys. In the 2011 survey, a total of 7908 and in 2016, 7584 number of women of reproductive age were included. Among the 10,061 child bearing mothers (15 – 49 years) included in the analysis by deviant status; 1831 (18.2%) were classified as positive deviants for ANC utilization and 1234 (12.3%) were PDs for health facility delivery in the two survey periods.

Findings from multilevel regression analysis stratified by rural/urban status, showed that the rural positive deviants were older (35 – 49 years) (AOR = 1.42, (95% CI: 1.00 – 2.01)) in 2011 or in the middle age (25 -34 years) (AOR = 1.35, (95% CI: 1.03 – 1.77)) in 2016 regarding use of ANC service. Moreover, the rural positive deviants were more likely to be employed in 2011, ANC uptake (AOR = 1.64, (95% CI: 1.28 – 2.10)) and health facility delivery (AOR = 1.77, (95% CI: 1.21 – 2.59)) compared to non-deviants. In addition, the rural PD women were more likely to have partners with primary or above education.

The rural PD mothers using ANC were more likely to be involved in one (AOR = 1.67, (95% CI: 1.11 – 2.52)) or more decision-making of the household (AOR = 1.77, (95% CI: 1.16 – 2.71)) during the two survey period. The same was not true for urban mothers. Both urban and rural women who had exposure to mass media were more likely to be positive deviants for the uptake of maternal healthcare utilization during the two survey periods. Furthermore, in 2016, rural PDs were more likely to initiate breastfeeding (AOR = 1.24, (95% CI: 1.03 – 1.50), for antenatal care utilization. Both rural (AOR = 1.45, (95% CI: 1.15 – 1.84)) and urban PDs (AOR = 2.02, (95% CI: 1.15 – 3.53)) were more likely to initiate breastfeeding if they gave birth at a health facility. Lastly, in both rural and urban PD women reporting health facility delivery were more likely to have had at least one ANC visit during pregnancy in the survey periods compared to non-deviants. The main findings from the three manuscripts are outlined in Table 3.

Table 3: Summary of main findings from the three studies included in this thesis

Study	Objectives	Main findings
I	To explore the social determinants of health that influence the antenatal care utilization in Ethiopia over time.	• Rural mothers used fewer ANC visits and services than urban women, but the overall percentage of women with at least one ANC visits increased ($p<0.01$). • The uptake of the number antenatal care services women attended, after adjusting for all other variables was affected by various social determinants: education, employment, household wealth status, media exposure, and women empowerment.
II	To explore the association between Intimate Partner Violence and maternal healthcare services and to assess if women's educational attainment and wealth status moderate this association.	• The prevalence of lifetime exposure to emotional IPV was 23.1% and 23.4% had physical IPV, while 9.4% of the study participants reported encountering sexual IPV. • There was no association between IPV and health care facility delivery. • The proportion of utilization of skilled maternal healthcare was relatively lower among women exposed to any IP violence. • After adjusting for potential confounding factors, the association between maternal exposure to emotional IPV and adequate use of ANC was statistically significant. • Associations with physical or sexual IPV were not identified.

	• Women's education attainment or household wealth status have no significant moderation effect in the relationships between some forms of IPV and maternal healthcare utilization. • However, we have observed two different marginal effects of emotional IPV between the two educational sub-groups on ANC use.
III	To identify positive deviant mothers for the uptake of skilled maternal services and to explore their characteristics	• 1831 (18.2%) were classified as positive deviants for ANC utilization and 1234 (12.3%) were PDs for health facility delivery in the two survey periods. • Factors associated with positive deviant for the use of ANC services were: partner's education status, involvement in household decision making, exposure to media, and distance to the health facility. • Factors associated with PD for health facility delivery were: partner's education, woman's employment status, exposure to media, perceived challenge to reach health facility and ANC visit during index pregnancy. • Rural-urban and time-related differences were also identified.

Chapter V: Discussion of main finings

This project adds to the existing body of knowledge needed to advance maternal health in low income settings. The thesis examines the contribution of individual, household, and contextual characteristics to the utilization of antenatal care, and health facility delivery in Ethiopia. The results of this study are relevant to maternal health policies and programs in the least developed countries of the world, where maternal health services remain relatively underutilized without clear understanding why. In this chapter, findings are discussed in view of the recent literature on the topics, with a special emphasis on implication for the attainment of Sustainable Developmental Goals to reduce maternal mortality. Subsequently, methodological considerations are discussed.

Maternal healthcare utilization as well as pregnancy outcomes are determined by different social and political determinants [105, 173]. Especially in sub-Saharan African, studies exploring the impact of social determinants of health are scarce. To a considerable extent, improving SDHs has turned out to be a major challenge [174]. Identifying and strategically targeting social determinants of health and affected population groups, especially in resource-limited settings, would assist in targeting and prioritising interventions. The lack of progress has retarded the momentum towards promoting health equity and improving the health status of the poor in Africa [175]. Responding to the increasing concern for integrating an emphasis on SDH into the health care system, Ethiopia's Health Sector Transformation Plan mentioned the need to pay attention to health determinants, for the first time in 2015 [11]. It is such developments that make it relevant to do research that identify local examples to apply to the processes needed to use the SDH approach. Therefore, the discussion section is grouped into two. Given the overall challenges in maternal health services utilization in Ethiopia, expanding understanding of the risks that lead to poor health outcomes and which protective factors contribute to resilience in pregnant women may be critical to for intervention, policy design and implementation in this critical area.

5.1 Utilization of skilled maternal healthcare Services

In paper I, we demonstrated that the proportion of women who received at least one ANC visit use increased significantly from 2005 (28.5%) to (62.8%) in 2016. Despite these

improvements, this figure is lower than the findings in neighbouring Sub-Saharan African countries such as Kenya [176], Uganda [177], and Tanzania [178]. This coverage is not sufficient to address the Ethiopian goals of ANC at the population level. To be effective, ANC must be adequate and in accordance with recommendation [78]. This is due to the fact that women who seek care during pregnancy are more likely to seek care for their delivery. It remains unknown whether ANC service content has improved accordingly. Only 32% of the Ethiopian women in our study met the current Ethiopian policy recommendation of four ANC visits. This might calls for efforts of the government to create awareness for the community about the significance of adequate ANC service if they intend to meet its maternal health outcome goals via Health Sector Transformation Plan [11]. Nevertheless, in 2016, more women had at least four ANC visits as compared to the results of the previous three DHS surveys [7 - 9].

Increasing utilization of ANC service is indispensable as it also improves women's likelihood for having a skilled delivery, using postnatal care and contraceptive services [179]. Disparities in ANC uptake between urban and rural areas, across regions and by socio-economic status statistically significant in our study although some improvement was demonstrated from 2011 to 2016. The progress in the rural areas has been reported earlier [180]. This might be due to the implementation of Reproductive, Maternal, Neonatal and Child Health Program and the proximity of the Health Extension Workers and their community mobilization of the health development army in the rural areas. The evolution of the Women's Development Army network at the village level might have contributed to better uptake of skilled maternal health care through health discussion within the network during regular meetings [181 - 182]. There has been a considerable expansion of primary health care units in the last decade via rehabilitation and advancing of the existing health facilities as well as the building of new facilities [35]. As such, health service efforts should be targeted at disadvantaged rural population.

Increasing health facility deliveries is important for reducing maternal and neonatal mortality [183]. However, access to health facilities in rural areas is more difficult than in urban areas because of distance, inaccessibility, lack of transportation or lack of appropriate facilities [184]. Although institutional delivery has been promoted in Ethiopia, home delivery is still common, primarily in remote areas. In our study, health facility deliveries for women living in rural areas increased substantially from 5.0% in 2011 to 24.1% in the 2016. Likewise, facility delivery

among urban women increased from 53.0% in 2011 to 84% in 2016. This growth between 2011 and 2016 in the prevalence of health facility delivery suggests government efforts to increase access to and use of these services are rapidly succeeding. However, the remaining large numbers of rural women giving birth at home without assistance, and without skilled postpartum care indicate a need for these efforts to continue. In addition, non-institutional delivery was higher among women who not recognise the risks associated with home delivery. A similar scenario was also evident in a study conducted in Sub-Saharan African countries [185 - 187]. Planning for health facility delivery is not part of traditional practice and health facilities are sought as a last resort after serious complications have developed especially in Ethiopia. Hence, if pregnant women are counselled during their ANC visits to have a plan for health facility delivery together with arrangement for transport and other amenities like money, blood and companions for emergency conditions, they are highly likely to give birth at a health facility.

Among the maternal healthcare indicators, four and more ANC and institutional delivery care are considered to be the most important indicators for the betterment of maternal and child health outcomes [188]. Universal access to safe and quality maternal healthcare services is targeted in SDG 3.1 [189]. In this study, the progress in adequate ANC visits does not match the improvement in health facility delivery during the study period. Therefore, Ethiopia is most likely to miss the SDG targets by 2030 in terms of at least four ANC visits and the universal health coverage in institutional delivery. Thus, it suggests that the best polices have yet to be widely implemented, for instance, the Ethiopian government should start to implement the new positive pregnancy experience model at health facility level in the health care system as an important resource for the country's endeavours to achieve the goal of ending preventable maternal and perinatal deaths by 2030 (the Sustainable Developmental Goals target) and moving faster towards universal health coverage [190].

5.2 Risks and protective factors associated with the use of skilled maternal health care

The identification of risk factors is critically important for informing strategies and programmes to ameliorate or buffer against risk (protective factors) and ultimately to guide prevention policy [191]. Expanding our understanding of which risk factors lead to poor maternal health outcomes and which protective factors build resilience is critical to improving women use of maternal health services and maternal health outcomes in Ethiopia. Our study

identified several risk and protective factors with a significant impact on the utilization of maternal healthcare services. The risk factor includes maternal age, second or above birth order, women with no education, residing in low wealth index households, living in rural and pastoralist region, high distance to reach health facility, and intimate partner violence. Also, the following identified as a potential protective factor: employed women, living with husband who have primary or above education, having employed partner's, media exposure, women's participation in household at least in one decision-making, and living in the urban, city or agrarian regions.

Young age appears to be a risk factor for poor maternal healthcare service utilization. The study indicates that the likelihood of uptake of maternal healthcare services is lower among younger mothers compared to older mothers in all surveys. This is consistent with the results from other studies [192]. One explanation may be that older women generally have more experience and accumulated knowledge on maternal health issues, and have higher decision-making autonomy than their counterparts which ultimately leads them positively to seek maternal healthcare service utilization. Higher birth order women generally were less likely to seek these services than women of first birth order. This is in support of previous studies which identified birth order as a possible risk factor [193]. Therefore, it is important to note that efforts to ensure birth limiting would help to enhance maternal health service utilization as well as to improve maternal health outcomes.

Education was found to have positive correlation with ANC visits and health facility delivery [194 - 195]. This means that women with good educational background had better maternal health care utilization. The general argument explaining this association includes the fact that increased education enhances women's knowledge of health problems, increase awareness of the health services availability and accessibility, enhances women decision-making power and produces changes in household dynamics [196 - 197]. Studies have also shown that women with an educated husband use maternal health services more than women with a less educated husband [198 - 199]. Health knowledge with formal education is deemed to be increases understanding of health issues, which in turn leads to greater use of maternal and child health services [200]. An educated person have better awareness about the risk of home delivery, thus, education influences the use of health care services through improved knowledge, attitude and practice [201 - 202].

Further, our studies found a low wealth status of women to be a risk factor with the two indicators of utilization of maternal healthcare services. This is probably because poor households do not have the resource for health care expenses, as their priority is to meet the basic needs of daily life [203]. On the other hand, exposure to mass media was identified as a potential protective factor for the utilization of maternal healthcare service. Women who were exposed to mass media were more likely to use maternal healthcare services. Previous studies have shown that exposure to mass media at the individual, and community level has a positive influence on the utilization of maternal healthcare services [204-206]. Consequently, media can play a crucial role to bridging these knowledge gaps and promoting scientific attitudes thereby encouraging women to use health services not just when illness arises but for maintaining health.

Our study also found that rural residence was found to be a risk factor with a lower odds of utilization of maternal healthcare services. This is consistent with previous studies that have reported significantly higher use of services in urban compared to rural areas [207- 208]. Several reasons could explain why the uptake of maternal healthcare services is higher among urban compared to rural women in Ethiopia. The scattered nature of settlement patterns, the relative level of underdevelopment and limited supply of health facilities in rural communities could hamper the uptake of such services in these communities. On the other hand, the shorter distance to health facilities in urban areas given the good road infrastructure and transportation facilities and the relative ease of access to information and media in these areas could also facilitate better diffusion of modern services than in rural areas. The findings of this study further demonstrated that far distance to reach health facility impede women from attending maternal health care service utilization. This study result is supported by previous studies in Ethiopia and other countries in SSA [209 - 212], where maternal health care service utilization was associated with physical access to a health facility. Despite the Ethiopian government's efforts to accelerate the improvement of accessibility of health facilities at Kebele level, physical proximity of the health facility remains a significant factor that delays women from reaching the health facility to use the service.

Additionally, the growing research literature regarding the public health impact of intimate partner violence exposes women to a wide range of health problems that can either directly or indirectly lead to maternal morbidity and mortality. Our findings revealed that exposure to IPV is a risk factor for a low utilization of maternal healthcare services. Women who were exposed

to emotional IPV had decreased odds of using adequate antenatal care compared to those who did not experience such IPV. This finding is consistent with other studies [213 - 215]. The results suggest that emotional violence may be a less noticeable yet important role in poor utilization of maternal healthcare services. Moreover, this may be due to the potential impact of IPV on women's ability to access health care services through limited decision-making power, reduced freedom of movement and higher economic dependence [216 -218]. These factors could delay help-seeking for antenatal care services. In this regard, collective measures to foster women's decision-making, empowerment and access to financial resources besides enforcement of existing laws and regulations on IPV to improve maternal healthcare service utilization among Ethiopian women. Therefore, integrated mitigation measures to reduce IPV in SSA should focus mainly on IPV in order to achieve the SDG's that will lead to sustainable changes in women's health.

We also identified positive deviant mothers who were at a high-risk for non-use of skilled maternal healthcare services. Positive deviant mothers reported having the following characteristics compared to their non-deviant counterparts for uptake of skilled maternal healthcare: more likely to be involved in at least one decision-making, employed, exposed for mass media, exhibit breastfeeding, had husband with primary or above education, were less likely to perceive a far distance to a health facility, or city dwellers. Specifically, mothers who were PDs for ANC uptake were more likely to have husbands who had job. Likewise, mothers who were PDs for health facility delivery care were more likely to report at least one ANC visit during pregnancy and living in the pastoralist region. This finding are consistent with previous studies [219 - 222]. The results demonstrate an understanding of the relationship between positive deviance and maternal healthcare service utilization can inform public health programming and public health interventions that aim to improve the service by providing insight on how women avoid adverse health outcomes and understanding the needs of harder-to-reach populations who may experience health risks, despite living in communities where others do not experience vulnerability. To sum up, this thesis mapping risk and protective factors, identifying social determinants relevant to maternal health and affected population groups, especially in resource limiting settings, would assist in targeting and prioritising interventions.

VI. Methodological considerations

In this thesis, data from cross-sectional study were used to assess, describe and explain the impact of social determinants on utilization of maternal health care in Ethiopia. In the paragraphs that follow, specific issues concerning the research methods used across the three studies included in the thesis will be explored.

6.1 Validity and generalizability

Validity is the extent to which a study measures the true value that is expected to be measured so that the study results are accurate and the conclusions made are valid (generalizable) [223]. The extents to which the findings are accurate and the conclusions derived from these findings can be generalized depending on the data quality at all stages of the study (relevance of the study design, adequate sample size and random sampling technique, right data collection tool and procedures and appropriate data analysis techniques are critical for validity).

This can also be explained as to what extent the role of chance, bias, or confounders are accounted for in the observed association between the independent variables and dependent variable there by reflecting the true relationship between explanatory variables and the outcome of interest [223].

6.1.1 Internal Validity

Internal validity refers the extent to which the information collected accurately answers the research question [223 - 224]. While the results of a study may reflect the true effect of an exposure on the development of the outcome of interest, it should always be considered that the findings may in fact be due to an alternative explanation such as the role of chance (random error), bias (selection, information or measurement) or confounding effect, that could produce spurious results, leading to the conclusion of the existence of a valid statistical association when one does not exist, or alternatively, the absence of an association when one is truly present.

Therefore, to maintain the internal validity of this study, the study instruments were adapted from standard instruments used in major national surveys, which were validated in the Ethiopian context. The EDHS used extensive interviewer training, standardized measurement tools and techniques, an identical core questionnaire, and instrument pretesting to ensure standardization and comparability across diverse sites and time [7 -10, 164 - 166]. The EDHS

used a standard questionnaire which is internationally used in the Demographic and Health Surveys and validated it with back translation of the questionnaire developed in three Ethiopian local languages (Oromiffa, Amarigna, and Tigrigna). In addition, literature evidence and expert opinion were used during the analysis stage to control for confounding effect in the associations explored. The sample in EDHS was randomly selected. Random sampling is an effective way to ensure internal validity. The studies used multilevel modelling technique, which would calculate the standard errors more accurately and reduce the chance of misestimating the significance of variables, as some of the assumptions inherent in traditional regression methods are not valid for nested data as well as that takes into consideration the nested structure of the data thus, allowing for the clustering effect of the outcome variable [59. 170].

The data used in the analysis is also prone to recall bias given the data was collected retrospectively on events that took place up to five years before the survey. Although there are concerns about self-reported behaviour, it is reasonable to assume that biases are less likely in maternal health care related events in comparison with other sensitive issues such as sexual behaviour. In order to mitigate this effect, analysis was based on the most recent birth in the five years preceding the survey. Moreover, non-response was minimum as the three surveys had a higher response rate (above 90%).

6.1.2 External validity (generalizability)

External validity or generalizability refers to the extent to which the inference drawn from study findings can be generalized to a broader population beyond the study population [224]. To increase the generalizability of the findings of this thesis, the scope of the sample size of the surveys were large providing high statistical power. The study was based on nationally representative data, which makes the results generalizable and applicable to nationwide (urban and rural) and regional levels, and for interventions and important policy options. This play an important part in the external validity of the results.

Moreover, to ensure that statistical estimates based on DHS data are valid, sampling weights should be used in the analysis. These weights compensate for different probabilities of selection within the samples, and different levels of non-response. By including the survey weights in the analysis, each interviewed unit becomes representative of similar units in the target population [225]. Therefore, sampling weight (based on the woman weight (V005)) variable was used in all analyses using the data to ensure the actual representative of the surveys at both

the national and domain levels. In paper II, special weights for the domestic violence module (D005) variable were also used. In the domestic violence module, only one eligible woman is randomly selected from each sampled household to complete the domestic violence questionnaire. To account for the within-household selection and for the non-response for the module, the design weight must be adjusted to take into consideration the within-household selection probability and the response rates for the domestic violence module.

6.2 Confidentiality

Confidentiality is a major concern because all data collected in DHS surveys are publically available to users. To protect survey participant's' identity and privacy, the data should not allow for potential identification of any household or individuals in the data file. In DHS surveys, strict rules are imposed at various steps during survey implementation to prevent the direct or indirect disclosure of the identity of individual respondents, their households, or clusters [225]. All information that could identify a cluster, household, or individual is omitted from the data file. This includes the cluster's selection probability. The sampling variables released in the data file are sufficient to describe the data structure and allow users to uniquely identify the clusters and household for data analysis, data management or tabulation purposes, but are not sufficient to disclose the location or identity of any cluster, household or individual. Therefore, all information that could be used to identify the respondents were removed. Hence, anonymity of the data was maintained.

6.3 Strengths and limitations of study

The data for the study were pooled from the survey datasets allowing the analysis to span the period 2001 to 2016 which enabled to study different dimensions and trends related to maternal healthcare outcome over time. The EDHS provides a comprehensive overview of population, maternal, and child health issues in Ethiopia. We present evidence on most of the key steps in the maternal healthcare "cascades" (antenatal care services, and health facility delivery services). The EDHS also has multiple maternal health related variables which allows for several factors to be accounted for, hence reducing omitted variable bias and unobserved heterogeneity.

In paper one, the utilization of count data modelling provides methodologically advantage by taking discrete observations (counts) into account that made the model estimates reliable [169]. The methods used in paper two, contributes to an understanding of the moderation effect of education and wealth index in the relationship between spousal IPV and maternal healthcare outcomes. In paper three, the positive deviant strategy offers an alternative to other approaches

used in exploring the uptake of skilled maternal healthcare. For all study outcomes, we have used appropriate statistical models and test statistics including multivariate analysis to adjust for the effects of confounding factors. Factors that were thought to confound the associations between exposures and each of the outcome variables were included in the multivariate analysis. Moreover, where appropriate we assessed the potential for moderation (interaction) using recommended procedures [226].

Furthermore, the findings from the studies included in the thesis should be seen in light of the following limitations. First, the data used for this thesis were from a cross-sectional survey, therefore, we could only examine the association between explanatory variables and two indicators of the use of maternal healthcare services and could not draw conclusions about causality. The study in paper II used the domestic violence module. The possibility of underreporting of violence by respondents should be taken into account while interpreting the findings using the domestic violence module. Although we used a measure of lifetime experience of IPV to capture exposure to each type of IPV, the point at which violence was experienced is not specified and may not overlap with the time period leading to the pregnancy and/or the birth for which care utilization is reported. Moreover, the study used an indirect measure of household wealth index. The DHS do not collect information on personal income, as it is rather difficult to obtain such information in developing countries settings such as SSA. Hence, the use of asset-based index as a proxy for household wealth has become the most widely used methodology, had been found to be reliable [167]. Another limitation of the thesis is that the datasets used are at least five-year-old and may not accurately reflect current conditions. These datasets were however chosen because of their advantages over other sub-national data sets.

Additionally, the EDHS survey did not include other variables at the community level, such as community norms, culture, and beliefs that are closely linked with health-seeking behaviour of mothers. Also, it used primary sampling unit (clusters) as the higher level unit of analysis, yet PSU boundaries do not necessarily coincide with community boundaries; therefore, they may not necessarily measure community and their impact on aggregate maternal health outcomes. The primary sampling unit as the community level may be biased results toward a functioning population as a result of endogeneity and selection effects [227 – 228]. In addition, the lack of measurement at policy-level data within the EDHS data set (such as the level of health status, economic status and variables used directly like gross national income or GDP, government

health expenditure as well as the presence or absence of national level health policies) has probably reduced in estimated models' power, and hence has contributed to the omission of the policy-level effects on utilization of maternal health care services.

The EDHS questionnaire, based on the DHS program's standard Demographic and Health Surveys questionnaires, were adapted to reflect the population and health issues relevant to Ethiopia. However, the cultural appropriateness of the international data collection tools used in the DHS needs further study in Ethiopia. Furthermore, the study followed the old guidelines of four ANC visits as adequate ANC visits but, new recommendations from WHO focuses on a minimum of eight ANC contacts for a positive pregnancy experience [78]. Finally, the datasets for the thesis point to other limitations of most studies based on nationally representative demographic and health surveys data for developing countries. However, understanding the significant risk and protective social determinants of health factors in this population is important because this is a more accessible population data, which will be easier to target for intervention.

VII. Conclusions, recommendations and future research
7.1 Conclusions

Ethiopia is among the Sub-Saharan African countries facing high maternal mortality rates whose circumstances are complicated by poor quality maternal healthcare and problematic maternal health-seeking behaviours. For instance, impressively high antenatal coverage rates, well over 62%, continue to coexist with relatively high maternal mortality ratio. Additionally, despite progress in maternal healthcare service utilization in the three surveys, the country still has unsatisfactory levels of optimum utilization of maternal healthcare services, such as having the recommended number of ANC visits and a considerable number of women are still giving birth at their home with evidence of a wide geographical variation in these service utilization across the country. Therefore, Ethiopia is unlikely to attain the SDGs of reducing MMR to less than 70 per 100, 000 live births by 2030. Given the poor performance towards attainment of the SDGs, and its relevance to the overarching national health policy, there is a need to further our understanding of the factors, which could be quite different across the country, that influence the utilization of maternal healthcare services.

The thesis examined the risk and protective social determinants of health factors of maternal healthcare services and indicate how to improve the poor maternal health outcomes in the country. It focused on two main maternal healthcare indicators. The first was to assess the factors, which determines the use of ANC particularly on FANC in Ethiopia. The second objective was to identify the determinants of skilled delivery care utilization at different levels, on the assumption that institutional delivery care is better than at home delivery care. These objectives were addressed empirically and using multiple data sets. In the first paper, the focus was to explore the SDH that influence the antenatal care utilization between 2001and 2016. These results imply that the use of ANC visits is driven mostly by the social determinants of health rather than biological and individual risk factors. The importance of various SDHs needs to be recognized by Ministry of health policy and program managers as a key driving force behind the country's challenges with reaching targets in the health agenda related to maternal health, particularly related to the recommended number of ANC visits.

The subsequent paper explores the added impact IPV and social determinants have on women's uptake of maternal healthcare services. We also explored if women's educational attainment and wealth status moderate any relationship between IPV and maternal health outcomes, using the 2016 nationally representative data set. The finding suggested that exposure to emotional IPV is a key risk factor than other forms of IPV and associated with poor uptake of adequate ANC service for married Ethiopian women. Even though there is limited relationship found in the moderators, targeting high risk mothers such as in low-income and low or no education sub-group who are reluctant to utilize maternal healthcare services, also crucial for prevention of IPV as a priority for improving maternal and child health. These underlines the critical need to integrate IPV prevention and intervention efforts within the existing Maternal and Child Health Programmes to address the needs of abused pregnant women in Sub-Saharan African settings including Ethiopia for the achievements of sustainable development goals. Moreover, the country should consider physical and emotional violence into operating procedure for the response and prevention of IPV in Ethiopia. Finally, the focus switched to identify positive deviant mothers for the uptake of skilled maternal services and to explore their characteristics. From a policy perspective, the PD approach provides a means for local policy makers and program managers to identify factors facilitating improved health behaviours, and ultimately, better health outcomes, despite an acknowledged adverse risk profile. Such strategy and knowledge could facilitate targeted efforts aimed at achieving global SDGs of reduction of maternal mortality in resource-poor populations.

In the whole, the thesis has shown that several social determinants, risk factors like IPV, and characteristics of positive deviants and service related factors constrain women's ability to use maternal healthcare services in poor resource settings. Thus, a holistic development approach may help. Endeavours to address the health challenges of the Ethiopian mothers should not only focus on improving access to, and the uptake of maternal health services, specifically antenatal care and institutional delivery. There should be an integrated approach to implement high-impact interventions that focus both on resilience building and a tailor-made development package that addresses the social determinants and poor health outcome faced by these populations. Actions at these multiple intersecting levels will provide women with the quality and responsive health services they deserve to make progress towards the SDGs. The challenging terrains and the poor transport infrastructure in rural communities meant focus should be on expanding road links between rural communities and given the skilled care is offered at secondary or tertiary levels of the health system which are further away from communities in the Ethiopian health system, upgrading health posts to provide obstetric services could be important in bringing skilled care closer to the communities.

7.2 Recommendations

The findings of the three papers included in this PhD thesis provide insight into how SDH is related to uptake of skilled maternal health care intervention in Ethiopia, from the individual, household and community level perspective. Therefore, the following are recommended:

- Policy makers should design and validate strategies aimed at the identified risk and protective SDH factors in order to improve utilization of skilled maternal healthcare services. This might support Ethiopia in achieving the set SDG targets. Social determinants affect pregnancy outcomes, and IPV has a great negative impact on women's health during all stages of pregnancy, including maternal mortality. Strategically targeting IPV could significantly alter the current situation.

- Ethiopia has a multi-ethnic population with cultural diversity per region, a key aspect to consider when developing strategies and interventions aimed at reducing health inequalities. In this perspective, political interventions with a multi-sectoral approach are important throughout the country.

- The maternal health program should emphasise equitable distribution of health infrastructure between rural and urban communities. This is especially important as some social determinants of health can be either harder or take longer to change locally.

- Given the significance of pregnancy complication, public awareness strategies, particularly focus on improving access to skilled care during pregnancy, childbirth, and postpartum period as are important interventions for all expecting women and their partners across Ethiopia.

7.3 Future research

This PhD project also identified some of areas that need further research, in order to improve the overall skilled maternal health care services with the goal of improving maternal health outcomes in the country. The areas for further research include the following:

- We encourage that the EDHS incorporate different levels of social determinants information at community, health facility and policy level. This would contribute to further insight as Ethiopia is aiming at achieving universal health coverage as part of Sustainable Development Goals.
- Further prospective studies should be conducted at large scale using mixed research methods. This would mitigate the challenges with only relying on retrospective cross-sectional surveys in Ethiopian context. This would facilitate designing intervention strategies that could be used for reducing maternal mortality within and between Ethiopian regions.

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Appendices
Appendix 1: Papers I, II, and III

Paper I

Social Determinants of Antenatal Care Service Use in Ethiopia: Changes Over a 15-Year Span

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Background: Improving maternal health in Ethiopia is a major public health challenge. International studies indicate that it is possible to improve maternal health outcomes through action on the Social Determinants of Health (SDH). This study aimed to explore the SDH that influence the antenatal care (ANC) utilization in Ethiopia over time.

Methods: The study used data from the nation-wide surveys conducted by the Ethiopian Central Statistical Agency (CSA) and ORC Macro International, USA in 2005, 2011, and 2016. A negative binomial with random effects at cluster level was used to model the number of ANC visits whereas a multilevel binary logistic regression modeled binary responses relating to whether a woman had at least 4 ANC visits or not. The model estimates were obtained with the statistical software Stata SE 15 using the restricted maximum likelihood method.

Results: Although the median number of ANC visits significantly increased between 2005 and 2016, the majority of the women do not obtain the four ANC visits during pregnancy as recommended. The odds of having at least four ANC visits were significantly lower among women: below 20 years, those living in the rural areas, having higher birth order, or Muslim. In contrast, higher educational attainment, higher socio-economic status, exposure to mass media, and self-reporting decision empowerment were significantly associated with having at least four ANC visits.

Conclusion: The use of ANC visits is driven mostly by the social determinants of health rather than individual health risk. The importance of the various SDHs needs to be recognized by Ministry of Health policy and program managers as a key driving force behind the country's challenges with reaching targets in the health agenda related to maternal health, particularly related to the recommended number of ANC visits.

Keywords: social determinants, ANC utilization, negative binomial RE, Ethiopia, sub-Saharan Africa

BACKGROUND

The global maternal mortality is at 830 deaths daily, 99% of these are in developing countries (1). Relative to other developing countries, the Ethiopian maternal mortality ratio of 412 per 100,000 live births is high (2). Maternal and newborn deaths can be prevented by high utilization and access to key essential services for mothers including antenatal care (ANC), skilled attendance at birth, and

postnatal care (3, 4). "The World Health Organization (WHO) recommended focused ANC (FANC) model consisting of at least four visits for low-risk pregnant women, with targeted interventions at each visit in 2002" (4). Few developing countries, including Ethiopia, have fully embraced and implemented the FANC model. In many resource-limited settings, increasing the number of ANC visits for women with uncomplicated pregnancies beyond four is not associated with improved birth outcomes (5, 6). According to the most recent Ethiopian Demographic Health Survey (EDHS) (2), 62 percent of women who gave birth in the 5 years preceding the 2016 survey had at least one antenatal care visit however, with suboptimal attendance of the recommended visits.

Social determinants are a major underlying cause for inequities in health. International studies suggest that it is possible to improve maternal health outcomes through action on the Social Determinants of Health (SDH), (7–10). This has, however, not been a systematic theme in the health agenda of low and middle-income countries (11, 12). In Ethiopia, the SDH are not systematically addressed in the Health Sector Transformation Plan (HSTP), although it is stated that targeting the social determinants of reproductive health could improve access to quality of services for mothers and children (13). To date, a number of studies have explored individual risk factors of antenatal care utilization in Ethiopia and driven by a complex set of factors that include demographic, cultural, and socio-economic factors, such as age of women, birth order, size of household, education, ethnicity, place of residence, religious background, marital status, employment, income level, and accessibility (14–19). Nonetheless, none of these studies have systematically reviewed the social factors to show their overall pooled effect on the interconnection between social determinants and ANC visit use at national level. Hence, demonstrating of these social factors on ANC use was warranted. The current study will explore the SDH at different levels and its associations with ANC utilization in Ethiopia over a period of 15 years.

MATERIALS AND METHODS

The study used data from the three latest EDHSs, conducted by the Ethiopian Central Statistical Agency (CSA) and ORC Macro International, USA, between April 2005—August 2005, December 2010—June 2011, and January 2016—June 2016. The full details of the methods and procedures used in the data collection of each EDHS, are published elsewhere (2, 14, 15). In the current study. We included total of 22, 799 weighted data from: 7306 women collected from 570 Enumeration Areas

(EA) (clusters) in 2005; 7908 women from 548 clusters in 2011; and data from 7585 women from 575 clusters in 2016. The eligibility criteria were: being in the reproductive ages 15–49 years, reporting at least one births in the last 5 years preceding the actual survey, and participating in one of the three surveys from any region in the country. The number of interviewed females were 14,070 in the 2005 EDHS, 16,515 in the 2011 EDHS, and 18,500 in the 2016, making a total of 49,085 respondents (2, 14, 15). However, among all female respondents, 22, 799 (46.5%) met the eligibility criteria, and those with complete data on one or more of the variables of interest. Data on these eligible women were pooled from the survey datasets allowing the analysis to span the period 2001 to 2016.

Outcome Variables

The analyses in the current study were based on two ANC-related outcomes: (1) The total number of ANC visits each participant had in the index pregnancy; (2) A binary outcome based on whether a woman had had four or more visits during the course of the pregnancy or not, according to at that time recommended four visits in the WHO guidelines for FANC (4), as recommended by the Ethiopian Ministry of Health during this period (13).

Explanatory Variables

Important individual and community level social determinants (SD) were considered in the analyses. *Individual level SD* included: marital status, religion, education level, employment status for both the participant and her partner, empowerment (relating to household decision making and whether the women were involved or not: on her own health care; large household purchases; and visits to family or relatives), household wealth index (low, middle, high), mass media (radio and TV) exposure (no exposure, exposed to either a radio or TV and exposed to both), sex of the household head, maternal age at last birth, birth order. The following *community level SD* were considered: place of residence, urban or rural, and if the region were classified as agrarian, pastoral, or urban.

Statistical Methods
Modeling Number of ANC Visits
The data available contained a significant number of zero counts due to the high number of women not attending ANC at all (71.5% in 2005, and 57.1% in 2011). We addressed these distributional challenges by fitting a negative binomial random effects (NBRE) model to our count data. It is important to note two key study assumptions that should be borne in mind when interpreting our findings: First, given the cross-sectional nature of DHS data, some of the information used in the analysis related to the time of the surveys rather than the time of birth and pregnancy. Secondly, we used 2005 as the reference survey year and estimated the incidence rate ratios (IRR), for 2011 and 2016. Estimates of IRR, which represents the *change* in the number of ANC visits in 2011 compared to 2016, relative

TABLE 1 | Socio-demographic characteristics of female survey participants in the 2005, 2011 and 2016, Ethiopian DHS.

Background characteristics	2005 n (%)	2011 n (%)	2016 n (%)	[a]P-value
n	7,306	7,908	7585	(Test for trend)
Individual Level SD				
Age when giving last birth (years)				
<20	992 (13.6)	861 (10.9)	704 (9.3)	<0.01
20-–34	4,308 (59.0)	5,021 (63.5)	4,922 (64.9)	<0.01
35–49	2,006 (27.4)	2,026 (25.6)	1,959 (25.8)	0.03
Order of the last birth				
First	1,190 (16.3)	1,399 (17.7)	1,431 (18.9)	<0.01
Second or third	2,089 (28.6)	2,462 (31.1)	2,282 (30.1)	0.05
Fourth or higher	4,027 (55.1)	4,047 (51.2)	3,872 (51.0)	<0.01
Marital status				
Not living with partner	535 (7.3)	723 (9.1)	480 (6.3)	0.02
Living with partner	6,771 (92.7)	7,185 (90.9)	7,105 (93.7)	0.02
Religion				
[1]Christianity	4,741 (64.9)	5,171 (65.4)	4,600 (60.7)	<0.01
Islam	2,382 (32.6)	2,563 (32.4)	2,824 (37.2)	<0.01
[2]Other	183 (2.5)	169 (2.2)	161 (2.1)	0.12
Education level of the women				
No education	5,734 (78.5)	5,270 (66.6)	4,791 (63.2)	<0.01
Primary	1,204 (16.5)	2,270 (28.7)	2,148 (28.3)	<0.01
Secondary and above	368 (5.0)	368 (4.7)	646 (8.5)	<0.01
[b]**Employment status of the women**				
Unemployed	5,497 (75.2)	5,132 (64.9)	5,416 (71.4)	<0.01
Employed	1,808 (24.7)	2,768 (35.0)	2,169 (28.6)	<0.01
Education level of their partners				
No education	4,282 (59.2)	3,858 (49.6)	3,346 (47.4)	<0.01
Primary	2,109 (29.2)	3,183 (41.0)	2,731 (38.7)	<0.01
Secondary and above	836 (11.6)	730 (9.4)	985 (13.9)	<0.01
Employment status of their partners				
Unemployed	204 (2.8)	148 (1.9)	1,042 (13.7)	<0.01
Employed	7,049 (97.2)	7,649 (97.2)	6,063 (79.9)	<0.01
In a polygamous relationship				
No	5,961 (88.6)	6,385 (88.9)	6,343 (89.3)	<0.01
Yes	769 (11.4)	800 (11.1)	762 (10.7)	0.34
Sex of household head				
Female	888 (12.2)	1,297 (16.4)	1,115 (14.7)	<0.01
Male	6,418 (87.8)	6,611 (83.6)	6,470 (85.3)	<0.01
[c]**Self-reported empowerment of women**				
Not involved at all in decision making	913 (13.5)	855 (11.9)	789 (11.1)	<0.01
Involved in one	1,306 (19.3)	981 (13.7)	491 (6.9)	<0.01
Involved in two	1,614 (23.8)	1,562 (21.7)	915 (12.9)	<0.01
Involved in at least three	2938 (43.4)	3787 (52.7)	4910 (69.1)	<0.01
Household wealth index				
Low	3,074 (42.1)	3,435 (43.4)	3,306 (43.6)	0.06
Middle	1,586 (21.7)	1,628 (20.6)	1,588 (20.9)	0.25
High	2,646 (36.2)	2,845 (36.0)	2,691 (35.5)	0.35
Exposure to mass media				
No exposure	4,630 (70.8)	3,214 (47.4)	5,024 (72.6)	<0.01
Exposed to either radio or TV	1,474 (22.6)	1,802 (26.6)	741 (10.7)	<0.01
Exposed to both radio and TV	434 (6.6)	1,767 (26.0)	1,156 (16.7)	<0.01

(Continued)

TABLE 1 | Continued

Background characteristics	2005 n (%)	2011 n (%)	2016 n (%)	[a]P-value
Use of antenatal care (ANC)				
No	5,225 (71.5)	4,517 (57.1)	2,818 (37.2)	<0.01
Yes	2,081 (28.5)	3,391 (42.9)	4,767 (62.8)	<0.01
Number of ANC Visits				
0	5,225 (71.5)	4,517 (57.1)	2,818 (37.2)	<0.01
1–3	1,164 (15.9)	1,856 (23.5)	2,342 (30.9)	<0.01
> 3	917 (12.6)	1,535 (19.4)	2,425 (31.9)	<0.01
Median	1.1	1.6	2.4	<0.01
[d] **Frequency of ANC services**				
Inadequate (<4 visits)	6,389 (87.8)	6,373 (80.9)	5,160 (68.2)	<0.01
Adequate (≥ 4 visits)	887 (12.2)	1,508 (19.1)	2,410 (31.8)	<0.01
Community level SD				
Area of residence				
Urban	632 (8.6)	1,188 (15.0)	965 (12.7)	<0.01
Rural	6,674 (91.4)	6,720 (85.0)	6,620 (87.3)	<0.01
Region				
Agrarian	6,691 (91.6)	7,271 (92.0)	6,895 (90.9)	0.13
Pastoralist	448 (6.1)	399 (5.0)	441 (5.8)	0.42
City	167 (2.3)	238 (3.0)	249 (3.3)	<0.01

[a]Chi-squared test for trend in proportions; [1]Orthodox, Catholic, Protestant [2]Traditional, and other unspecified; [b]Total figure may not add to 100 percent due to "do not know" and "missing cases." [c]Empowerment: decision (i. on her own health care; ii. large household purchases; and iii. visits to family or relatives in the household). [d]Frequency: Inadequate by Ethiopian MOH definition less than four ANC visits.

to the number of ANC visits in 2005, were obtained from the NBRE model.

Modeling Binary Responses

Due to data clustering at the survey level, binary data relating to whether a woman had at least four ANC visits in pregnancy or not, were modeled using a binary logistic multilevel regression model after adjustments for several confounders. We identified the main confounding variables from the literature as: age while giving last birth, order of the last birth, place of residence, and husband's education. Multiple multilevel logistic regression model was used to control the effects of potential confounders and from the model, adjusted odds ratios (AOR) with 95% confidence intervals were obtained. In addition, we computed an estimate of intra-cluster correlation coefficient (ICC), which described the amount of variability in the response variable attributable to differences between the clusters. We then used the McKelvey & Zavoina Pseudo R^2 to assess the fit of the model (20, 21).

Modeling Strategies

Both bivariate (data not given) "see **Tables S1a,b**." and adjusted models were fitted to count and binary response data. Individual and cluster level SD that were significantly ($P \leq 0.05$) associated with having ANC visits were included in the multiple Poisson and logistic regression models while controlling for the effect of other variables contained in the model. The model parameter estimates were obtained in the

statistical software StataSE 15 using the restricted maximum likelihood method (REML). The level of significance was set at $\alpha = 0.05$.

Ethical Consideration

The study was conducted by confirming to national and international ethical guidelines for biomedical research involving human subjects (22) including the Helsinki declaration. This study was reviewed and approved from the Regional Committee for Medical and Health Research Ethics (REK) and Norwegian Center for Research data (NSD) at the University of Oslo. Our team also requested permission to have access to the data from the CSA and ICF international by registering online on the website www.dhsprogram.com[1] and submitting the study protocol (see **Additional File 2**). We also highlighted the objectives of the study as part of the online registration process. The ORC Macro Inc removed all information that could be used to identify the respondents; hence, confidentiality of the data was maintained.

RESULTS

Participants' Characteristics

Out of the 22 799 eligible women, 32.0 % were from the 2005, 34.7% from the 2011 and 33.3% were from the 2016 survey with a mean age of 29.1 (±7) years. As detailed in **Table 1**, the majority

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[1]http://dhsprogram.com/data/available-datasets.cfm

TABLE 2 | Social determinants and estimates of negative binomial differences in the number of ANC visits pregnant women attended given as adjusted incident rates ratios (aIRR) using the 2005, 2011, and 2016 Ethiopian Demographic Health Surveys.

Survey periods	2005		2011		2016	
Covariates	aIRR (95% CI)	*P*-value	aIRR (95% CI)	*P*-value	aIRR (95% CI)	*P*-value
Individual level SD						
Age when giving last birth (ref: < 20 years)						
20–34	1.13 (0.97, 1.33)	0.12	1.21 (1.03, 1.41)	0.02	1.22 (1.05, 1.42)	0.01
35–49	1.14 (0.95, 1.38)	0.16	1.20 (1.00, 1.44)	0.05	1.16 (0.97, 1.38)	0.10
Order of the last birth (ref: first)						
Second or third	0.56 (0.49, 0.65)	<0.01	0.88 (0.76, 1.00)	0.06	0.92 (0.82, 1.03)	0.16
Fourth or higher	0.54 (0.46, 0.65)	<0.01	0.74 (0.63, 0.87)	<0.01	0.85 (0.74, 0.98)	0.03
Religion (ref:christianity[1])						
Islam	1.07 (0.93, 1.23)	0.32	0.83 (0.74, 0.94)	<0.01	0.87 (0.77, 0.97)	0.02
Others[2]	0.49 (0.30, 0.79)	<0.01	0.84 (0.60, 1.18)	0.32	1.16 (0.82, 1.65)	0.40
Women's education level (ref: no education)						
Primary	1.36 (1.19, 1.57)	<0.01	1.08 (0.97, 1.20)	0.16	1.09 (0.99, 1.20)	0.07
Secondary and above	1.71 (1.26, 2.32)	<0.01	1.42 (1.04, 1.93)	0.03	0.89 (0.73, 1.07)	0.22
Woman's employment status (ref: not employed)						
Employed	1.03 (0.92, 1.16)	0.58	1.25 (1.14, 1.38)	<0.01	1.11 (1.02, 1.21)	0.01
Partner's education level (ref: no education)						
Primary	1.00 (0.89, 1.12)	0.99	1.19 (1.08, 1.31)	<0.01	1.13 (1.03, 1.24)	0.01
Secondary and above	1.34 (1.12, 1.61)	<0.01	1.55 (1.27, 1.89)	<0.01	1.06 (0.91, 1.23)	0.43
Partner's employment status (ref: not employed)						
Employed	0.74 (0.55, 0.98)	0.03	0.80 (0.56, 1.12)	0.19	1.07 (0.95, 1.20)	0.27
In a polygamous relationship (ref: no)						
Yes	1.04 (0.88, 1.23)	0.63	0.93 (0.80, 1.08)	0.36	1.11 (0.97, 1.28)	0.13
Household wealth index (ref: low)						
Middle	1.39 (1.21, 1.59)	<0.01	1.23 (1.09, 1.38)	<0.01	1.27 (1.14, 1.41)	<0.01
High	1.84 (1.62, 2.10)	<0.01	1.51 (1.34, 1.70)	<0.01	1.16 (1.05, 1.29)	0.01
Exposure to media (ref: no mass media exposure)						
Exposed to either radio or TV	1.21 (1.07, 1.37)	<0.01	1.44 (1.29, 1.61)	<0.01	1.15 (1.01, 1.31)	0.04
Exposed to both radio and TV	1.53 (1.26, 1.86)	<0.01	1.80 (1.61, 2.02)	<0.01	1.14 (1.02, 1.28)	0.02
Sex of household head (ref: male headed)						
Female headed	1.13 (0.93, 1.37)	0.21	0.91 (0.78, 1.05)	0.20	0.96 (0.84, 1.09)	0.51
Self-reported empowerment of women (ref: not involved at all in decision making)						
Involved in one	0.78 (0.65, 0.93)	0.01	1.74 (1.44, 2.10)	<0.01	1.54 (1.27, 1.87)	<0.01
Involved in two	1.03 (0.86, 1.22)	0.78	1.77 (1.49, 2.10)	<0.01	1.53 (1.29, 1.81)	<0.01
Involved in at least three	1.05 (0.89, 1.24)	0.54	2.10 (1.79, 2.45)	<0.01	1.49 (1.30, 1.71)	<0.01
Community level SD						
Area of residence (ref: urban)						
Rural	0.38 (0.29, 0.49)	<0.01	0.45 (0.37, 0.55)	<0.01	0.79 (0.65, 0.96)	0.02
Contextual region (ref:agrarian)						
Pastoralist	1.37 (1.08, 1.72)	0.01	1.08 (0.86, 1.36)	0.49	1.01 (0.82, 1.23)	0.93
City	3.39 (2.15, 5.33)	<0.01	2.17 (1.55, 3.06)	<0.01	1.19 (0.83, 1.70)	0.33

[1]*Orthodox, Catholic, Protestant,* [2]*Traditional, and other unspecified; ref, reference category; aIRR, adjusted incidence rate ratios.*
a: adjusted for: age at last birth, order of last birth, religion, place of residence, region, women education, women employment, husband education, husband employment, polygams relation, wealth, media, sex of household head, empowerment.

of women were living with their partners (94%), were Christians (65%), residing in rural areas (91%), and from the agrarian regions (92%). Most of the women and their partners were not educated and of low socio-economic status. The employment status of the women improved slightly between 2005 and 2016 ($P < 0.01$), in contrast to the employment status of their partners, which dropped significantly from 97.2% in 2005, 2011 to 79.9% in 2016 ($P < 0.01$). More and more women were involved in at least three major decision making of the household ($P < 0.01$). Over the years, more women had at least one ANC visit ($P < 0.01$).

Determinants Influencing the Number of ANC Visits

Table 2 presents the estimates of the IRRs and the corresponding 95% confidence intervals (CI) obtained from the NB RE model. Women aged 20–34 years had more ANC visits compared to younger women after controlling for all other variables in the model. Birth order was inversely associated with the number of ANC visits. For example, women whose last births were number four or higher had 46% fewer visits in 2005, 26% fewer visits in 2011 and 15% fewer visits in 2016 than primipara women adjusting for all other variables in the model. Islamic women had across the surveys fewer ANC visits than Christian women. Throughout the survey periods, women in the rural areas had fewer ANC visits than women in the urban areas. Although the attendance improved, women in rural areas had 55% in 2011 and 21% in 2016 fewer ANC visits. Highly educated women (secondary education and above) had 71% more visits in 2005 and 42% more visits in 2011 than illiterate women. However, the effect of education on the number of ANC visits disappeared in 2016. Similar association was also noted related to the partners' education level.

The analyses (**Table 2**) also exposed that women with jobs had 25% more ANC visits in 2011 and 11% more ANC visits in 2016 than those unemployed. Household wealth index was significantly associated with the number of ANC visits in all three-survey years. Women from households with middle wealth indices had 39% in 2005, 23% in 2011 and 27% in 2016 more visits than women from low wealth indexed households. Women from high indexed households had 84% in 2005, 51% in 2011, and 16% in 2016 more ANC visits than women from households with low wealth index. In all three surveys, women exposed to mass media had more ANC visits than women who were not exposed to any mass media. For instance, being exposed to both radio and TV increased the number of ANC visits by 53% in 2005, 80% in 2011, and 14% in 2016. Similarly, women empowerment was also found to be an important determinant for ANC use. Women who were empowered stating three or more major household decisions had 2.1 times more in 2011 and 49% higher ANC visits in 2016 than women who were not empowered at all controlling for all other variables in the model. **Figure 1** show selected social determinant for the evolution of inequity in the mean distribution of ANC visits.

Trends and Changes in the Number of ANC Visits in Ethiopia

The changes in the number of ANC visits in each category of the predictors with the 2005 survey as the reference was observed (not shown) "see **Table S2**" The number of ANC visits increased in each category from 2005 to 2016. For instance, women below 20 years had 43% more ANC visits in 2011 and 2.7 times more ANC visits in 2016 relative to the number of antenatal visits in 2005. Illiterate women had 60% more visits in 2011 and 3.08 times more visits in 2016, relative to the number of visits they had in 2005. Rural women had 52% more visits in 2011 than in 2005 and 3.09 times more visits in 2016 than in 2005. Similar trends were also observed in different
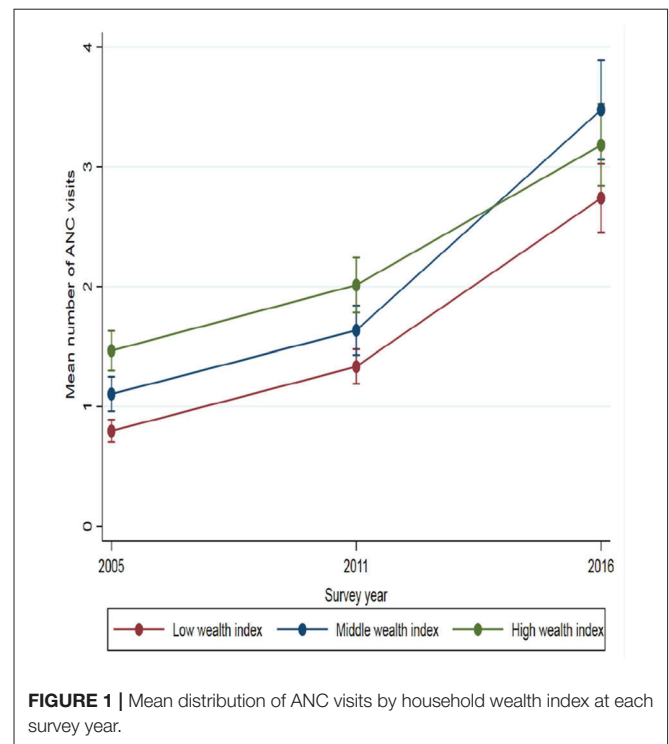
FIGURE 1 | Mean distribution of ANC visits by household wealth index at each survey year.

categories of employment status, partner's level of education and their employment status, levels of household wealth index, exposure to mass media and the levels of empowerment of women as measured by self-reported participation in decision making.

Changes in Completing Four or More ANC Visits Over Time

Changes in having at least four ANC visits during any pregnancy in each key social determinants over time were observed after controlling for potential confounding effects of age while giving last birth, order of the last birth, place of residence, and husband's education. Between 2011 and 2016, the odds of ANC use among pregnant women increased significantly by 2-fold: 1.13 (95% CI: 0.96 - 1.32, $p = 0.13$) to 2.14 (95% CI: 1.84 - 2.49, $p < 0.01$) (**Table 3**). Furthermore, the results for the covariates included in the multilevel logistic regression model as controls (not shown) "see **Table S3**" conformed that mothers age, birth order of the child, religion, place of residence, women's education, wealth index, media exposure, sex of household head, and women empowerment were significant determinants for completing four or more ANC visits. Overall for these Ethiopian women, the odds of having at least four ANC visits were significantly higher in 2016 than in 2005 ($P < 0.01$). We obtained an intra-cluster correlation coefficient (ICC) of 0.11 from the adjusted multilevel logistic regression. This means that the differences between the clusters account for 11% of the variability in the distribution of women with adequate ANC visits. Based on the McKelvey & Zavoina Pseudo R^2, the models provided a good fit of the data.

TABLE 3 | Adjusted multiple multilevel logistic regression model showing the association between selected individual and social covariates of women reporting at least four ANC visits in the 2011 and 2016 surveys relative to the 2005 Ethiopian Demographic Health Survey.

Survey periods	2011		2016	
Covariates	AOR (95% CI)	*P*-value	AOR (95% CI)	*P*-value
Overall time effect (ref: 2005)	**1.13 (0.96, 1.32)**	**0.13**	**2.14 (1.84, 2.49)**	**<0.01**
Individual level SD				
Age when giving last birth (years)				
<20	0.64 (0.41, 0.99)	0.05	1.36 (0.91, 2.04)	0.14
20–34	1.18 (0.97, 1.43)	0.10	2.32 (1.93, 2.79)	<0.01
35–49	1.32 (0.98, 1.79)	0.07	2.16 (1.62, 2.88)	<0.01
Order of the last birth				
First	0.83 (0.60, 1.15)	0.27	1.19 (0.88, 1.62)	0.27
Second or third	1.19 (0.97, 1.47)	0.10	2.53 (2.07, 3.08)	<0.01
Fourth or higher	1.29 (0.96, 1.75)	0.10	2.23 (1.79, 3.19)	<0.01
Religion				
Christianity[1]	1.23 (1.01, 1.51)	0.04	2.24 (1.84, 2.72)	<0.01
Islam	0.98 (0.76, 1.26)	0.86	1.97 (1.55, 2.51)	<0.01
Others[2]	1.43 (0.36, 5.65)	0.61	2.41 (0.65, 8.93)	0.19
Women's education level				
No education	1.20 (0.99, 1.47)	0.07	2.63 (2.18, 3.17)	<0.01
Primary	1.12 (0.83, 1.51)	0.45	2.01 (1.51, 2.67)	<0.01
Secondary and above	0.73 (0.43, 1.24)	0.25	0.78 (0.50, 1.22)	0.28
Woman's employment status				
Not employed	1.09 (0.89, 1.33)	0.42	2.31 (1.92, 2.79)	<0.01
Employed	1.15 (0.90, 1.47)	0.28	1.90 (1.49, 2.42)	<0.01
Partner's education level				
No education	1.08 (0.85, 1.37)	0.51	2.67 (2.15, 3.32)	<0.01
Primary	1.46 (1.12, 1.90)	<0.01	2.58 (2.00, 3.33)	<0.01
Secondary and above	0.80 (0.56, 1.14)	0.21	1.05 (0.77, 1.42)	0.77
Partner's employment status				
Not employed	0.89 (0.47, 1.69)	0.72	1.55 (0.97, 2.50)	0.07
Employed	1.15 (0.98, 1.35)	0.09	2.21 (1.89, 2.59)	<0.01
In a polygamous relationship				
No	1.15 (0.98, 1.36)	0.09	2.19 (1.86, 2.56)	<0.01
Yes	0.95 (0.60, 1.49)	0.82	1.82 (1.20, 2.76)	0.01
Household wealth index				
Low	1.38 (1.02, 1.88)	0.04	3.41 (2.57, 4.52)	<0.01
Middle	1.41 (0.96, 2.09)	0.08	3.27 (2.28, 4.70)	<0.01
High	0.97 (0.79, 1.20)	0.81	1.41 (1.15, 1.73)	<0.01
Exposure to media				
No mass media exposure	1.08 (0.86, 1.36)	0.49	2.47 (2.03, 3.00)	<0.01
Exposed to either radio or TV	1.01 (0.76, 1.35)	0.94	2.36 (1.74, 3.20)	<0.01
Exposed to both radio and TV	1.10 (0.79, 1.53)	0.59	1.40 (1.00, 1.96)	0.05
Sex of household head				
Male headed	1.25 (1.05, 1.48)	0.01	2.29 (1.95, 2.70)	<0.01
Female headed	0.57 (0.38, 0.86)	0.01	1.30 (0.89, 1.90)	0.17
Self-reported empowerment of women				
Not involved at all in decision making	0.71 (0.44, 1.15)	0.16	2.02 (1.31, 3.11)	<0.01
Involved in one	1.19 (0.81, 1.76)	0.38	3.69 (2.49, 5.48)	<0.01
Involved in two	0.97 (0.71, 1.33)	0.84	2.09 (1.51, 2.87)	<0.01
Involved in at least three	1.27 (1.03, 1.58)	0.03	2.03 (1.66, 2.47)	<0.01
Community level SD				
Area of residence				
Urban	0.71 (0.52, 0.98)	0.04	0.76 (0.56, 1.04)	0.09
Rural	1.29 (1.06, 1.56)	0.01	3.00 (2.50, 3.58)	<0.01
Contextual region				
Agrarian	1.37 (1.10, 1.71)	0.01	2.87 (2.34, 3.52)	<0.01
Pastoralist	0.74 (0.54, 1.00)	0.05	1.34 (1.00, 1.80)	0.05
City	1.06 (0.73, 1.53)	0.77	1.63 (1.13, 2.35)	0.01

[1]*Orthodox, Catholic, Protestant.* [2]*Traditional, and other unspecified; AOR, adjusted odds ratios; ref, reference category.*
a: adjusted for: time effect, age at last birth, order of lastbirth, religion, place of residence, region, women education, women employment, husband education, husband employment, polygams relation, wealth, media, sex of household head, empowerment.

DISCUSSION

This is the first Ethiopian study exploring the association between various SDH and the use of ANC during pregnancy over a longer time span. The study demonstrates that the ANC use in Ethiopia increased significantly from 2005 (28.5%) to 62.8 in 2016. However, only 32% of the Ethiopian women met the current Ethiopian policy recommendation of four ANC visits (**Table 1**). This is somewhat lower than in studies from other sub–Saharan African countries (41% to 87%) (23–25). The finding indicated that ANC use depended on the joint effect of individual and community level determinants (**Table 1**). We explored, on the basis of available evidences, some of those factors which act as social determinants of ANC use.

Globally, economically disadvantaged women suffer from maternal health inequity facilitated by several identifiable and modifiable social determinants, including household wealth (26–28). We demonstrate in this study that inequity is still there and the increase in utilization included the most vulnerable women, with low economic status or no formal education. Fortunately, the magnitude of disparity detected in our study was smaller than earlier studies in Ethiopia and other developing countries (29–35). Likewise, it is noteworthy that having a partner with a high educational level was one of the social determinants for ANC attendance in Ethiopia. The role of men in ANC use in a patriarchal society like Ethiopia, where women might seek a husband's permission or approval before taking decisions related to care, warrants further studies. The importance of men's education on maternal health issues, as well as the use of ANC, may play a critical role when politically shaping family priorities and health-seeking behaviors.

The current study demonstrates that there is significant differences in the use of ANC services between women of different socio-demographic, cultural, and geographic backgrounds. Women from rural communities have had fewer ANC visits, with significant variations in the number of ANC visits across administrative regions. This should guide regional and local initiatives aimed at increasing utilization of ANC and other preventive services. Especially, pregnant women from pastoralist regions might require special support as poor health resources might be attenuated by a lower literacy rate in this population (36). Muslim women had fewer ANC visits than Christian women across all survey years. This warrants exploration and more in-depth qualitative studies.

Our findings also indicate that women, not empowered in household decision-making or exposed to any form of mass media, have lower ANC utilization. This finding is consistent with other studies (37–40). For the last two decades the political environment in Ethiopia has enabled more options for accessing public health information (41). Findings from our logistic regression model also suggest that the odds of having at least four ANC visits in pregnancy were significantly higher among women in higher age groups and those with higher education status. In general, Ethiopian health policy initiatives such as deploying Health Extension Workers (HEWs) and Women Developmental Armies (WDA), thus identify pregnant woman in rural communities earlier, might have contributed to increased

awareness through health promotion, aimed at improved ANC utilization among poor women living in rural areas (42).

Strength and Weakness of the Study

The findings from this study are based on three waves of survey data that were collected by two reputable institutions: The Ethiopian Central Statistical Agency and the ORC Macro International, USA. The sample sizes of the three surveys were large providing high statistical power. The utilization of count data modeling provides methodologically advantage by taking discrete observations (counts) into account that made the model estimates reliable. Although these data were collected at three different time points, the outcome measures and the predictors were taken from different women in each survey. This makes it impossible to relate the changes in the utilization of the ANC services to the individual level but offer good estimates at the community or village level. Also, the cross-sectional nature of the data does not allow to draw causal inferences and DHS data are associated with recall bias that data was collected retrospectively on events that took place 5 years before the surveys.

CONCLUSION

The maternal health status could not be improved without fundamental changes in education, household wealth status, employment, media exposure, and empowerment. The importance of the various SDH needs to be recognized by the Ministry of Health policy and program managers as a key driving force behind the country's challenges with reaching targets in the health agenda related to maternal health, particularly related to the recommended number of ANC visits. To ensure adequate use of antenatal service in Ethiopia, upstream approaches that address social issues need to be considered. Such efforts could help improve health equity for maternal health outcomes in the country. More research should investigate whether the SDH identified in this study impact other maternal health indicators.

ETHICS STATEMENT

The EDHS data used in this study has an ethical clearance from at least one of the following institutes: Ethiopian Central Statistical Authority (CSA); Federal Ministry of Health; National Research Ethics Review Committee (NRERC); and the Institutional Review Board of ICF International through DHS Program. Consent was obtained from each study participant before conducting an interview. We obtained the data by submitting the study protocol through registering online on the website www.dhsprogram.com.

AUTHOR CONTRIBUTIONS

SO, VT, and JM conceived the research. IM and SO designed the study, analyzed the data, and developed the first draft. JM,

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2019.00161/full#supplementary-material

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Conflict of Interest Statement: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Paper II

II

Maternal exposure to intimate partner violence and uptake of maternal healthcare services in Ethiopia: Evidence from a national survey

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Abstract

Background: Women exposed to Intimate Partner Violence (IPV) may not utilize health care optimally, including skilled maternal health services. The current study aims to explore this association among Ethiopian women and to assess if women's educational attainment and wealth status moderate this association.

Methods: The analyses included 2836 currently married women with one live birth in the five years preceding the 2016 Ethiopian Demographic and Health Survey (EDHS) participating, in the domestic violence sub-study. Exposure was determined by maternal reports of physical, emotional, or sexual IPV. The utilization of antenatal care (ANC) and place of delivery were used as proxy outcome variables for uptake of skilled maternal healthcare utilization. Women's education attainment and wealth status were selected as potential moderators as they can enable women with psychological and financial resources to combat impact of IPV. Multilevel logistic regression analyses were used to explore the association between spousal IPV and maternal health outcomes. Moderation effects by education and wealth status were tested, and the data stratified. Using statistical software Stata MP 16.1, the restricted maximum likelihood method, we obtained the model estimates.

Results: After adjusting for potential confounding factors, the association between maternal exposure to emotional IPV and adequate use of ANC was statistically significant (**OR = 0.77, (95% CI:0.61 - 0.98**)). Maternal exposure to emotional IPV made a difference in ANC use probability with an approximately 3% points increase in the secondary or higher education group, and about 5% points lower in the primary/none education. Additionally, maternal exposure to emotional IPV variable makes a difference in ANC probability of 3% points lower in the high wealth sub-group, and about 4% points lower in the low wealth sub-group. Associations with physical or sexual IPV were not identified.

Conclusion: Exposure to emotional IPV is associated with poor uptake of adequate ANC service for married Ethiopian women. When service providers identify expecting mothers reluctant to use maternal healthcare services, exposure to violence should be explored, and women should be encouraged to seek services.

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Keywords: Maternal exposure, intimate partner violence, uptake of maternal healthcare, DHS, Ethiopia

1. Background

Intimate Partner Violence (IPV) is defined as the intentional use of physical force, emotional or sexual abuse, by an intimate partner. IPV is linked to a wide range of health problems that directly or indirectly impact maternal morbidity and mortality [1]. As 30% of women report emotional, physical and/or sexual violence by an intimate partner in their life time, it is a significant global public health problem [2]. Emotionally, physically or sexually abused women report higher rates of health problems including preterm birth, low birth weight, abortion, depression, and HIV/STI infection, [1]. The negative impact of IPV are not limited to women's health but children in these families are also vulnerable to the physical and mental health consequences of such adverse experiences [3]. Exposure to IPV has an inconsistent and often nonlinear relationship with the uptake of maternal healthcare services. Some studies indicate a negative association of different forms of IPV and the uptake of adequate antenatal care (ANC), skilled delivery care, and postnatal care [4 – 10], while studies in developing countries conclude that different forms of IPV do not have any significant association with the uptake of skilled maternal healthcare [11 – 12].

IPV is common in urban and rural Ethiopian families. One-third (34%) of ever-married women aged 15-49 years report experience of physical, sexual, or emotional IPV [13]. Furthermore, close to one in five women reported at least three form of marital controlling behaviour from their partner [13]. Living in rural areas, low maternal education and poor household wealth, are strong predictors of IPV [14 - 15]. Literature regarding the effects of IPV on women's health in Ethiopia found associations between IPV and adverse birth outcomes [16], unintended pregnancy [17], pregnancy loss [18], unmet need for family planning [19], depression [20 - 21], Human Immuno-deficiency Virus (HIV) status [22], and antiretroviral therapy adherences [23]. Mediation effect of contraceptive use and women's autonomy on the relationship between IPV and unintended pregnancy has also been documented [24].

In addition, some regional studies reported linkages between exposure to IPV and maternal health outcomes in Ethiopia [25 - 27]. A number of socio-demographic factors are known to influence exposure to IPV, or the uptake of appropriate maternal healthcare services [4,10, 12,28]. Other studies have demonstrated that mother's educational attainment and household wealth status together accounted for a large share of impact on IPV and in the uptake of maternal health services in Ethiopia [29]. Mothers with low educational attainment and low income might have a greater susceptibility to the adverse impacts of IPV than mothers with

higher educational attainment and income, who may be protected by greater psychological, social and financial resources. However, no earlier study has explored if there are any moderators of the relationship between different forms of IPV and maternal health outcomes in Ethiopia. The current study aims to understand the effect of IPV on women's uptake of maternal healthcare services (adequate ANC visits and use of health facility delivery) and whether women's educational attainment or wealth status moderate any relationship between IPV and maternal health outcome using a large Ethiopian national sample. Determining if education level and wealth status are moderators of the association between IPV and maternal healthcare service would help clarify which women tend to be negatively affected by IPV and assist in tailoring and targeting the intervention to those most likely to respond to specific intervention efforts.

2. Materials and methods

2.1 Data source: The publically available data of the fourth nationally representative survey of the 2016 Ethiopia Demographic and Health Survey (EDHS) was collected between January – June 2016. The full details of the data collection methods and procedures as well as the standards for protecting the privacy of study participants have been published [13]. IPV information for ever-married women age 15–49 ever reporting exposure of spousal emotional, physical, or sexual violence was collected using a modified and abbreviated version of the Revised Conflict Tactics Scales (CTS2) [30]. After excluding missing values, a total of 3061 (unweighted) ever-married women in reproductive age were considered in this study [13]. Special domestic violence weights were used to make the survey data on violence nationally representative accounting for non-response [31]. The final study sample was further limited to those who were currently married and had at least one live birth in the five years preceding the survey (weighted, n=2836).

2.2. Measurement of Variables

2.2.1. Outcome measurement

The analyses in the current study address two maternal healthcare binary outcomes: (1) adequate antenatal care (ANC) use; categorized into four or more visits (≥4) and less than four visits (<4, this included women with no visit), in accordance with the 2002 WHO ANC model [32], recommended by the Ethiopian Federal Ministry of Health (FMoH), and (2) place of delivery, categorized as home birth or birth at a health facility.

2.2.2. Predictors

The predictor variables were reported as exposure to emotional, physical, or sexual IPV. In the current study, emotional IPV is a composite binary variable based on responses to three questions: Had the husband ever: (1) said or did something to humiliate her in front of others; (2) threatened to hurt or harm her or someone she cared about; or (3) insulted or made her feel bad about herself, with yes (experiencing at least one of these); and (not experiencing any), [13, 28, 33]. Similarly, physical IPV is a composite binary variable based on women's responses to the questions about whether the husband ever had done any of the seven following acts: (1) push, shake, or throw something; (2) slap; (3) twist arm or pull hair; (4) punch with fist or with something that could be harmful; (5) kick, drag, or beat her up; (6) tried to choke or burn her; (7) threaten or attacked with any material to deliberately hurt her at one point in lives [13, 28, 33]. Lastly, sexual IPV was, responding yes to any of these three questions: (1) physically forced to have sex; (2) forced to other sexual acts; (3) forced by threats when she did not want to [13, 28, 33].

2.2.3. Moderators

Based on the literature, two variables – women's education level and household wealth status were considered as potential moderators [27 - 28]. Education level of the woman was based on: the highest level of education attained by the respondent and grouped into two: as primary/none, or secondary and above. Household wealth index; a composite index of household possessions, assets, and amenities, derived using principal component analysis (PCA), grouped as: low household wealth status (poorest, poorer and middle); and high household wealth status (richer and richest) [34].

2.2.4. Confounders

Based on the current literature, we included several potential confounding variables. The woman's self-reported age at the time of the survey, was categorized as younger (15–24 years); middle (25–34 years) and older (35–49 years) as age affects health seeking behaviors, [35]; the order of the last birth closes to the time of the survey; education level of the partner reported as none, primary or secondary and above; exposure to mass media (composite variable based on the access to and frequency of use of radio and/or television at least once a week), [36]; decision-making autonomy in making three household decisions (access to health care; large household purchases; and freedom to visit families and relatives), grouped into, low autonomy (no participation in any decision making), medium autonomy (participation in 1 or 2) and high

autonomy (participation in all decision making); attitude towards wife beating was created using scenarios: (1) she burns the food; (2) she argues with him; (3) she goes out without telling him; (4) she neglects the children and (5) she refuses to have sex with him. A woman was regarded as accepting violence if she said it was justified for any of these five reasons and as rejecting if she reported that beating was not justified for any reasons, [37] and the place of residence at the time of the survey categorized as urban or rural. The regions were defined according to the FMoH as agrarian (Tigray, Amhara, Oromia and SNNPR), pastoralist (Somali, Afar, Gambella, and Benishangul Gumuz regions) and city dwellers (Addis Ababa, Dire Dawa, and Harar).

2.3. Statistical analysis

We used bivariate analyses to describe the characteristics of the women in relation to the outcome of interest and each type of IPV along with the Pearson Chi-square (X^2) test of independence to examine whether there were any significant differences in the sociodemographic characteristics, and the associated *p*-value calculated. Sampling weights were applied for the data when we computed both the bivariate and multivariate analysis to manage the unequal probability of selection between the strata defined by geographical location and for non-responses. We fitted separate random-effects multilevel logistic regression models, for each outcome of interest (ANC and delivery care) using only the variables that were significantly associated with each outcome and type of IPV in the bivariate models.

2.3.1. Modeling Binary Responses

We used a binary logistic multilevel regression model, as the data was clustered at the survey level (2836 women nested in 626 clusters). Univariate logistic regression was performed to estimate the crude odds ratios (COR), (See, additional File S1). And the 95% confidence intervals (95%CI) of facility delivery or not, and if she had at least four ANC visits or not. Potential predictors and confounders significantly associated with the outcome variables in the univariate analysis were entered in the multilevel logistic regression analysis. We conducted three separate fully adjusted models for each type of IPV (emotional, physical, and sexual violence) for each outcome variable while controlling for confounders to identify the association between spousal IPV on the use of maternal healthcare services.

To assess any moderating effect of education and/or wealth in the association between exposure to spousal IPV and maternal healthcare services, interactions were checked (interaction between IPV and education/wealth). Finally, analyses of the association between

exposure to spousal IPV and maternal healthcare services were stratified by level of education and household wealth status. Prior to the multivariate regression analysis, multi-collinearity was checked using variance inflation factors (VIF) and variables with VIF less than 10 were considered for the subsequent analysis. In addition, we computed an estimate of intra-cluster correlation coefficient (ICC), which described the amount of variability in the response variables attributable to differences between the clusters. We examined the model fit measured using the Akaike information criteria (AIC). A lower AIC value represents a better model fit [38]. IBM SPSS 26.0 was used for data preparation and the model parameter estimates were obtained in the statistical software Stata MP 16.1 using the restricted maximum likelihood method (REML). The level of significance was set at 0.05.

2.4. Ethical Consideration

The study adhered to national and international ethical guidelines for biomedical research involving human subjects [39], including the Helsinki declaration. The study protocol was reviewed and approved by the Regional Committee for Medical and Health Research Ethics (Code number: 2016/967/REK sør-øst A) and the Norwegian Centre for Research Data (Code number: 48407) at the University of Oslo. Our team also requested permission and access to the data from the CSA in Ethiopia and Inner City Fund (ICF) international by registering online on the website www.dhsprogram.com [40] and submitting the study protocol by highlighting the objectives of the study as part of the online registration process, (See, additional File S2). The ICF Macro Inc, removed all information that could be used to identify the respondents; hence, anonymity of the data was maintained.

3. Results

3.1. Characteristics of participants

The mean age of all respondents was 29.1 (SD±6.6) years. The prevalence of lifetime exposure to emotional and physical IPV among mothers were nearly 23.0% each, while 9.4% of the study participants reported encountering sexual IPV. The proportion of utilization of skilled maternal healthcare was relatively lower among women exposed to any violence. For instance, 23.6% of women who were exposed to emotional IPV had adequate uptake of ANC as compared to 32.2% of women not exposed to emotional IPV. Similarly, 22.4% of women who were exposed to sexual IPV had adequate uptake of ANC, vs. 31.0% of those not exposed to sexual IPV, (Fig 1).
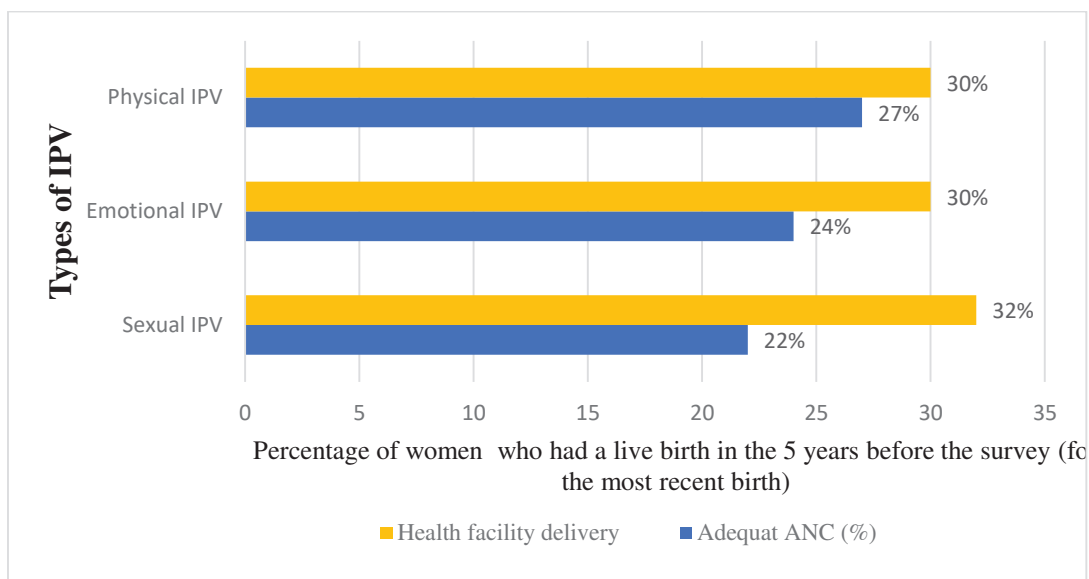
Fig.1 Prevalence of maternal healthcare service use among women's who had exposure to intimate partner violence in Ethiopia (2016, EDHS).

Bivariate associations show considerable differences in the use of maternal healthcare services (adequate ANC visits, and health facility delivery) by socio-demographic background characteristics. The overall use of maternal healthcare services was higher among women in urban areas (59.4% for adequate ANC & 85.2% for health facility delivery) as compared to their rural counterparts (26.2% for adequate ANC & 27.0% for health facility delivery). The percentage of women receiving maternal healthcare services was lower among older women (35 -49 years). Similarly, the percentage of women with adequate ANC (32.9%) and health facility delivery (36.8%) was higher among those respondents who had medium decision-making autonomy as compared to other sub-groups. Women who had exposure to mass media received a higher proportion of maternal healthcare services (49.6% for adequate ANC, & 62.9% for health facility delivery), as compared to those who had no mass media exposure. The result also showed that the utilization of maternal healthcare services differs considerably across geographical contextual regions. The usage of adequate ANC was highest was in the city dweller's, while the lowest ANC utilization was observed in the pastoralist regions. The same differences is observed for health facility delivery, (Table 1).

Table 1. Sociodemographic characteristics and exposure to IPV by utilization of maternal healthcare services among 2836 women in the 2016 Ethiopian Demographic Health Survey.

	Maternal Health Service Utilization			
Types of maternal healthcare	ANC		Place of delivery	
	Adequate ANC visits	Inadequate ANC visits[b]	Home	Health facility
Mean age (Year) (±SD)	28.7 (±6.2)	29.3 (±6.7)	29.6 (±6.7)	28.2 (±6.2)
Intimate Partner Violence (IPV)	856 (30.2%)	1980 (69.8%)	1871 (66.0%)	965 (34%)
Emotional IPV	*p*[a] *=0.003*		*p =0.148*	
Yes (23.1%)	23.6	76.4	69.7	30.3
No (76.9%)	32.2	67.8	64.9	35.1
Physical IPV	*p = 0.231*		*p = 0.107*	
Yes (23.4%)	27.4	72.6	69.9	30.1
No (76.6%)	31.0	69.0	64.8	35.2
Sexual IPV	*p = 0.051*		*p = 0.386*	
Yes (9.4%)	22.4	77.6	67.9	32.1
No (90.6%)	31.0	69.0	65.8	34.2
Individual level Factors				
Age (years)	*p = 0.043*		*p = 0.000*	
15—24 (22.4%)	28.2	71.8	57.5	42.5
25—34 (51.7%)	33.1	66.9	66.5	33.5
35—49 (25.9%)	26.1	73.9	66.0	34.0
Order of last birth	*p = 0.000*		*p = 0.000*	
First (18.2%)	38.6	61.4	42.5	57.5
Second or third (30.2%)	34.5	65.5	59.2	40.8
Fourth or higher (51.6%)	24.7	75.3	78.2	21.8
Education level of the women	*p = 0.000*		*p = 0.000*	
Primary or No education (90.9%)	27.1	72.9	71.4	28.6
Secondary and above (9.1%)	60.4	39.6	12.4	87.6
Education level of their partners	*p = 0.000*		*p = 0.000*	
No education (45.4%)	21.7	78.3	76.8	23.2
Primary (35.3%)	33.5	66.5	66.7	33.3
Secondary and above (19.3%)	44.0	56.0	39.3	60.7
Household wealth index	*p = 0.000*		*p = 0.000*	
Low household wealth status (65.5%)	24.1	75.9	76.1	23.9
High household Wealth status (34.5%)	41.7	58.3	46.9	53.1
Exposure to mass media	*p = 0.000*		*p = 0.000*	
No exposure (67.2%)	24.1	75.9	74.4	25.6
Exposed to either radio or TV (19.2%)	37.9	62.1	56.9	43.1
Exposed to both radio and TV (13.5%)	49.6	50.4	37.1	62.9
Relationship Factors				
Attitude towards Wife Beating	*p = 0.007*		*p = 0.084*	
Accepts violence (fully) (69.0%)	35.4	64.6	61.6	38.4
Rejects violence (31.0%)	27.6	72.4	68.2	31.8

Decision-making Autonomy[c]		p = 0.000		p = 0.001	
No autonomy (10.0%)	12.8	87.2	80.6	19.4
Medium autonomy (22.0%)	32.9	76.1	63.2	36.8
High autonomy (68.1%)	32.1	67.9	64.6	35.4
Contextual community level					
Place of residence		p = 0.000		p = 0.000	
Urban (12.1%)	59.4	40.6	14.8	85.2
Rural (87.9%)	26.2	73.8	73.0	27.0
Contextual Regions		p = 0.000		p =0.000	
Agrarian (91.4%)	29.2	70.8	66.9	33.1
Pastoralist (5.8%)	22.6	77.4	77.8	22.2
City dweller's (2.8%)	77.6	22.4	12.0	88.0

Note: a) *P* refers to a *p*-value of the Chi-squared test(X^2); b) Inadequate - less than four ANC visits; Adequate & Inadequate ANC visits are additive. c) Total figure may not add to 100 percent due to "do not know" and "missing cases;

3.2. Association between maternal exposure to IPV and use of maternal healthcare services

The association between maternal exposure to emotional IPV and the use of adequate ANC was found to be statistically significant (**OR = 0.77, (95% CI:0.61 - 0.98)**), after controlling for significant confounders. In a model adjusting for key covariates, we identified no significant association between neither physical IPV nor sexual IPV and the use of ANC. Similarly, we found no significant association between any forms of IPV and utilization of health facility delivery. We obtained an ICC of 0.23 for ANC and 0.35 for health facility delivery from the adjusted multilevel logistic regression. This implies that the differences between the clusters account for 23% of the variability in the distribution of women with uptake of adequate ANC visits and 35% of the variability in the distribution of facility delivery, (Table 2). The results of the complete regression for all determinants by emotional type of IPV and outcome variables are available: (See additional File S3).

Table 2. Multiple multilevel logistic regression for association between maternal ever exposure to different forms of IPV and use of maternal healthcare services for currently married women.

| | ANC Visits & Place of delivery | |
	Adequate ANC visits AOR (95 % CI)	Health facility delivery AOR (95 % CI)
Emotional IPV		
No (ref) (76.9%)	1 (1,1)	1 (1,1)
Yes (23.1%)	**0.77 (0.61, 0.98)****	1.02 (0.78, 1.35)
Physical IPV		
No (ref) (76.6%)	1 (1,1)	1 (1,1)
Yes (23.4%)	0.95 (0.74, 1.21)	0.84 (0.63, 1.12)
Sexual IPV		
No (ref) (90.6%)	1 (1,1)	1 (1,1)
Yes (9.4%)	0.81 (0.55, 1.20)	0.99 (0.64, 1.52)
Intraclass Correlation Coefficient	0.23	0.35
Akaike Information Criterion	3179.15	2590.30

Note: sig. at **sig. at 5% level; ref = reference group; CI = Confidence Interval; n = Number of participants; IPV = Intimate Partner Violence; ANC = Antenatal Care; AOR = Adjusted Odds ratios. Models adjusted for: Mother's age, birth order, husband's education, media exposure, decision making autonomy, place of residence, and contextual regions.

3.3 Moderation of education or wealth on the association between maternal exposure to IPV and use of maternal healthcare service utilization

To assess whether education and/or wealth moderated the effects of spousal IPV on maternal health outcomes, wealth/education and IPV interaction terms (wealth/education x emotional IPV) were analysed. In the interaction model, neither the woman's education *(AOR = 1.55, p = 0.299)*, nor the household wealth status *(AOR = 1.08, p = 0.754)*, had a significant moderation effect on the relationship between exposure to emotional IPV and ANC service utilization, (Table 3).

Table 3. Association between ever exposure to emotional IPV, and utilization of antenatal care and the moderating effect of education and wealth.

Adequate ANC Visits					
education x emotional IPV Model			**wealth x emotional IPV Model**		
Characteristics	AOR (95 % CI)	*P-value*	**Characteristics**	AOR (95 % CI)	*P-value*
Emotional IPV			**Emotional IPV**		
No (ref)	1 (1,1)		No (ref)	1 (1,1)	
Yes	0.75 (0.58, 0.96)	*p = 0.023***	Yes	0.76 (0.56, 1.02)	*p = 0.065*
Education level of the women			**Household wealth index**		
Primary or No education (ref)	1 (1,1)		Low household wealth status (ref)	1 (1,1)	
Secondary and above	1.53 (1.03, 2.26)	*p = 0.034***	High household Wealth status	1.21 (0.90, 1.63)	*p = 0.204*
Emotional IPV and Education level of the women (interaction term)			**Emotional IPV and wealth index** (interaction term)		
Yes X Secondary and above	1.55 (0.68, 3.53)	*p = 0.299*	Yes X High wealth index	1.08 (0.66, 1.77)	*p = 0.754*

Note: sig. at **sig. at 5% level; ref = reference group; CI = Confidence Interval; ANC = Antenatal Care; AOR = Adjusted Odds ratios. Models adjusted for: Mother's age, birth order, mother's and husband's education or household wealth index, media exposure, decision making autonomy, place of residence, and contextual regions.

Average marginal effects model

Although, no significant interaction effect was detected in the model between exposure to emotional IPV and maternal education (Table 3), we observed two different effects of emotional IPV on ANC use: The effect of exposure to emotional IPV on ANC is significant in the negative direction among those with primary/none education. In those with secondary education and above, the direction appears to be positive, but the association was not statistically significant. Maternal exposure to emotional IPV variable makes a difference in ANC probability of approximately 3% points increase in the secondary or higher education group, and about 5% points lower in the primary/none education group. Regarding wealth, the effect of exposure to IPV on ANC is borderline significant in the negative direction for low wealth index. In those with high wealth sub-group, the direction appears to be negative, but the association was not statistically significant. Maternal exposure to emotional IPV variable makes a difference in ANC probability of 3% points lower in the high wealth sub-group, and about 4% points lower in the low wealth sub-group, (See, additional File S4).

 In the stratified analyses, women who exposed to spousal emotional IPV were less likely to use adequate ANC service for women who belonged to with no education or who did not complete their primary education (*AOR = 0.74, (95% CI:0.57 - 0.96, P = 0.021*)), than those with secondary or higher education, (*AOR = 1.24, (95% CI:0.61 - 2.53 P = 0.546*)). Stratified analysis did not indicate meaningful difference in emotional IPV effects on adequate ANC uptake by household wealth status; (See, additional File S5). The stratified analyses also did not show any statistical effect of IPV on the utilization of health facility delivery in any subgroup.

4. Discussion

In this paper, we identified associations between emotional IPV and the uptake of maternal healthcare services in Ethiopia. The observed associations between maternal exposure to emotional IPV and the low uptake of ANC services are in concert with international studies [9, 41 - 42]. Emotional IPV affects a woman's emotional and physical health; compromising pursuit of appropriate maternal healthcare [10]. Additionally, the finding revealed no significant association between specific forms of IPV and utilization of health facility delivery. This is consistent with a statewide survey in Malawi [43]. The results may partly underline the effectiveness of the Ethiopian health extension workers in timely identification of pregnancies and encouraging to access health facility services closer to their communities [44]. Therefore,

regardless of whether women may experience IPV in these settings, they still manage skilled delivery since these initiatives make the services easily accessible.

To the best of our knowledge, this is the first Ethiopian study exploring if there is moderation effect of women's educational attainment or household wealth status on the adverse impact IPV has on maternal healthcare service utilization. Adjusting for relevant confounding variables, the uptake of adequate ANC among women with less education (primary/none) were affected by exposure to emotional IPV. This finding is consistent with previous reports that low education reduces a woman's exposure as well as access to resources, thus increasing the acceptance of violence and maintains unequal gender norms [28]. Possibly, a higher level of education may be a protective factor, since some studies report less IPV among women with higher level of education [33]. International studies emphasize the high risk of poor uptake of skilled maternal healthcare among IPV exposed women with low education [45 - 48]. Contrary to prior research from Ethiopia [25 – 27, 49 – 50] and elsewhere [6,8- 9, 51], findings from the current study do not demonstrate a significant association between physical or sexual IPV and maternal healthcare service utilization. The methodological quality of prior studies, the various IPV assessment tools used, sample size or outcome measurement variability might contribute to the disparity among studies.

Maternal healthcare utilization in Ethiopia in general has been lower than in most other countries [52]. The factors affecting uptake of services are many: education, empowerment, economic attainment and IPV affect all aspect of women's lives. This is compounded in Ethiopia by cultural diversity, institutionalized gender roles and structural power imbalances between women and men [53]. The social inequalities can increase the risk as well as the overall impact of IPV, constraining women from access to maternal healthcare services [4]. This is highlighting the importance to consider IPV when planning and implementing maternal health programs in the Ethiopian society. Given the high prevalence of IPV in Ethiopia, focused efforts are required by government and other stakeholders to change the cultural, structural, institutional and social barriers to mitigate impact and reduce occurrence of IPV. The perspective of community stakeholders and healthcare providers related to IPV underscore these challenges [54 – 55]. Together with other recent studies addressing the effect of IPV on maternal health and healthcare utilization [25, 46], it is evident that in order to reach several of the health care and political goals set in Ethiopia, IPV prevention has to be high on the agenda. There is a critical need to integrate IPV prevention and intervention efforts within the existing maternal and child health programmes to address the needs of abused pregnant women and

contribute to change in maternity care in Ethiopia for the achievements of the sustainable development goals.

Study strength and limitations

This study used nationally representative data and the sample size of the survey was relatively large, providing high statistical power. However, our reliance on cross-sectional data and the retrospective nature of the study limits the ability to draw causal inferences between exposure to IPV and the outcomes. Women in the current survey may not have felt comfortable to disclose exposure of IPV during pregnancy, and the data collection may be subject to recall or response bias. In addition, we used a measure of lifetime experience of IPV to capture exposure to violence, but the point at which violence was experienced is not specified and may not overlap with time period leading up to the birth for which care utilization is reported. The study assessed lifetime IPV and the use of maternal healthcare services rather than IPV within the last 12 months. Another factor might be the contextual acceptance of sexual IPV as it is defined in the data collection tools used in the current survey. The cultural appropriateness of the international data collection tools used in the DHS needs further study in Ethiopia.

5. Conclusion

Exposure to emotional IPV was associated with poor uptake of adequate ANC service for married Ethiopian women. There is a need to develop IPV prevention strategies as well as identify and manage IPV in routine maternal healthcare service settings in the Ethiopian health care system as it affects maternal healthcare utilization.

Acknowledgments

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Supporting information

Additional File Table S1. Univariate logistic regression. (pdf)

Additional File S2. Approval letter for data access. (pdf)

Additional File Table S3. The full results of Regression Analysis. (pdf)

Additional File Table S4. Average marginal effects models. (pdf)

Additional File Table S5. Stratified adjusted logistic regression model. (pdf)

Paper III

III

Article

Uptake of Skilled Maternal Healthcare in Ethiopia: A Positive Deviance Approach

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Abstract: Risk factor approaches are often used when implementing programs aimed at enforcing advantageous health care behaviors. A less frequently-used strategy is to identify and capitalize on those who, despite risk factors, exhibit positive behaviors. The aim of our study was to identify positive deviant (PD) mothers for the uptake of skilled maternal services and to explore their characteristics. Data for the study came from two waves of the Ethiopian Demographic and Health Surveys conducted in 2011 and in 2016. PD mothers were defined as those reporting no formal education but with adequate use of antenatal care (ANC) and/or institutional delivery services. Two-level multilevel regression analysis was used to analyze the data. Factors associated with PD for the use of ANC services were: partner's education status, involvement in household decision making, exposure to media, and distance to the health facility. Factors associated with PD for health facility delivery were: partner's education, woman's employment status, ANC visit during index pregnancy, exposure to media, and perceived challenge to reach health facility. Rural-urban and time-related differences were also identified. The positive deviance approach provides a means for local policy makers and program managers to identify factors facilitating improved health behaviour and ultimately better health outcomes while acknowledging adverse risk profiles.

Keywords: positive deviance; skilled maternal healthcare; multilevel approach; DHS; Ethiopia

1. Introduction

Maternal healthcare service utilization is an important predictor of favorable maternal and child health outcomes. Improving maternal and newborn healthcare is a priority of the Sustainable Development Goals (SDGs) [1]. In Ethiopia, 27–33 mothers die every day due to birth-related complications, equivalent to a maternal mortality ratio (MMR) of 412 per 100,000 live births [2]. Despite a decline from 871 per 100 000 live births in 2000 [3], much work is needed in Ethiopia to reach the political MMR goal of less than 70 deaths per 100,000 live births by 2030 [1]. Evidence suggests that maternal deaths are reduced by widespread utilization of skilled maternal healthcare services [4–6]. There is currently an underutilization of all maternal healthcare services by a significant proportion of women [2,7–9], and strategies and programs aimed at improving use of maternal health services have been implemented [10,11]. Despite these efforts, a recent report states that in Ethiopia less than half of all pregnant women received skilled maternal healthcare services (antenatal, delivery, and postnatal care) by a trained health professional at home or at health facilities [12,13].

Previous studies focusing on all women of reproductive age have identified factors influencing uptake and utilization of skilled maternal healthcare at multiple levels. Individual and household level factors identified are maternal age and education, household wealth, women's decision-making power, parity, the woman's or husband's occupation, and media exposure [14,15]. Community level factors are geographical accessibility, residing in a community where women have higher levels of health knowledge, decision-making autonomy, low community poverty rate, and availability of community media [16]. At the policy level, government health strategies aimed at improving utilization of skilled maternal services have influenced uptake and utilization of maternal healthcare services [17–19].

Prior research from different areas of public health also shows that in every community there are certain individuals or groups whose behaviors and strategies enable them to find better solutions to common challenges than their peers, despite access to the same limited resources. These individuals are considered positive deviants (PDs) [20]. Their strategies result in improved health outcomes, favorable health behaviors or increased adherence to policy advice, despite exhibiting risk factors indicating otherwise [21–27]. Research adopting a PD strategy when exploring factors influencing the use of maternal healthcare services is however still in its infancy [22], as existing literature in general focuses on all women in the reproductive age [14–19]. Identifying Ethiopian mothers with positive health behaviors despite an adverse risk profile and exploring their characteristics could help health policy implementation, enable program managers to optimize public health initiative's performance, and ultimately improve population health. Against this background, the current study aims to identify women at a high risk for underutilization of skilled maternal healthcare services and to explore factors that characterize the PD women for maternal healthcare services uptake in Ethiopia.

2. Materials and Methods

2.1. Data Source

We used data from the two latest Ethiopian Demographic Health Surveys (EDHS), conducted by the Ethiopian Central Statistical Agency (CSA) and ORC Macro International, USA, between December 2010–June 2011, and January 2016–June 2016. The full details of the methods and procedures used in the data collection of each EDHS, are published elsewhere [2,3,28]. The current study includes weighted data from 7584 women collected from 641 enumeration areas (EAs) (clusters) in 2016 and 7908 women from 595 EA clusters in 2011 (additional Figure S1). The eligibility criteria were: being of reproductive age (15 to 49 years); reporting at least one birth during the five years preceding the actual survey (i.e., 2006–2011 and 2012–2016); and participating in one of the two surveys from any region in the country.

2.2. Measurement of Variables

2.2.1. Outcome measurement

The analyses in the current study addressed two maternity healthcare binary outcomes: (1) antenatal care (ANC) use, categorized into four or more visits (≥4) and less than four visits (<4), in accordance with the 2002 WHO ANC model; and (2) place of delivery, either home birth or birth at a health facility.

2.2.2. Potential Predictors

Individual level: Age at the last birth, the birth order, education level of the woman and her partner, employment status of the participant and her partner, empowerment (related to household decision making and whether the woman was involved or not in aspects related to- her own health care, large household purchases, visits to family or relatives), household wealth index (low and high household wealth as calculated by demographic health survey (DHS) algorithm), mass media (radio, TV) exposure (no exposure, exposed to either a radio or TV, exposed to both), relationship status (being

in a polygynous union or not), breastfeeding status (Yes/No), and perceived distance to a health facility to get medical help ('yes, big problem'; or, 'not big problem').

Contextual community level: place of residence (urban or rural), and if the region was classified as agrarian, pastoral, or a city.

2.3. Identification of Positive Deviants

We used Anderson's behavioral model of health service use [29], to identify positive deviants and the factors associated with being a PD. We selected women with no formal education as a sub group with very low likelihood of skilled maternal healthcare utilization, as education was the strongest predictor of both outcomes ANC and utilization of skilled health care during delivery after adjusting for the other risk factors associated with skilled maternity care in this population [2,28]. PD mothers were mothers who reported no formal education, but had an adequate use of ANC visits and or institutional delivery services. Thereafter, the analyses compared the characteristics of the PD mothers to those of their counterparts. Due to significant variations by place of residence in the overall use of skilled maternal healthcare, analyses were stratified by place of residence.

2.4. Statistical methods

Modeling Binary Responses

We used a binary logistic multilevel regression model, as the data was clustered at the survey level. We adjusted for confounders, decided a priori from the literature as age while giving last birth and order of the last birth. Bivariate logistic regression was performed to estimate the crude odds ratios (COR) and 95% confidence intervals of facility delivery or not, and if she had at least four ANC visits or not. Variables significantly associated with the outcome variable in the univariate analysis were entered in the multiple multilevel logistic regression analysis.

The study uses several explanatory variables that might be correlated to each other (such as maternal age at last birth and birth order). Multi-collinearity was checked using variance inflation factors (VIF) and variables with VIF less than 10 were considered for the analysis. In addition, we computed an estimate of intra-cluster correlation coefficient (ICC), which described the amount of variability in the response variables attributable to differences between the clusters. We used the McKelvey & Zavoina Pseudo R^2 to assess the fit of the model [30,31]. Since the data were obtained from surveys conducted at two different time points, interactions with time were performed to describe any changes in adequate ANC services and health facility delivery among PDs in 2011 compared to 2016.

Sampling weights were applied for the data when we computed the univariate analysis to manage the unequal probability of selection between the strata defined by geographical location and for non-responses. Descriptive statistics were used to describe the characteristics of mothers. Bivariate analyses were first conducted. We then fitted two separate random-effects multilevel logistic regression models, one for each outcome of interest (ANC, and delivery care) using only the variables that are significantly associated with each outcome in the bivariate model. The model parameter estimates were obtained in the statistical software StataSE 15 using the restricted maximum likelihood method (REML). The level of significance was set at 0.05.

2.5. Ethical Consideration

The study adhered to national and international ethical guidelines for biomedical research involving human subjects [32], including the Helsinki declaration. The study was reviewed and approved by the Regional Committee for Medical and Health Research Ethics (Code number: 2016/967/REK sør-øst A) and the Norwegian Centre for Research Data (Code number: 48407) at the University of Oslo. Our team also requested permission and access to the data from the CSA in Ethiopia and Inner City Fund (ICF) international by registering online on the website www.dhsprogram.com [33] and submitting the study protocol (See, additional File S1) by highlighting the objectives of the study

as part of the online registration process. The ICF Macro Inc removed all information that could be used to identify the respondents; hence, anonymity of the data was maintained.

3. Results

3.1. Characteristics of Participants

A total of 15,492 women reported a live birth in the past five-years preceding the surveys, 6720 (85.0%) (rural), and 1188 (15.0%) (urban) in 2011 (with mean age of 29.1 (±6.9) years), and 6619 (87.3%) (rural), and 965 (12.7%) (urban) in the 2016 survey, (29.3 (±6.8) years). Overall, in terms of pregnancy characteristics, both the number of antenatal care visits and the proportion of health facility delivery were consistently higher among urban women compared to rural dwellers. Indeed, more than 63% of urban mothers made the minimum four antenatal visits versus 27% of the rural mothers, and 84% of urban mothers reported health facility delivery versus 24% of the rural mothers in 2016. Table 1 presents the background characteristics of the women included.

Table 1. Background characteristics of 15,492 women with a live birth in the five years preceding the 2011 or 2016 surveys (Ethiopian Demographic Health Survey (EDHS)).

EDHS Years	2011		2016	
Stratified by Place of Residence	Rural	Urban	Rural	Urban
Individual level Factors (N)	6720	1188	6619	965
Age of Mothers (Year) Mean (±SD)	29.3 (±7.1)	28.2 (±5.8)	29.4 (±7.1)	28.8 (±5.8)
Age when giving last birth (years)				
15—24	1691 (25.2)	319 (26.8)	1623 (24.5)	181 (18.7)
25—34	3234 (48.1)	638 (53.7)	3217 (48.6)	604 (62.6)
35—49	1795 (26.7)	231 (19.4)	1779 (26.9)	180 (18.7)
Order of the last birth				
First	1038 (15.4)	361 (30.4)	1100 (16.6)	331 (34.3)
Second or third	1990 (29.6)	472 (39.7)	1883 (28.4)	399 (41.3)
Fourth or higher	3692 (54.9)	355 (29.9)	3636 (54.9)	235 (24.4)
Marital status				
Not living with partner	567 (8.4)	156 (13.1)	393 (5.9)	87 (9.0)
Living with partner	6153 (91.6)	1032 (86.9)	6226 (94.1)	878 (91.0)
Education level of the women				
No education	4863 (72.4)	407 (34.3)	4562 (68.9)	229 (23.7)
Primary	1764 (26.2)	506 (42.6)	1833 (27.7)	315 (32.6)
Secondary and above	93 (1.4)	275 (23.1)	224 (3.4)	421 (43.6)
[b] Working status of the women				
Working	2219 (33.0)	550 (46.3)	1702 (25.7)	466 (48.3)
Not working	4494 (66.9)	638 (53.7)	4917 (74.3)	499 (51.7)
Education level of their partners				
No education	3628 (54.0)	230 (19.3)	3200 (48.3)	146 (15.1)
Primary	2676 (39.8)	507 (42.7)	2480 (37.5)	251 (26.0)
Secondary and above	416 (6.2)	451 (38.0)	939 (14.2)	568 (58.9)
Working status of partners				
Working	6687 (99.5)	1172 (98.7)	6129 (92.6)	927 (96.1)
Not working	33 (0.5)	16 (1.3)	490 (7.4)	38 (3.9)
In a polygamous relationship				
Yes	1290 (19.2)	233 (19.6)	1094 (16.5)	148 (15.4)
No	5430 (80.8)	955 (80.4)	5525 (83.5)	817 (84.6)

Table 1. *Cont.*

EDHS Years	2011		2016	
[b] Self-reported empowerment of women				
Not involved at all in decision making	795 (12.9)	60 (5.8)	764 (12.3)	25 (2.8)
Involved in one	891(14.5)	90 (8.7)	457 (7.3)	33 (3.8)
Involved in two	1373 (22.3)	189 (18.3)	793 (12.7)	122 (13.9)
Involved in at least three	3093 (50.3)	694 (67.2)	4212 (67.6)	698 (79.5)
Household wealth index				
Low household wealth status	5015 (74.6)	48 (4.1)	4815 (72.7)	79 (8.1)
High household Wealth status	1705 (25.4)	1140 (95.9)	1804 (27.3)	886 (91.9)
Exposure to mass media				
No exposure	3051 (45.4)	163 (13.7)	4831 (73.0)	192 (19.9)
Exposed to either radio or TV	2246 (33.4)	346 (29.1)	1207 (18.2)	335 (34.7)
Exposed to both radio and TV	1423 (21.2)	679 (57.2)	581 (8.8)	438 (45.4)
[b] Ever had a terminated pregnancy				
Yes	740 (11.0)	96 (8.1)	603 (9.1)	77 (8.0)
No	5980 (89.0)	1092 (91.9)	6016 (90.9)	888 (92.0)
Number of under 5 children				
No child	278 (4.1)	91 (7.7)	219 (3.3)	63 (6.5)
One child	2844 (42.3)	720 (60.6)	3101 (46.9)	638 (66.1)
Two or more	3598 (53.5)	377 (31.7)	3299 (49.8)	264 (27.4)
Currently breastfeeding				
Yes	4573 (68.1)	651 (54.8)	4277 (64.6)	534 (55.4)
No	2147 (31.9)	537 (45.2)	2342 (35.4)	431 (44.6)
[b] Perceived distance to a health facility to get medical help				
Big problem	5360 (79.8)	397 (33.6)	4244 (64.1)	162 (16.8)
Not a big problem	1356 (20.2)	786 (66.4)	2375 (35.9)	803 (83.2)
Anemia status during pregnancy				
Anemic	1472 (21.9)	235 (19.8)	2076 (31.4)	224 (23.2)
Not Anemic	5248 (78.1)	953 (80.2)	4543 (68.6)	741 (76.8)
Community level factors				
Contextual Regions				
Agrarian	6406 (95.3)	865 (72.8)	6223 (94.0)	671 (69.6)
Pastoralist	291 (4.3)	108 (9.1)	370 (5.6)	71 (7.3)
City dweller's	23 (0.3)	215 (18.1)	26 (0.4)	223 (23.1)
Maternal Healthcare Service				
ANC Utilization				
No ANC visits	4249 (63.2)	295 (24.8)	2734 (41.3)	99 (10.3)
At least one ANC visit	2471 (36.8)	893 (75.2)	3885 (58.7)	866 (89.7)
At least 4 antenatal care visits	973 (14.5)	562 (47.3)	1815 (27.4)	609 (63.1)
Below 4 antenatal care visits	5747 (85.5)	626 (52.7)	4804 (72.6)	356 (36.9)
Place of delivery				
Home birth	6389 (95.1)	558 (47.0)	5024 (75.9)	155 (16.1)
Health Institution	331 (4.9)	630 (53.0)	1595 (24.1)	810 (83.9)

[b] Total figure may not add to 100 percent due to 'do not know' and 'missing cases'.

3.2. Factors Associated with Positive Deviant Behaviour for Better Maternal Health Outcomes

3.2.1. Factors Associated with Positive Deviant Behaviour for Antenatal Care

In 2011, among women with no formal education, 542 out of 4863 (11.2%) rural women and, 122 out of 407 (30.0%) urban women received at least four ANC services. In 2016 the numbers were 1050 out of 4562 (23.0%) rural women and 117 out of 229 (51.1%) urban women. These were classified as positive deviants (PDs) for ANC utilization. Between 2011 and 2016, the number of PDs for the uptake of adequate ANC services increased significantly by threefold (Adjusted Odds Ratio (AOR) = 3.01, (95% CI:2.55–3.55)) in rural areas, and by nearly double (AOR = 1.98, (95% CI:1.29–3.03)) in urban areas (Table 3 and Figure 1). There was no association with the order of the last birth or the number of under five children of PDs for the uptake of adequate ANC in the univariate models, so this was excluded from the multilevel models.
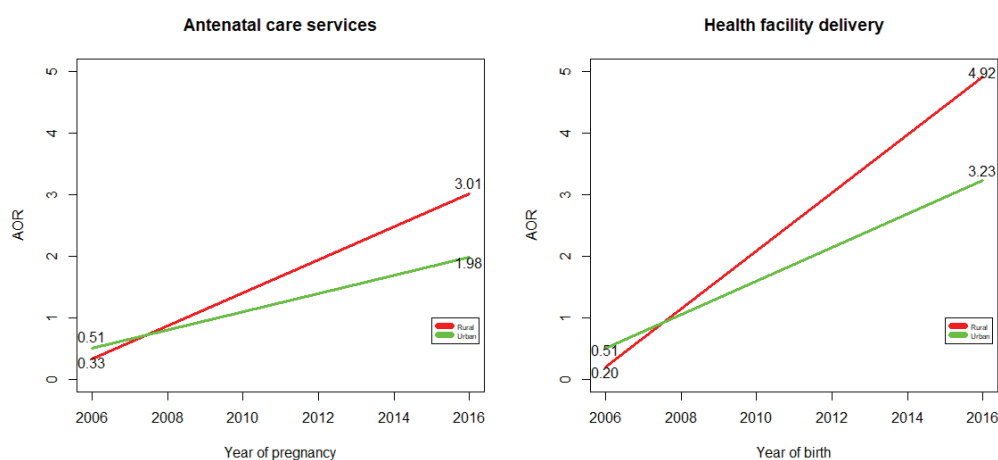
Figure 1. The changes in odds of uptake of skilled maternal healthcare service utilization (antenatal care or health facility delivery) among positive deviant women in urban and rural areas in Ethiopia between 2006 and 2016. Vertical axis = adjusted odds ratio (AOR); horizontal axis = survey periods.

In 2011, rural mothers who were PDs for ANC uptake were more likely to be employed ($p < 0.01$), and in 2016, more likely to have husbands who were employed ($p < 0.05$), than their counterparts. The same was not true for urban PD mothers. The analysis also revealed that as compared to their counterparts, the rural PD women had partners with primary or above education ($p < 0.05$), were more likely to be involved in one or more decision making of the household ($p < 0.05$), and less likely to perceive a high distance to a health facility ($p < 0.05$) in both survey periods. In 2016, rural PDs were more likely to breastfeed ($p < 0.05$) compared to non-deviants' peers. Both rural and urban PDs were more likely to report exposure to media ($p < 0.05$) in all surveys compared to non-deviants. In 2011, urban PD mothers were more likely to be from the city dwellers ($p < 0.01$), than non-deviants. Tables 2 and 3 present the results of the multilevel regression analyses showing the characteristics of the PDs and ANC utilization in 2011 and 2016, respectively.

3.2.2. Factors Associated with Positive Deviant Behaviour for Health Facility Delivery Utilization

In 2011, among women with no formal education, 160 out of 4863 (3.3%) rural women and 115 out of 407 (28.3%) urban women used health facility delivery services. Similarly, in 2016, 806 out of 4562 (17.7%) rural women, and 153 out of 229 (66.8%) urban women reported health facility delivery, and were classified as PDs. Tables 5 and 5 presents the results of the multilevel logistic regression analyses showing the characteristics of the PDs in 2011 and 2016, respectively. Between 2011 and 2016, the odds of uptake of health facility delivery among PD women increased significantly, nearly by fivefold (AOR = 4.92, (95% CI:3.92–6.18)) in rural areas and by more than threefold (AOR = 3.23, (95% CI:2.03–5.15)) in urban dwellers (Table 5 and Figure 1).

Table 2. Results of multiple multilevel logistic regression exploring factors associated with being a positive deviant for antenatal care utilization among urban and rural women, 2011 Ethiopia DHS.

Survey Years	2011 Model							
Stratified by (N)	Rural (4863)				Urban (407)			
Deviance Status	PDs N (%)	Non-PDs N (%)	AOR (95 % CI)		PDs N (%)	Non-PDs N (%)	AOR (95% CI)	
Co-variates (n)	542 (11.2%)	4321 (88,8%)	AOR (95 % CI)		122 (30.0%)	285 (70.0%)	AOR (95% CI)	
Age when giving last birth (years)								
15—24 (ref)	87 (8.9)	893 (91.1)	1 (1,1)		17 (22.9)	57 (77.1)	1 (1,1)	
25—34	288 (11.7)	2171 (88.3)	1.26 (0.91, 1.73)		72 (33.5)	145 (66.5)	1.03 (0.50, 2.12)	
35—49	167 (11.7)	1257 (88.3)	**1.42 (1.00, 2.01) ****		33 (28.4)	83 (71.6)	1.25 (0.52, 3.00)	
[b] Working status of the women								
Not-working (ref)	298 (8.9)	3038 (91.1)	1 (1,1)		68 (32.9)	140 (67.1)	1 (1,1)	
Working	243 (16.0)	1278 (84.0)	**1.64 (1.28, 2.10) *****		54 (27.2)	145 (72.8)	1.06 (0.60, 1.87)	
Education level of their partners								
No education (ref)	302 (9.6)	2864 (90.4)	1 (1,1)		48 (28.5)	122 (71.5)	1 (1,1)	
Primary	213 (13.6)	1353 (86.4)	**1.47 (1.15, 1.88) *****		55 (30.4)	126 (69.6)	1.17 (0.64, 2.11)	
Secondary or above	27 (20.6)	104 (79.4)	**1.90 (1.10, 3.27) ****		19 (34.3)	37 (65.7)	1.26 (0.56, 2.88)	
Working status of partners								
Not- working (ref)	6 (23.8)	19 (76.2)	1 (1,1)		9 (32.8)	5 (67.2)	1 (1,1)	
Working	536 (11.1)	4302 (88.9)	1.38 (0.35, 5.46)		113 (32.8)	280 (67.2)	1.23 (0.33, 4.61)	
[b] Self-reported empowerment of women								
Not involved at all in decision making (ref)	34 (5.4)	599 (94.6)	1 (1,1)		5 (14.8)	28 (85.2)	1 (1,1)	
Involved in one	63 (9.8)	582 (90.2)	1.25 (0.78, 1.99)		2 (4.4)	42 (95.6)	0.34 (0.10, 1.20)	
Involved in two	123 (12.4)	868 (87.6)	**1.77 (1.16, 2.71) *****		22 (27.7)	56 (72.3)	0.58 (0.21, 1.61)	
Involved in at least three	287 (13.0)	1917 (87.0)	**1.73 (1.16, 2.56) *****		78 (40.8)	113 (59.2)	1.22 (0.48, 3.12)	

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Table 2. *Cont.*

Survey Years	2011 Model					
Household wealth index						
Low HH wealth status(ref)	376 (9.6)	3554 (90.4)	1 (1,1)	1 (3.9)	30 (96.1)	1 (1,1)
High HH wealth status	166 (17.8)	767 (82.2)	**1.77 (1.35, 2.32) *****	121 (32.3)	255 (67.7)	**3.65 (1.01, 13.13) ****
Exposure to mass media						
No exposure (ref)	177 (7.2)	2295 (92.8)	1 (1,1)	27 (24.1)	84 (75.9)	1 (1,1)
Exposed to either radio or TV	210 (13.3)	1363 (86.7)	1.26 (0.97, 1.63)	36 (24.5)	112 (75.5)	1.31 (0.65, 2.63)
Exposed to both radio and TV	155 (19.0)	663 (81.0)	**1.90 (1.38, 2.61) *****	59 (40.3)	89 (59.7)	**2.80 (1.32, 5.94) *****
Currently breastfeeding						
No (ref)	191 (12.7)	1313 (87.3)	1 (1,1)	52 (31.2)	117 (68.8)	1 (1,1)
Yes	351 (10.4)	3008 (89.6)	0.80 (0.64, 1.02)	70 (29.4)	168 (70.6)	0.74 (0.43, 1.27)
[b] Perceived distance to a health facility to get medical help						
Not-big problem (ref)	135 (15.1)	762 (84.9)	1 (1,1)	80 (31.4)	177 (68.6)	1 (1,1)
Big problem	407 (10.3)	3555 (89.7)	**0.71 (0.54, 0.95) ****	42 (28.0)	108 (72.0)	1.05 (0.59, 1.87)
Anemia status						
Non-anemic(ref)	450 (12.0)	3300 (88.0)	1 (1,1)	104 (33.5)	208 (66.5)	1 (1,1)
Anemic	92 (8.2)	1021 (91.8)	0.81 (0.62, 1.06)	18 (18.9)	77 (81.1)	0.70 (0.38, 1.29)
Community level Factors						
Contextual Region						
Agrarian (ref)	525 (11.4)	4076 (88.6)	1 (1,1)	79 (26.8)	215 (73.2)	1 (1,1)
Pastoralist	15 (6.1)	228 (93.9)	**0.65 (0.44, 0.96) ****	8 (12.2)	54 (87.8)	0.72 (0.27, 1.88)
City dweller's	2 (11.7)	17 (88.3)	0.87 (0.48, 1.59)	35 (71.0)	16 (29.0)	**4.92 (2.02, 12.00) *****

sig. at ** sig. at 5% level(in bold); *** sig. at 1% level (in bold); [b] Total figure may not add to 100 percent due to 'do not know' and 'missing cases'. ref = reference group; PDs = Positive Deviants; N = Number of participants., AOR = Adjusted Odds ratios. Note: PD defined as illiterate women with an adequate use of antenatal care services.

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Table 3. Results of multiple multilevel logistic regression exploring factors associated with being a positive deviant for antenatal care utilization among urban and rural women, 2016 Ethiopia DHS.

Survey Years	2016 Model					
Stratified by (N)	Rural (4562)			Urban (229)		
Deviance Status	PDs N (%)	Non-PDs N (%)	AOR (95 % CI)	PDs N (%)	Non-PDs N (%)	AOR (95 % CI)
Co-variates (n)	1050 (23%)	3512 (77.0%)	AOR (95 % CI)	117 (51.1%)	112 (48.9%)	AOR (95 % CI)
Overall time effect (ref: 2011)			3.01 (2.55, 3.55) ***			1.98 (1.29, 3.03) ***
Age when giving last birth (years)						
15—24(ref)	119 (17.3)	567 (82.7)	1 (1,1)	13 (80.5)	3 (19.5)	1 (1,1)
25—34	608 (25.6)	1763 (74.4)	1.35 (1.03, 1.77) **	75 (51.3)	72 (48.7)	0.49 (0.21, 1.11)
35—49	323 (21.5)	1182 (78.5)	1.11 (0.83, 1.49)	29 (44.0)	37 (56.0)	0.41 (0.17, 0.99) **
ᵇ Working status of the women						
Not-working(ref)	770 (22.4)	2664 (77.6)	1 (1,1)	60 (47.4)	66 (52.6)	1 (1,1)
Working	280 (24.8)	848 (75.2)	1.00 (0.80, 1.25)	57 (55.8)	45 (44.2)	1.08 (0.63, 1.87)
Education level of their partners						
No education(ref)	559 (20.7)	2145 (79.3)	1 (1,1)	43 (40.6)	62 (59.4)	1 (1,1)
Primary	377 (26.0)	1073 (74.0)	1.32 (1.07, 1.62) **	46 (64.4)	26 (35.6)	1.28 (0.71, 2.30)
Secondary or above	114 (27.9)	294 (72.1)	1.63 (1.06, 2.48) **	28 (54.2)	24 (45.8)	1.18 (0.58, 2.42)
Working status of partners						
Not-working(ref)	48 (13.0)	320 (87.0)	1 (1,1)	11 (61.9)	7 (38.1)	1 (1,1)
Working	1002 (23.9)	3192 (76.1)	1.52 (1.07, 2.14) **	106 (50.3)	105 (49.7)	1.07 (0.52, 2.18)
ᵇ Self-reported empowerment of women						
Not involved at all in decision making(ref)	91 (16.2)	470 (83.8)	1 (1,1)	2 (20.0)	8 (80.0)	1 (1,1)
Involved in one	81 (25.9)	231 (74.1)	1.67 (1.11, 2.52) **	4 (69.5)	2 (30.5)	3.10 (0.72, 13.34)
Involved in two	145 (25.7)	419 (74.3)	1.17 (0.81, 1.69)	12 (37.5)	21 (62.5)	0.84 (0.23, 3.03)
Involved in at least three	657 (22.9)	2210 (77.1)	1.43 (1.07, 1.92) **	84 (54.5)	70 (45.5)	1.98 (0.67, 5.90)

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Table 3. *Cont.*

Survey Years	2016 Model					
Household wealth index						
Low HH wealth status(ref)	756 (21.3)	2801 (78.7)	1 (1,1)	15 (27.6)	38 (72.4)	1 (1,1)
High HH wealth status	294 (29.3)	711 (70.0)	1.20 (0.93, 1.56)	102 (58.2)	74 (41.8)	1.46 (0.71, 3.00)
Exposure to mass media						
No exposure (ref)	754 (21.2)	2807 (78.8)	1 (1,1)	45 (41.8)	63 (58.2)	1 (1,1)
Exposed to either radio or TV	207 (29.8)	487 (70.2)	**1.38 (1.07, 1.78)****	39 (52.3)	35 (47.7)	**1.88 (1.06, 3.35) ****
Exposed to both radio and TV	89 (28.9)	218 (71.1)	1.27 (0.85, 1.90)	33 (71.0)	14 (29.0)	**4.71 (2.10, 10.59)***
Currently breastfeeding						
No (ref)	327 (19.4)	1353 (80.6)	1 (1,1)	41 (42.5)	55 (57.5)	1 (1,1)
Yes	723 (19.4)	2159 (80.6)	**1.24 (1.03, 1.50) ****	76 (57.4)	57 (42.6)	1.55 (0.93, 2.59)
[b] Perceived distance to a health facility to get medical help						
Not-big problem(ref)	468 (29.5)	1120 (70.5)	1 (1,1)	96 (54.3)	81 (45.7)	1 (1,1)
Big problem	582 (19.6)	2392 (80.4)	**0.73 (0.60, 0.90) ***	21 (40.3)	31 (59.7)	0.94 (0.53, 1.67)
Anemia status						
Non-anemic(ref)	714 (23.5)	2322 (76.5)	1 (1,1)	93 (51.2)	89 (48.8)	1 (1,1)
Anemic	336 (22.0)	1190 (78.0)	0.98 (0.81, 1.20)	24 (51.1)	23 (48.9)	0.61 (0.35, 1.05)
Community level Factors						
Contextual Region						
Agrarian(ref)	1006 (23.7)	3237 (76.3)	1 (1,1)	85 (52.0)	79 (48.0)	1 (1,1)
Pastoralist	36 (11.9)	264 (88.1)	**0.49 (0.35, 0.69) ***	13 (33.1)	25 (66.9)	**0.44 (0.21, 0.92) ****
City dweller's	8 (40.6)	11 (59.4)	1.27 (0.72, 2.24)	19 (71.6)	8 (28.4)	0.82 (0.39, 1.71)

sig. at ** sig. at 5% level (in bold); *** sig. at 1% level (in bold); ** sig. at 1% level in bold); [b] Total figure may not add to 100 percent due to 'do not know' and 'missing cases'. ref = reference group; PDs = Positive Deviants; N = Number of participants., AOR = Adjusted Odds ratios. Note: PD defined as illiterate women with an adequate use of antenatal care services.

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Table 4. Results of multiple multilevel logistic regression exploring factors associated with being a positive deviant for having a health facility delivery among urban and rural women, 2011 Ethiopia DHS.

Survey Years	2011 Model							
Stratified by (N)	Rural (4863)				Urban (407)			
Deviant Status	PDs N (%)	Home Birth N (%)	AOR (95 % CI)		PDs N (%)	Home Birth N (%)	AOR (95 % CI)	
Co-variates (n)	160 (3.3%)	4703 (96.7%)	AOR (95 % CI)		115 (28.3%)	292 (71.7%)	AOR (95 % CI)	
Age when giving last birth (years)								
15—24(ref)	41 (4.2)	939 (95.8)	1 (1,1)		19 (25.9)	55 (74.1)	1 (1,1)	
25—34	82 (3.3)	2378 (96.7)	1.46 (0.84, 2.54)		76 (34.9)	141 (65.1)	0.91 (0.38, 2.17)	
35—49'	37 (2.6)	1386 (97.4)	1.45 (0.74, 2.86)		20 (17.0)	96 (83.0)	0.67 (0.22, 2.03)	
Order of the last birth								
First(ref)	37 (7.1)	494 (92.9)	1 (1,1)		21 (29.6)	49 (70.4)	1 (1,1)	
Second or third	38 (2.7)	1344 (97.3)	**0.30 (0.16, 0.56)** ***		49 (32.2)	103 (67.8)	0.60 (0.23, 1.58)	
Fourth or higher	85 (2.9)	2865 (97.1)	**0.32 (0.16, 0.63)** ***		45 (24.3)	140 (75.7)	0.60 (0.20, 1.79)	
[b] Working status of the women								
Not-working(ref)	77 (2.3)	3258 (97.7)	1 (1,1)		60 (28.7)	148 (71.3)	1 (1,1)	
Working	82 (5.4)	1438 (94.6)	**1.77 (1.21, 2.59)** ***		55 (27.6)	144 (72.4)	0.73 (0.39, 1.35)	
Education level of their partners								
No education(ref)	102 (3.2)	3064 (96.8)	1 (1,1)		32 (20.3)	136 (79.7)	1 (1,1)	
Primary	52 (3.3)	1513 (96.7)	**1.62 (1.12, 2.36)** **		58 (30.1)	124 (69.9)	1.49 (0.79, 2.82)	
Secondary and above	6 (4.2)	126 (95.8)	1.55 (0.67, 3.61)		25 (60.0)	32 (40.0)	**3.05 (1.26, 7.36)** **	
Working status of partners								
Not-working(ref)	3 (11.2)	22 (88.8)	1 (1,1)		3 (2.5)	13 (97.5)	1 (1,1)	
Working	157 (3.2)	4681 (96.8)	0.34 (0.10, 1.20)		112 (29.1)	279 (70.9)	1.06 (0.24, 4.75)	

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Table 4. *Cont.*

Survey Years	2011 Model						
[b] Self-reported empowerment of women							
Not involved at all in decision making(ref)	13 (3.7)	620 (98.0)	1 (1,1)	7 (20.4)	27 (79.6)	1 (1,1)
Involved in one	16 (2.6)	629 (97.4)	**0.53 (0.29, 0.96) **	13 (29.1)	31 (70.9)	0.90 (0.25, 3.30)
Involved in two	31 (3.1)	959 (96.9)	0.60 (0.34, 1.05)	12 (15.7)	66 (84.3)	1.20 (0.39, 3.72)
Involved in at least three	79 (3.6)	2125 (96.4)	0.67 (0.40, 1.11)	60 (31.7)	130 (68.3)	1.41 (0.47, 4.17)
Household wealth index							
Low HH wealth status(ref)	108 (2.7)	3822 (97.3)	1 (1,1)	2 (5.2)	29 (94.8)	1 (1,1)
High HH wealth status	52 (5.6)	881 (94.4)	1.26 (0.81, 1.95)	113 (30.1)	263 (69.9)	1.47 (0.46, 4.67)
Exposure to mass media							
No exposure (ref)	79 (3.2)	2393 (96.8)	1 (1,1)	17 (15.4)	93 (84.6)	1 (1,1)
Exposed to either radio or TV	52 (3.3)	1521 (96.7)	0.88 (0.59, 1.31)	43 (28.7)	106 (71.3)	1.01 (0.48, 2.11)
Exposed to both radio and TV	29 (3.5)	789 (96.5)	0.91 (0.53, 1.58)	55 (37.2)	93 (62.8)	1.62 (0.73, 3.60)
Number of under 5 children							
No child(ref)	18 (9.7)	161 (90.3)	1 (1,1)	7 (30.1)	16 (69.9)	1 (1,1)
One child	84 (4.4)	1847 (95.6)	**0.35 (0.17, 0.73) ***	57 (28.1)	145 (71.9)	3.52 (0.79, 15.65)
Two or more	58 (2.1)	2695 (97.9)	**0.25 (0.12, 0.53) ***	51 (28.0)	131 (72.0)	3.02 (0.64, 14.20)
Currently breastfeeding							
No(ref)	55 (3.6)	1449 (96.4)	1 (1,1)	42 (24.5)	127 (74.5)	1 (1,1)
Yes	105 (3.1)	3254 (96.9)	1.23 (0.83, 1.82)	73 (30.8)	165 (69.2)	1.35 (0.74, 2.46)
[b] Perceived distance to a health facility to get medical help							
Not-big problem(ref)	51 (5.7)	845 (94.3)	1 (1,1)	73 (28.4)	184 (71.6)	1 (1,1)
Big problem	109 (2.7)	3854 (97.3)	**0.64 (0.42, 0.97) **	42 (27.7)	108 (72.3)	0.65 (0.35, 1.19)

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Table 4. *Cont.*

Survey Years	2011 Model					
Anemia status						
Non-anemic(ref)	124 (3.3)	3627 (96.7)	1 (1,1)	97 (30.9)	215 (69.1)	1 (1,1)
Anemic	36 (3.2)	1076 (96.8)	0.89 (0.60, 1.31)	18 (19.3)	77 (80.7)	**0.41 (0.21, 0.79) ***
ANC Utilization						
No ANC visits(ref)	66 (2.0)	3258 (98.0)	1 (1,1)	21 (12.5)	146 (87.5)	1 (1,1)
At least one ANC visit	94 (6.1)	1445 (93.9)	**2.77 (1.90, 4.04) ***	94 (39.1)	146 (60.9)	**2.89 (1.54, 5.43) ***
Community level Factors						
Contextual Regions						
Agrarian(ref)	146 (3.2)	4456 (96.8)	1 (1,1)	71 (24.1)	223 (75.9)	1 (1,1)
Pastoralist	13 (5.3)	230 (94.7)	**2.53 (1.48, 4.32) ***	10 (16.1)	52 (83.9)	1.08 (0.39, 2.98)
City dweller's	1 (6.3)	17 (93.7)	**2.78 (1.22, 6.32) **	34 (66.2)	17 (33.8)	**10.12 (3.85, 26.61) ***

sig. at ** sig. at 5% level (in bold); ***sig. at 1% level (in bold); [b] Total figure may not add to 100 percent due to 'do not know' and 'missing cases'. ref = reference group; PDs = positive deviants; N = number of participants., AOR = adjusted odds ratios. Note: PD defined as illiterate women with use of institutional delivery services.

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Table 5. Results of multiple multilevel logistic regression exploring factors associated with being a positive deviant for having a health facility delivery among urban and rural women, 2016 Ethiopia DHS.

Survey Years	2016 Model					
Stratified by (N)	Rural (4562)			Urban (229)		
Deviant Status	PDs N (%)	Home Birth N (%)	AOR (95 % CI)	PDs N (%)	Home Birth N (%)	AOR (95 % CI)
Co-variates (n)	806 (17.7%)	3756 (82.3%)	AOR (95 % CI)	153 (66.8%)	76 (31.2%)	AOR (95 % CI)
Overall time effect (ref: 2011)			**4.92 (3.92, 6.18)** ***			**3.23 (2.03, 5.15)** ***
Age when giving last birth (years)						
15—24(ref)	135 (19.7)	551 (80.3)	1 (1,1)	10 (68.1)	6 (31.9)	1 (1,1)
25—34	402 (17.0)	1968 (83.0)	1.08 (0.73, 1.58)	108 (73.4)	39 (26.6)	1.16 (0.44, 3.01)
35—49	269 (17.8)	1237 (82.2)	1.37 (0.88, 2.14)	35 (53.2)	31 (46.8)	1.05 (0.35, 3.14)
Order of the last birth						
First(ref)	106 (28.2)	270 (71.8)	1 (1,1)	24 (84.3)	5 (15.7)	1 (1,1)
Second or third	216 (18.5)	950 (81.5)	**0.47 (0.30, 0.75)** ***	51 (70.3)	22 (29.7)	0.71 (0.25, 2.05)
Fourth or higher	484 (16.0)	2536 (84.0)	**0.45 (0.27, 0.74)** ***	78 (61.4)	49 (38.6)	0.55 (0.18, 1.70)
b Working status of the women						
Not-working(ref)	575 (16.7)	2859 (83.3)	1 (1,1)	81 (64.5)	45 (35.5)	1 (1,1)
Working	231 (20.4)	897 (79.6)	1.14 (0.89, 1.47)	72 (70.5)	30 (29.5)	0.94 (0.50, 1.76)
Education level of their partners						
No education(ref)	425 (15.7)	2278 (84.3)	1 (1,1)	64 (61.9)	41 (38.1)	1 (1,1)
Primary	289 (19.9)	1162 (80.1)	**1.34 (1.05, 1.70)** **	50 (69.6)	22 (30.4)	0.96 (0.49, 1.87)
Secondary and above	92 (22.4)	316 (77.6)	**1.98 (1.25, 3.14)** ***	39 (74.6)	13 (25.4)	1.73 (0.79, 3.79)
Working status of partners						
Not-working(ref)	49 (13.3)	319 (86.7)	1 (1,1)	11 (70.1)	6 (29.9)	1 (1,1)
Working	757 (18.0)	3437 (82.0)	1.30 (0.87, 1.93)	142 (67.0)	70 (33.0)	0.84 (0.38, 1.86)

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Table 5. *Cont.*

Survey Years	2016 Model					
[b] Self-reported empowerment of women						
Not involved at all in decision making(ref)	83 (14.8)	478 (85.2)	1 (1,1)	5 (45.2)	6 (54.8)	1 (1,1)
Involved in one	65 (20.9)	246 (79.1)	**1.68 (1.04, 2.69)** **	4 (67.2)	2 (32.8)	1.10 (0.23, 5.19)
Involved in two	107 (18.9)	457 (81.1)	1.19 (0.78, 1.82)	14 (43.6)	19 (56.4)	1.38 (0.38, 5.02)
Involved in at least three	503 (17.5)	2364 (82.5)	1.14 (0.81, 1.61)	116 (74.6)	39 (25.4)	1.57 (0.53, 4.66)
Household wealth index						
Low HH wealth status(ref)	568 (16.0)	2989 (84.0)	1 (1,1)	18 (35.2)	35 (64.8)	1 (1,1)
High HH wealth status	238 (23.6)	767 (76.4)	1.19 (0.89, 1.60)	135 (76.8)	41 (23.2)	**2.29 (1.12, 4.70)** **
Exposure to mass media						
No exposure (ref)	557 (15.6)	3005 (84.4)	1 (1,1)	61 (56.4)	47 (43.6)	1 (1,1)
Exposed to either radio or TV	165 (23.9)	528 (76.1)	**1.37 (1.02, 1.84)** **	55 (75.4)	18 (24.6)	**2.02 (1.05, 3.90)** **
Exposed to both radio and TV	84 (27.5)	223 (72.5)	1.27 (0.81, 2.00)	37 (79.3)	11 (20.7)	1.47 (0.61, 3.54)
Number of under 5 children						
No child(ref)	27 (19.2)	113 (80.8)	1 (1,1)	8 (63.4)	5 (36.6)	1 (1,1)
One child	349 (17.3)	1663 (82.7)	0.95 (0.50, 1.81)	87 (69.4)	39 (30.6)	1.92 (0.48, 7.66)
Two or more	430 (17.8)	1980 (82.2)	1.10 (0.57, 2.14)	58 (64.5)	32 (35.5)	2.76 (0.66, 11.56)
Currently breastfeeding						
No(ref)	253 (15.0)	1427 (85.0)	1 (1,1)	54 (57.1)	42 (42.9)	1 (1,1)
Yes	553 (19.2)	2329 (80.8)	**1.45 (1.15, 1.84)** ***	99 (74.5)	34 (25.5)	**2.02 (1.15, 3.53)** **
[b] Perceived distance to a health facility to get medical help						
Not- big problem(ref)	367 (23.1)	1221 (76.9)	1 (1,1)	126 (71.0)	52 (29.0)	1 (1,1)
Big problem	439 (14.8)	2535 (85.2)	**0.72 (0.57, 0.91)** ***	28 (54.1)	24 (45.9)	0.58 (0.32, 1.08)

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Table 5. *Cont.*

Survey Years	2016 Model					
Anemia status						
Non-anemic(ref)	593 (19.5)	2444 (80.5)	1 (1,1)	126 (69.4)	57 (30.6)	1 (1,1)
Anemic	213 (14.0)	1312 (86.0)	1.04 (0.83, 1.30)	27 (58.6)	19 (41.4)	1.47 (0.80, 2.72)
ANC Utilization						
No ANC visits(ref)	118 (5.4)	2061 (94.6)	1 (1,1)	17 (42.2)	26 (57.8)	1 (1,1)
At least one ANC visit	688 (28.9)	1695 (71.1)	**7.14 (5.42, 9.41) *****	136 (73.0)	50 (27.0)	**4.49 (2.16, 9.33) *****
Community level Factors						
Contextual Regions						
Agrarian(ref)	761 (17.9)	3482 (82.1)	1 (1,1)	116 (71.0)	48 (29.0)	1 (1,1)
Pastoralist	39 (13.0)	261 (87.0)	**0.54 (0.38, 0.78) *****	15 (39.4)	23 (60.6)	**0.20 (0.09, 0.46) *****
City dweller's	6 (29.2)	13 (70.8)	**1.96 (1.09, 3.52) ****	22 (82.5)	5 (17.5)	0.96 (0.40, 2.31)

sig. at **sig. at 5% level (in bold); ***sig. at 1% level (bold); [b] Total figure may not add to 100 percent due to 'do not know' and 'missing cases'. ref = reference group; PDs = Positive Deviants; N = Number of participants., AOR = Adjusted Odds ratios. Note: PD defined as illiterate women with use of institutional delivery services.

In 2011, rural mothers who were PDs for institutional health care delivery were more likely to have a job ($p < 0.01$) than non-deviant counterparts. Both rural and urban PD women were more likely to have partners with primary or above education ($p < 0.05$), and in both surveys the PDs reported at least one ANC visit during pregnancy ($p < 0.01$). Likewise, in 2016, both urban and rural PDs were more likely to report exposure to either radio or TV than no exposure ($p < 0.05$) and to have breastfeed ($p < 0.05$) compared to non-deviants. In 2016, the rural PDs were more likely to be involved in one decision than no decision making for the household ($p < 0.05$); the same was not true for urban PDs. Rural mothers with birth order two or more ($p < 0.01$), and who perceive distance as a challenge to reach health facility ($p < 0.05$) were less likely to be PDs in both surveys. Lastly, in 2011, both rural and urban PDs for institutional health care delivery were more likely to be living in the city than agrarian communities ($p < 0.01$); rural PDs were also more likely to be living in pastoralist than agrarian communities.

4. Discussion

The study investigated factors associated with PD, i.e., an adequate use of ANC services or institutional delivery services despite no formal education, and thus classifying as at high-risk for non-use. In all models, compared to their counterparts, the odds of utilization of skilled maternal healthcare services (adequate ANC or health facility delivery) among PD women increased significantly from 2011 to 2016; the increase was higher in rural areas than in urban areas and higher for health facility delivery compared to ANC utilization uptake. Our study identified factors at multiple levels associated with PD behaviour. The results of this study are in concert with earlier studies reporting that level of education is associated with utilization of maternal healthcare services in Ethiopia and elsewhere [9,34–38]. Mothers with no education are at a particularly high risk of low utilization of maternal healthcare services and are consequently a key target group for intervention. Factors associated with PD behaviour might inform such interventions. The current study found that the employment status of women, partners' education status, access to media, the level of women's self-reported empowerment, and perceived adversity of distance to a health facility were associated with uptake of skilled maternal healthcare, and in concert with prior studies using risk factor analysis [39–48].

The relation between rural women's employment and skilled maternal healthcare services among rural PDs might be related to employment making healthcare affordable, which might increase maternal healthcare service utilization. Moreover, employed women might be more likely to receive information at work that promotes health-seeking behaviour [49,50]. Interestingly, our analyses suggested that, compared to their counterparts, rural PD women with employed partners were more likely to used ANC services, but not health facility delivery, in the 2016 survey. This is interesting, because a woman whose husband is employed is likely to have better financial resources, which could facilitate access to skilled delivery. A study in Bangladesh showed that employed partners of PD women may spend more time away from their households than unemployed husbands, which might influence decisions about place of delivery [22].

In our study, both rural and urban women who were PDs for the uptake of skilled care were more likely to have partners with at least primary education. These findings are in line with findings of studies from Ethiopia and elsewhere suggesting that husband's education may lead to greater involvement in maternity care utilization, as it is men who generally have an upper hand in decision-making at the household level in a patriarchal society like Ethiopia [51–56]. Similarly, we demonstrated that all PDs for the uptake of skilled care were more likely to report exposure to media compared to non-deviants in both surveys, irrespective of their location. Previous studies have shown that exposure to mass media at the individual and community level positively influences the development of positive behaviour toward the utilization of maternal healthcare services [57–60]. The impact of mass media exposure was however less consistent for health facility delivery in the present study. The current findings suggest that as compared to their counterparts, rural PD women for the uptake of skilled care were involved in one or more decision making of the household. This finding is consistent with those

of previous studies from Ethiopia and elsewhere suggesting that women's involvement in decision making is associated with utilization of skilled care [49,61–66]. However, involvement in two or more decisions was not associated with PD for health facility delivery, which is a surprising finding that needs further exploration.

We also found that rural PD were less likely to perceived distance to the health facility as a challenge to receive care in both surveys. It can be argued that with limited transport availability, as well as the mountainous and rugged topography in rural parts of the country, women find accessing skilled care very challenging [8,15,35,40,43]. In 2016, both rural and urban PDs for health facility delivery were more likely to breastfeed than their peers. This might reflect personal characteristics of these PD women, who might have a higher self-efficacy towards adopting healthier behaviours, better perceptions and norms regarding infant-feeding [67,68]. Both rural and urban PDs for health facility delivery were significantly more likely to have attended at least one ANC visit during index pregnancy. The role of usage of ANC when enhancing health facility delivery has been reported previously [9,34,37,47,48].

The findings of this study highlight factors at the socio-economic, behavioural, and structural levels associated with the uptake of skilled maternal healthcare services in an otherwise high-risk population. These factors should be taken into consideration when aiming to improve maternal healthcare among high-risk populations. Our study indicated that women in disadvantaged circumstances can still achieve good outcomes amidst a host of contextual barriers that usually predict poor health outcomes. Positive deviants in this context are shown to be women who have husbands with primary education or above, who have access to information through mass media, and who are involved at least with one decision made in the household. By knowing these characteristics, multiple government sectors (i.e., education, information and culture among others, alongside ministry of health) can identify women who fit the description and thus develop and amplify action plans encouraging more positive deviant behaviours. Finally, further qualitative research is warranted to explore in-depth what other exceptional characteristics PD women possess in order to shed light on potential mechanisms behind some of the associations identified in this study.

Study Strength and Limitations

The study has several methodological strengths, including the use of multilevel modelling. The study was based on two different time points, and the data was nationally representative. The sample sizes of the surveys were large, providing high statistical power. The PD strategy offers an alternative to other approaches used in exploring the uptake of skilled maternal healthcare. Nonetheless, the PD sample size for urban women was small; thus, a lack of power might impact the multilevel analysis. The cross-sectional analyses at the two time points limited inference about causality.

5. Conclusions

In this study, we identified mothers with no education as a group at high risk of poor uptake of maternal healthcare services. The women's employment status, their partners' education, access to media, self-reported empowerment, and perceived distance to reach a health facility were associated with PD behaviour and utilization of skilled maternal healthcare services. Differences between rural and urban PD women were documented. Indeed, the positive deviance approach provides a means for local policy makers and program managers to identify factors facilitating improved health behaviour, and ultimately better health outcomes, despite an acknowledged adverse risk profile. Such strategy and knowledge could facilitate targeted efforts aimed at achieving global SDGs of reduction of maternal mortality in resource-poor populations.

for intellectual content from M.K.G., J.S. and J.H.M. All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest: The authors declare that they have no competing interests.

Abbreviations

ANC	Antenatal Care
AOR	Adjusted Odds Ratio
COR	Crude Odds Ratios
CSA	Ethiopian Central Statistical Agency
EA	Enumeration Areas
EDHS	Ethiopian Demographic and Health Survey
HFD	Health Facility Delivery
HSDP	Health Sector Development Plans
HSTP	Health Sector Transformation Plan
ICC	Intra-cluster Correlation Coefficient
MMR	Maternal Mortality Ratio
NSD	Norwegian Center for Research Data
PD	Positive Deviance
REK	Regional Committee for Medical and Health Research Ethics
REML	Restricted Maximum Likelihood method
SDGs	Sustainable Development Goals
USA	United States of America
VIF	Variance Inflation Factors
WHO	World Health Organization.

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Appendix 2.

Literature review search strategies

We searched for studies that examined the impact of access and utilization on maternal health care services for Sub-Saharan Africa and Ethiopia. We searched in three databases (PubMed, EMBASE and Cochrane library) and was conducted using medical subject heading terms (MESH). The search limited articles published before 2017 and used English language literatures. We employed the following search strategy:

1. Access to Maternal Health Care in SSA

Search #	Query
1	**(Access to health services) OR (maternal health care)**
2	(maternal healthcare) OR (maternal healthcare services)
3	(maternal health care services) OR (Sub-Saharan Africa)
4	(English[Language]) OR ([Date – Publication before]: "2017"
5	(((#1) AND (#2)) AND (#3)) AND (#4)

2. Access to Maternal Health Care in Ethiopia

Search #	Query
1	**(Access to health services) OR (maternal health care)**
2	(maternal healthcare) OR (maternal healthcare services)
3	(maternal health care services) OR (Ethiopia)
4	(English[Language]) OR ([Date – Publication before]: "2017"
5	(((#1) AND (#2)) AND (#3)) AND (#4)

3. Utilization of Maternal Health Care in SSA

Search #	Query
1	**(**Utilizat* health services) OR (maternal health care)
2	(maternal healthcare) OR (maternal healthcare services)
3	(utilization maternal health care services) OR (Sub-Saharan)
4	(English[Language]) OR ([Date – Publication before]: "2017"
5	(((#1) AND (#2)) AND (#3)) AND (#4)

4. Utilization of Maternal Health Care in Ethiopia

Search #	Query
1	(Utilizat* health services) OR (maternal health care)
2	(maternal healthcare) OR (maternal healthcare services)
3	(utilization maternal health care services) OR (Ethiopia)
4	(English[Language]) OR ([Date – Publication before]: "2017"
5	(((#1) AND (#2)) AND (#3)) AND (#4)

Appendix 3. Ethical approvals for the studies

Region:	Saksbehandler:	Telefon:	Vår dato:	Vår referanse:
REK sør-øst	Camilla Bø Standal	22845821	29.06.2016	2016/967/REK sør-øst A
			Deres dato:	**Deres referanse:**
			03.05.2016	

Vår referanse må oppgis ved alle henvendelser

Viva Combs Thorsen

Universitetet i Oslo, Medisinsk fakultet

2016/967 Social derterminanter for av bruke av mødrehelse tjernster

Forskningsansvarlig: University of Oslo
Prosjektleder: Viva Combs Thorsen

The Regional Committee for Medical and Health Research Ethics, Section A, South East Norway, reviewed your Application during its meeting on the June 9th 2016.

The Project was assessed in accordance to the Norwegian Research Ethics Act § 4 (2006), and the Health Research Act § 10 (2008), for Regional Committees for Medical and Health Research Ethics.

Chief investigator's project description

Project title: Social Determinants of Health and Utilization of Antenatal Care and Skilled Birth Attendance in Ethiopia: A Multilevel Analysis Using 2005, 2011 and 2016

Ethiopian Demographic and Health Survey Introduction Complications during pregnancy or childbirth cause a woman to die every minute of every day, totalling 303,000 women in 2015. For every woman who dies of pregnancy-related causes, 20 to 30 others experience acute or chronic morbidity, often with permanent sequelae that undermine their normal functioning. Safe Motherhood programs, which include antenatal, intrapartum and postnatal care, are designed with the intent to reduce the high numbers of deaths and morbidities resulting from complications of pregnancy and childbirth. Ethiopia is one of the sub-Saharan African countries that experience the highest maternal mortality ratios in the world; that is, 676 per 100,000 live births and more than 14,000 mothers die as the result of pregnancy and related causes each year.

This study will include the sample of mothers aged 15–49 years who had at least one live birth during the 5 years preceding the three surveys to identify individual and community level factors associated with maternal health care utilization.

The data is extracted from a national household survey, specifically the Ethiopian 2005, 2011, and 2016 Demographic and Health Survey (EDHS), which have been conducted by the Ethiopian Central Statistical Agency (a government agency). Before conducting the survey interviews, informed consent was obtained from all participants who were willing to participate.

EDHS surveys are designed to collect data on marriage, fertility, family planning, reproductive health, child health, and HIV/AIDS.

Besøksadresse:
Gullhaugveien 1-3, 0484 Oslo

Telefon: 22845511
E-post: post@helseforskning.etikkom.no
Web: http://helseforskning.etikkom.no/

All post og e-post som inngår i saksbehandlingen, bes adressert til REK sør-øst og ikke til enkelte personer

Kindly address all mail and e-mails to the Regional Ethics Committee, REK sør-øst, not to individual staff

The Committee's ethical considerations

The Committee has no objections to the implementation of the Research Project, on the condition that the project is approved by a Local Research Ethics Committee in Ethiopia.

The Committee's decision

The project is approved in accordance with the Health Research Act § 9 and § 33 (2008) on the basis that the condition, as specified above, are fulfilled. In addition to that condition, approval is given under the provision that the Project is implemented as described in the Application Form and the Research Protocol.

The approval is valid until 31st of December 2018

The data must be stored as de-identified data, i.e. with identifying information kept separate from the other data. For purposes of documentation, the data shall be kept until 31st of December 2023, and deleted or anonymised after this date.

The Committee's decision was unanimous.

The decision of the Committee may be appealed to the National Committee for Research Ethics in Norway. The appeal will need to be sent to the Regional Committee for Research Ethics in Norway, South-East A. The deadline for appeals is three weeks from the date on which you receive this letter.

Yours sincerely

Knut Engedal
Professor dr. med.
Leder

<div align="right">

Camilla Bø Standal
Seniorrådgiver

</div>

Kopi til:k.t.stokke@medisin.uio.no; Universitetet i Oslo ved øverste administrative ledelse: universitetsdirektor@uio.no

Viva Combs Thorsen
Institutt for helse og samfunn Universitetet i Oslo
Postboks 1130 Blindern
0318 OSLO

TILBAKEMELDING PÅ MELDING OM BEHANDLING AV PERSONOPPLYSNINGER

Vi viser til melding om behandling av personopplysninger, mottatt 19.04.2016. All nødvendig informasjon om prosjektet forelå i sin helhet 05.07.2016. Meldingen gjelder prosjektet:

48407	*Social Determinants of Health and Utilization of Antenatal Care and Skilled Birth Attendance in Ethiopia: A Multilevel Analysis Using 2005, 2011 and 2016 Ethiopian Demographic and Health Survey*
Behandlingsansvarlig	*Universitetet i Oslo, ved institusjonens øverste leder*
Daglig ansvarlig	*Viva Combs Thorsen*
Student	*Seman Kedir Osman*

Etter gjennomgang av opplysninger gitt i meldeskjemaet og øvrig dokumentasjon, finner vi at prosjektet ikke medfører meldeplikt eller konsesjonsplikt etter personopplysningslovens §§ 31 og 33.

Dersom prosjektopplegget endres i forhold til de opplysninger som ligger til grunn for vår vurdering, skal prosjektet meldes på nytt. Endringsmeldinger gis via et eget skjema, http://www.nsd.uib.no/personvern/meldeplikt/skjema.html.

Vedlagt følger vår begrunnelse for hvorfor prosjektet ikke er meldepliktig.

Vennlig hilsen

Vigdis Namtvedt Kvalheim

Hildur Thorarensen

Kontaktperson: Hildur Thorarensen tlf: 55 58 26 54
Vedlegg: Prosjektvurdering
Kopi: Seman Kedir Osman s.k.ousman@studmed.uio.no

Dokumentet er elektronisk produsert og godkjent ved NSDs rutiner for elektronisk godkjenning.

Personvernombudet for forskning

Prosjektvurdering - Kommentar

Based on the information we have received about the project, the Data Protection Official cannot see that the project will entail a processing of personal data by electronic means, or an establishment of a manual personal data filing system containing sensitive data. The project will therefore not be subject to notification according to the Personal Data Act.

The Data Protection Official presupposes that all information processed using electronic equipment in the project is anonymous.

Anonymous information is defined as information that cannot identify individuals in the data set in any of the following ways:
- directly, through uniquely identifiable characteristic (such as name, social security number, email address, etc.)
- indirectly, through a combination of background variables (such as residence/institution, gender, age, etc.)
- through a list of names referring to an encryption formula or code, or
- through recognizable faces on photographs or video recordings.

Furthermore, the Data Protection Official presupposes that names/consent forms are not linked to sensitive personal data.

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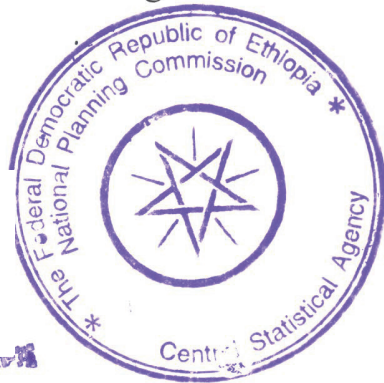ቁጥር 3 -15/578

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Date :

To: **University of Oslo, Faculty of Medicine, Norway**

Subject: **Approval letter for data Access**

SemanKedirOusman requested our organization to write a letter of approval inorder to use the Ethiopian Demographic and Health Survey (EDHS) raw data for the year 2000, 2005, 2011, and 2016 for third degree fulfillment.

Therefore, the Centeral Statistical Agency of Ethiopia (CSA) will authorize to use the after mentioned raw data for his doctoral project purpose based on the raw data access police of the organization. Accordingly, the requested data should only be used for the purpose of the registered research or study.

With regards

[signature removed]

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Addis Ababa - Ethiopia

 Gmail

Seman Osman <seman2002@gmail.com>

DHS Download Account Application

archive@dhsprogram.com <archive@dhsprogram.com>   Mon, Jun 20, 2016 at 4:25 PM
To: seman2002@gmail.com

  Please read the attached file.

You have been authorized to download data from the Demographic and Health Surveys (DHS) Program. This authorization is for unrestricted countries requested on your application, and the data should only be used for the registered research or study. To use the data for another purpose, a new research project should be submitted using the "Create A New Project" link in your user account.

All DHS data should be treated as confidential, and no effort should be made to identify any household or individual respondent interviewed in the survey. The data sets must not be passed on to other researchers without the written consent of DHS. Users are required to submit a copy of any reports/publications resulting from using the DHS data files to: archive@dhsprogram.com.

To begin downloading datasets, please login at:
http://www.dhsprogram.com/data/dataset_admin/login_main.cfm . Once you are logged in, you may also edit your contact information, change your email/password, request additional countries or Edit/Modify an existing Research Project.

The files you will download are in zipped format and must be unzipped before analysis. Following are some guidelines:

After unzipping, please print the file with the .DOC extension (found in the Individual/Male Recode Zips). This file contains useful information on country specific variables and differences in the Standard Recode definition. You will also need the DHS Recode Manual: http://dhsprogram.com/publications/publication-dhsg4-dhs-questionnaires-and-manuals.cfm . This manual contains a general description of the recode data file, including the rationale for recoding; a description of coding standards and recode variables, and a listing of the standard dictionary, with basic information relating to each variable.

It is essential that you consult the questionnaire for a country, when using the data files. Questionnaires are in the appendices of each survey's final report: http://dhsprogram.com/publications/publications-by-type.cfm . We also recommend that you make use of the Data Tools and Manuals at:
http://www.dhsprogram.com/accesssurveys/technical_assistance.cfm .

For problems with your user account, please email archive@dhsprogram.com. For data questions, please register to participate in the DHS Program User Forum at: http://userforum.dhsprogram.com .

The Demographic and Health Surveys (DHS) Program
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Rockville, MD 20850
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Fawzia Shahed
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to me

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Appendix 5. Data Extraction procedure from EDHS data set

Sampling Procedure	Ethiopian Demographic and Health Surveys (EDHS)		
	2005	2011	2016
Enumeration areas/ clusters selected	540	624	645
Households selected for EDHS	13,721	16,702	16,650

Eligible Women in Reproductive Age (15 – 49) for EDHS

EDHS 2005 n = 14,070	EDHS 2011 n = 16,515	EDHS 2016 n = 15,683

Clusters which fulfill entry criterion for this study

EDHS 2005 n = 532	EDHS 2011 n = 595	EDHS 2016 n = 641

Eligible Women for this study

Paper I (n = 7306)	Paper I (n = 7908) Paper III (n = 7908)	Paper I (n = 7585) Paper II (n = 2836) Paper III (n = 7584)

Final Sample Size estimate for the three EDHS = 41,127