Build and they will come?: Access to health facilities and maternal care usage in rural Ethiopia

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Abstract

This paper investigates the impacts of an ambitious program to improve access to health facilities in rural Ethiopia. In about a decade the government of Ethiopia managed to construct and staff health posts in all of the rural communities. The program was primarily geared towards provision of mother-child health services. This was motivated by the fact that even at the turn of the 21 century, ninety percent of deliveries in the country were not attended by skilled practitioners, contributing to a high maternal mortality ratio. I employ the mother fixed effects model to study the impact of the program on use of maternal care and incidence of pregnancy complications at birth. To my knowledge this is the only rigorous analysis of the Ethiopia program that takes into account the time invariant unobserved heterogeneity at the individual level. The findings suggest that the program led to an increase in utilization of antenatal care (13 percent for each additional facility). I do not find any impact on the usage of the facilities for deliveries or use of skilled birth attendants. I also do not find a reduction in incidences of pregnancy complications at birth. At the conclusion I point to findings of other descriptive studies which, together with mine, suggest that the main barrier to utilization of maternal care may lie in the culture and norms surrounding birth practices in rural Ethiopia.

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1 Introduction

WHO estimates that over 200,000 mothers die every year due to pregnancy complications (WHO, 2012). Access to maternal care during pregnancy and at birth is considered essential to reduce maternal deaths. However, even the basic form of access to maternal care (availability of those services) is still a challenge particularly in the rural settings of developing countries. Indeed, reviews on maternal health studies have placed physical accessibility (distance to facilities) among the most critical barrier to utilization of maternal care, and hence an obstacle to reducing maternal deaths (Sabine and Oona, 2009).

Nevertheless, despite calls to invest on health and health infrastructure (WHO, 2001), few rigorous studies have examined whether improving physical access to health facilities leads to improved use of maternal care and maternal health in developing countries (Admassie et al., 2009; Frankenberg et al., 2009; Valente, 2014). The findings from these three studies are not encouraging. Improving access to health facilities does not appear to improve usage of maternal care as expected. Among the three studies, only one examined the issue in the Sub-Saharan region, the region with highest burden of maternal mortality (Admassie et al., 2009). The study by Admassie et al. (2009) looks at the impact of the program to construct health facilities and training health extension workers in rural Ethiopia. They found that while the program increased vaccination of the children, it had no effect on the usage of antenatal or delivery care among pregnant women.

Ethiopia is an interesting case study because of its surprisingly low levels of use of facilities and skilled birth attendants for deliveries, and high maternal mortality. With maternal mortality ratio (MMR) of about 676[1](CSA and ICF International, 2012), Ethiopia has one of the highest maternal mortality ratio in Sub-Saharan. The country also has one of the lowest levels of maternal care utilization, with only about 10 percent of all

[1]Deaths per 100,000 live births

births being attended by a skilled practitioner (nurse, midwife, doctor)(CSA and ICF International, 2012). Maternal deaths accounts for about 30 percent of all deaths of women of reproductive age in the country. Moreover, unlike many other countries in the region which experienced a decline in MMR over the last decade, MMR has essentially remained stagnant over the same period in Ethiopia.

In 2003 the government initiated an ambitious Health Extension Program (HEP) to construct health posts in all communities (Kebeles) in Ethiopia by 2010. The objective of the program was to improve access to health services particularly in the rural areas. HEP paid special attention on the need for mother and children health care. The program also sought to train and deploy over 30,000 health extension workers (HEW) to be stationed in the health posts and serve the community. By 2014, the targets set by the government had all been attained. Using data of about 1358 households from 100 rural communities in three regions of the country, this paper investigate the impact of improving access to health facilities on utilization of maternal care, which is considered the main channel for reducing maternal mortality (Starrs, 1997).

The main challenge of identifying the impacts is that placement of the facilities may be influenced by the communities' unobserved factors which also affect usage of maternal care. Moreover, individual unobserved characteristics such as innate health or perception towards health care may influence their decision to use the care. To investigate the impacts I use mother fixed effects model. The impact is thus identified by comparing the health care choice of the mother before and after an increase in the number of facilities. The model controls for any time invariant fixed characteristics of the mother (such as unobserved innate health), or the community (pre-existing levels of health care use that may influence allocation of health resources.).

From 2004 through 2014, the study areas experienced a massive increase in number of health facilities. In 2004 only around 20 percent of the communities had a facility that provide general and antenatal care. By 2014 that figure had grown to 90 percent. Facilities providing delivery care increased from less than 20 percent to about 70 percent

over the same period. Results suggest that the improving access to the facilities increased significantly use of antenatal care. Each additional facility increased the proportion of mothers who use antenatal care at least once by nine percentage points, or 13 percent. The proportion of mothers who completed the recommended four antenatal visits increased by 24 percent. However, there is no evidence to suggest any impact on use of facilities for delivery care or skilled birth attendants.

The remaining part of this paper is organized as follows. Section two presents the background consisting of the literature review and the description of the settings of the study. Section three details the data used and the summary statistics. The empirical model and description of the variables used in the model are explained in section four. Section five presents the results and section six concludes.

2 Background

2.1 The Literature

Physical access to facilities has long been recognized as a critical barrier to health care use in both developing and developed countries' settings. For example Acton (1975) investigates the impact of travel distance on demand for medical services in New York, a setting where the municipal clinics and hospital provide free outpatient care. Distance was found to serve as price in determining the demand for health care. In addition, distance elasticity of demand for care was found to be similar to price elasticity found in other similar studies.

Also in the United States, Douglas et al. (2006) found that a significant reduction in infant mortality rates among blacks in the 1960s in the rural parts of southern states could be attributed to the improved access to health facilities. Their study examined the impact of a civil right act which mandated racial desegregation for hospitals that received federal funds. The desegregation meant that black people could access health facilities with good

quality of care. Using a community fixed effects model, the findings suggest that about 5000 to 7000 additional black infants are estimated to have survived through their first year of life between 1965-75.

Although physical access may be a crucial determinant of usage of certain types of health care in developed countries (Buchmueller et al., 2006), it is in the developing countries where it considered to be critical (Stock, 1983; Thaddeus and Maine, 1994). Especially the rural areas where the availability of health facilities is likely to be limited coupled with poor transportation networks. Improving physical access could lead to a reduction of infant, child and maternal deaths. For example Frankenberg (1995) examined the impact of access to health facilities and health professionals in Indonesia. The study report about 43 percent increase in number of maternity clinics between 1983-86, a significant improvement in access to health facilities. Using village fixed effects model, the study found that an additional maternal clinic reduced the odds death of an infant by about 15 percent, compared to an infant born before the clinic was established.

Wilson (2015) examines the impact of expansion of prevention of mother-to-child transmission of HIV (PMTCT) care on fertility and child mortality risk in Zambia. Between 2000 and 2006 the number of health facilities providing PMTCT care increased from less than six to about 600, a significant improvement in access to PMTCT. Using difference-in-differences approach the study finds that introduction of the care within 20kms of a respondent reduced pregnancy rates by about 10 percent. Breastfeeding rates also improved significantly which contributes to healthy children.

For maternal care outcomes, however, there is a dearth of rigorous evidence on the impact of access to health facilities. Majority of existing studies rely on cross-sectional comparisons without adequately controlling for endogenous placement of the facilities (Abbas and Walker, 1986; Do, 2009; Tsegay et al., 2013). In a review of barriers to utilization of maternal care, Sabine and Oona (2009) also raise concerns about interpretation of the findings from such studies. Only three studies (Admassie et al., 2009; Frankenberg et al., 2009; Valente, 2014) investigate the impact of access to facilities on maternal care

use, with attempts to control for the non-random placement of the facilities.

Frankenberg et al. (2009) evaluates the Indonesia midwifery program in which about 50,000 midwives were trained and placed in communities areas from late 1980s to 1998. The communities were selected on being poor and distant from health facilities. The activities of the midwives involved providing health and family planning care, and work with traditional birth attendants in referring pregnant mothers to get proper medical care. They use data from the Indonesia Family and Life Survey (IFLS) which shows that between 1993 and 1997 the percentage of communities with midwives increased from 9.6 percent to 46.3 percent. Mother fixed effects is used in evaluating the impact of having a midwife in the community. They also include some time varying characteristics at community level: road pavement, phone availability and household expenditure per capita within the community to reduce endogeneity due to time varying community factors. The results indicate that the program had a significant effect on improving the use of iron tablets during pregnancy. There was some indication of positive impact of the program on antenatal care use, although the coefficient was not significant at conventional levels (likely due to imprecise estimation). The impact on using modern delivery care (medically oriented delivery) was positive although marginally significant.

The next study by Valente (2014) looked on the impact of access to legal abortion centers in Nepal on abortion and maternal care health inputs. The study uses Demographic Survey Data (DHS) and mother fixed effect estimation model to estimated the impact. A linear trend specific to each community is included to control for some unobserved time-varying characteristics within the community. The results indicated that although access to the centers reduced the likelihood of a live birth condition on conception by about 7.4 percentage points, there was no significant effect on use of maternal care inputs such as antenatal care or skilled birth attendants. Surprisingly, the centers appear to have increased deliveries at home, although the author did not attempt to explain this result.

The last paper by Admassie et al. (2009) evaluates the impact of the Health Services

Extension Program (HEP) in Ethiopia[2] which involved construction of health facilities and training and deployment of health workers. They investigate the impact in three regions of the country.[3] between 2003 and 2007. The evaluation method employed is the propensity matching method in which treatment (those that have been affected by HEP) villages were matched with control villages based on observable characteristics. They find that the program improved full child immunization against major diseases by about 16 percent. However, they do not find any impact on usage of antenatal care, skilled birth attendants or postnatal care, albeit there was significant impact on reduction of time (months) the mother delay to make the first antenatal care visit.

The preceding review indicates that, while it is generally considered that improving physical access to health services will improve uptake of maternal care, there is little evidence to support such conjecture. Nevertheless, the body of evidence is still limited and perhaps some of there programs might have impacts in the long term. In that regard, this study offers the following contributions to the existing literature. First it extends the literature on access and use of maternal care by providing a rigorous evidence of the impact of access on maternal care use in the spirit of (Admassie et al., 2009; Frankenberg et al., 2009; Valente, 2014). Secondly, to my knowledge, this is the first longitudinal study to provide rigorous evidence on the relationship between physical access and maternal care use in Sub-saharan Africa, the region with the highest maternal morbidity and lowest maternal care use. Lastly, unlike existing studies which examine the impact of access in a short to medium term period, the data used in this paper allows one to explore long term impacts of up to a decade.

2.2 The context

Although Ethiopia is among the poorest nations in the world, the country has registered remarkable economic development over the last 15 years (World Bank Group, 2015). The

[2]The program is described in detail in section 2.3

[3]Amhara, Oromia and Southern Nations, Nationalities and Peoples (SNNP)

Gross Domestic Product (GDP) grew at an annual rate of eight to 14 percent and the annual per capita growth averaged 8.3 percent between 2000 and 2011. The growth has contributed to poverty reduction. Over 50 percent of the population in the country were living under US$1.25 PPP a day in 2000. By 2011, that number had gone down to less than 30 percent.

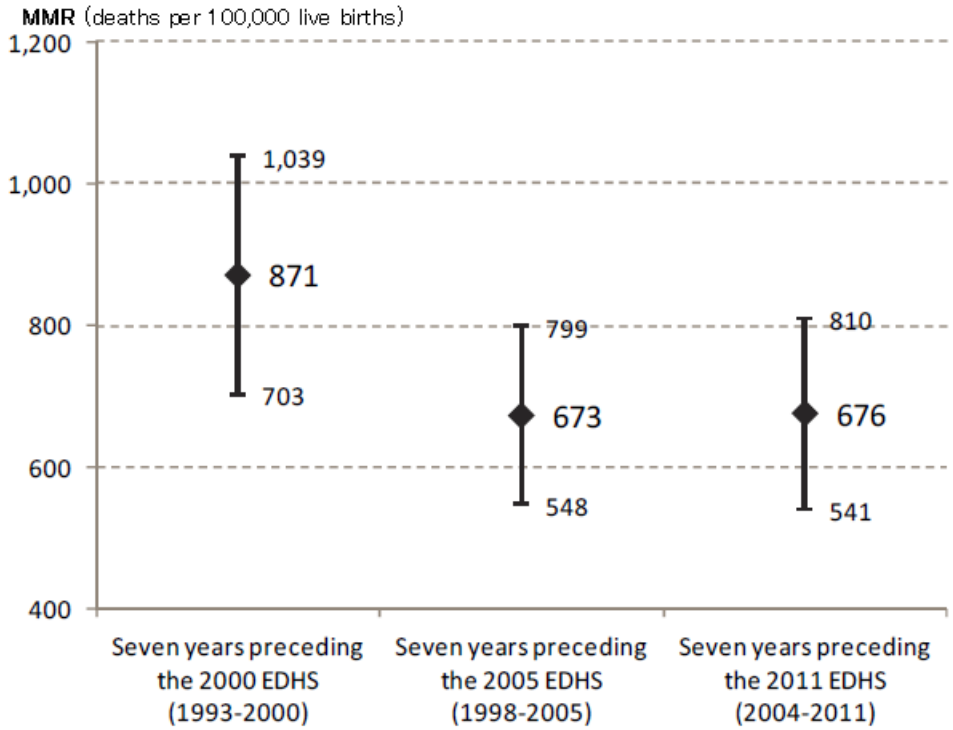
The recent improvement in standard of living has also been reflected in improvement of several health indicators. Between 2000 and 2011 under five mortality declined by about 42 percent from 166 to 88 per 1000 live births (CSA and ICF International, 2012). In 2000 about 58 percent of children under five years were stunted, an indicator of chronic malnutrition. By 2011 stunting had declined appreciably to about 44 percent of children under five.

Despite the achievements, however, Ethiopia is facing a high burned of maternal morbidity and mortality. Maternal mortality accounts for almost a third of all deaths of women of reproductive age (15-49years) (CSA and ICF International, 2012). Maternal mortality ratio (MMR) has remained high and stagnant. Graph 1 shows MMR estimates and their 95 percent confidence intervals from the 2012 Ethiopia Demographic Health Survey (DHS). The graph shows that MMR has not declined significantly between 1993 and 2011. This experience is in contrast to that of majority of other countries in the East Africa region which experienced a significant decline of maternal mortality over the last 10 to 15 years.[4]

The high maternal maternal deaths and morbidity in the country can partly be explained by the low usage of maternal care. Less than half of pregnant women attend antenatal care at least once. Only about 10 percent deliver at a health facility, and similar figure for those who are attended by a skilled birth practitioner. These figures implies that over 2.2 million babies are born annually without assistance of a skilled birth attendant.[5] Maternal care usage in the country is low by far even by Sub-Saharan standards (Wamai,

[4]Excluding Ethiopia and Somalia, the MMR for the other countries in the East Africa region ranges between 440 to 500 for the data as recent as 2011. Data for the war torn Somalia is only available in 2006 showing an MMR of 1000 (World Bank, 2015).

[5]Author's calculations based on the World Bank population data. With a population of about 94.1 million growing at a natural rate of about 2.6, number of births not attended by a skilled birth attendant is: 94.1million $\times$ 0.026 $\times$ 0.9 = 2201940



Source:Adopted from (CSA and ICF International, 2012)

Figure 1: Stagnant Maternal Mortality Ratio (MMR)

2009).[6]

A wide dispersion exists in maternal care usage across the eleven geographical regions of Ethiopia.[7] For example use of skilled birth attendants in Gembela, Harari, Dire Dawa regions is at least 27 percent, and in the capitol Addis Ababa is around 83 percent. However in the other regions the usage ranges between six and 11 percent (CSA and ICF International, 2012). One of the central challenges to improve use of maternal care in the country has been access to these services especially in the rural areas where about 81 percent of the population live. To improve access to health care, and maternal care in particular a number of strategies have been under taken by the government. Central among them is the community based Health Services Extension Program (HEP) initiated in 2003.

[6]The Sub-Saharan region average use of antenatal care (at least one visit during pregnancy) is 77 percent, and about 49 percent for use of skilled birth attendants (World Bank, 2015).

[7]Ethiopia has 11 geographic/administrative regions (nine regional states and two city administrations).

2.3 The Program

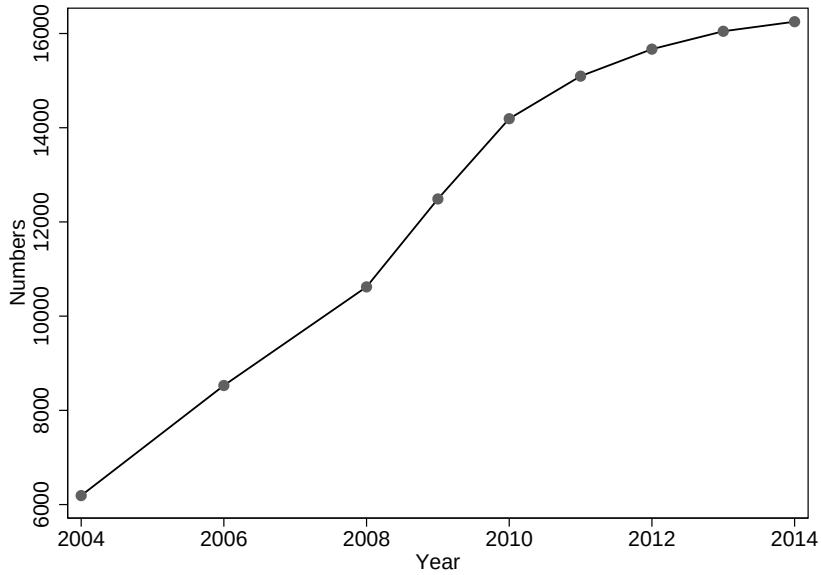
The HEP was part of the initiatives under the Health Sector Development Program (HSDP) which covered the period between 2002 and 2005. HEP has two key components: Construction of health posts in the villages; training and deployment of health extension workers (HEW).

The first key component of HEP involve construction and equipping health posts (HPs) in the villages where HEW would be stationed. The health post serve between 3,000 and 5,000 people (Ministry of Health, 2010). Above the health posts is the health center which serves about 15,000 to 30,000 people. The health center and the health posts are connected by a referral system to a primary hospital[8], and the three levels of facilities form a Primary Health Care Unit (PHCU). Above the PHCU are the general hospitals and specialized hospitals offering special types of health care such as reproductive care, mental care[9]. The cost of construction of the health posts was covered by the local government. Communities also contributed by offering labor and construction materials. As seen in graph 2, the number of HPs has more than doubled between 2004 and 2014. The government planned to construct and equip 16,253 HPs by 2010, which represented 100 percent of all communities. However, this target was attained in 2014.

The second component is training of HEW. The need for training new calibre of health workers arose due to the fact that Ethiopia faced a critical shortage of health workers of all cadres especially in the rural areas. The pre-existing training of health workers produced clinically-oriented nurses, midwives and doctors who preferred to stay in urban areas where better professional opportunities were available. HEP sought to train rural-oriented community health workers who are more relevant to the rural areas and likely to stay in the villages (Nejmudin et al., 2011). The government set a target of training and deploying 30,000 HEW by 2010 (Ministry of Health, 2010).

The candidates for the training are recruited from female-members of the village with

[8]Primary hospital covers about 60,000 to 100,000 people.
[9]General hospital covers 1 to 1.5 million people, and specialized hospitals covers 3.5 to 5 million people.

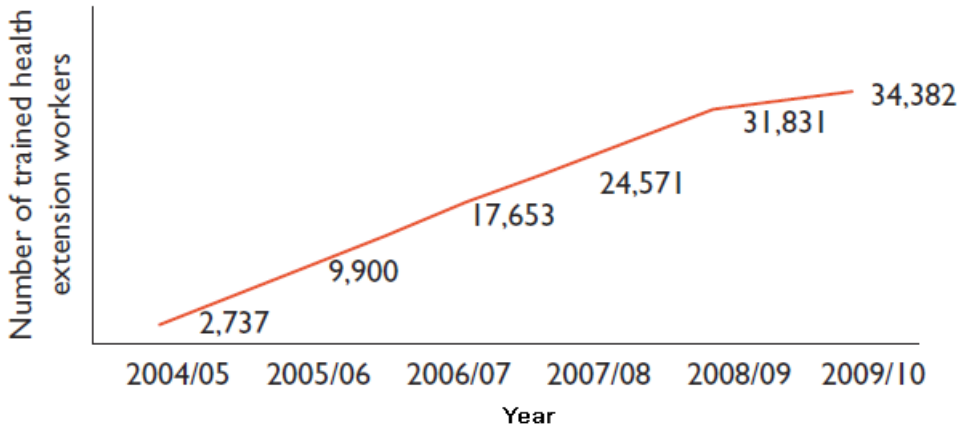


Source:(Ministry of Health, 2014)

Figure 2: A significant increase in the number of health posts.

at least 18 years of age and completed at least 10th grade education (secondary school). Female members are selected because most of the HEP health packages deal with issues affecting women and children. The selection is done by a committee nominated by the local community and representatives from the district offices. The candidates undergo a 12 month theoretical and practical training on managing the health posts, promoting preventive care, provide contraceptive, conduct safe and clean deliveries and refer cases to higher level health facilities. Upon graduation the HEW are recruited by the government and posted in the villages. The cost of training HEWs is covered by the federal government while the regional governments are responsible for the salaries of the deployed HEWs. As seen on graph 3 there has been a significant increase in the number health workers overtime. Between 2004 and 2010 the number of HEW increased by more than 12 fold, surpassing the target of 30,000 HEWs set by the government.

Roll-out of HEP was influenced by several factors ranging from availability of resources to health conditions of the communities. Admassie et al. (2009) note their discussion with health officials which suggested that communities which could raise necessary resources for construction of HPs were more likely to get the facility and the HEW



Source:Adopted from (Nejmudin et al., 2011)

Figure 3: A significant increase in the number of HEW

earlier. Other factors included availability of female secondary school graduates within the community or district, availability of other health centers near the community. Also communities with a history of poor health outcomes (including maternal outcomes) were prioritized.

While HEP has been successful in deploying HEW and establishing HPs, the services that could be offered at the HPs has been limited by the availability of necessary equipment. For example an evaluation of implementation of the HEP (Center for National Health Development in Ethiopia, and Columbia University, 2011) found that only 12 percent of the HPs were fully equipped with the minimum[10] set of supplies for provision of delivery and newborn care services. Seventy one percent of the HPs had only 40 percent of the minimum set. Because of lack of equipment, nurses or midwives some of the HPs cannot provide certain services such as antenatal care or delivery services.

Therefore the effective provision of services may not be realized until the necessary inputs are in place. Hence the number of facilities per se might not indicate effective availability of services. The data used for this study contains specific years when the facility actually started to provide general care, antenatal and delivery care. This helps, to some degree, capture precisely the services available at a facility in a particular year. The

[10]The minimum set comprise of: Blood pressure apparatus, adult weighing scale, foetoscope, delivery bed, neonatal resuscitation mask and bag, home delivery kits.

next section contains a detailed discussion of the data used in this study.

3 Data

Data for this study comes from the 2014 Ethiopia Research on Poverty, Environment and Agriculture Technologies (RePEAT) survey. The survey covered 100 communities (also known as Kebeles in Ethiopia) from three regions of Amhara, Oromiya and SNNP (Southern Nations, Nationalities and Peoples'). Approximately 14 households were randomly sampled from each of the village, making a total of 1358 households who were interviewed. RePEAT is a longitudinal survey with three waves of data (2004, 2006 and 2014). However, because of high attrition in the first two waves, this study uses data only from the new households only that were randomly sampled in 2014.

Women aged 15 to 49 provided information about their delivery history ten years prior to the survey. A total of 746 women had at least one pregnancy case over the last ten years. This group of women provided information related to their health seeking behavior during pregnancy. Specifically they provided information about: where they went to receive maternal care, who attended them, modes of travel, fees for the care, travel time and transportation cost to seek the care.

Figure 4 plots the annual average maternal care use between 2005 and 2014 for the primary outcomes of interest; antenatal care use, facility delivery and skilled birth attendance. The trends of the outcomes on the figure suggest a positive increase in utilization of maternal care particularly for antenatal care use. The proportion of mother who made at least one antenatal care visit increased from about 41 percent in 2007 to 80 percent in 2014, a 95 percent increase. Skilled birth attendance and facility delivery more than doubled from around 17 percent in 2005, to about 38 percent in 2014. Although the rate of increase was low for most of the period (2005-2012) until after 2012. The average utilization of maternal care is indicated in table 1. In 67 percent of all pregnancy cases

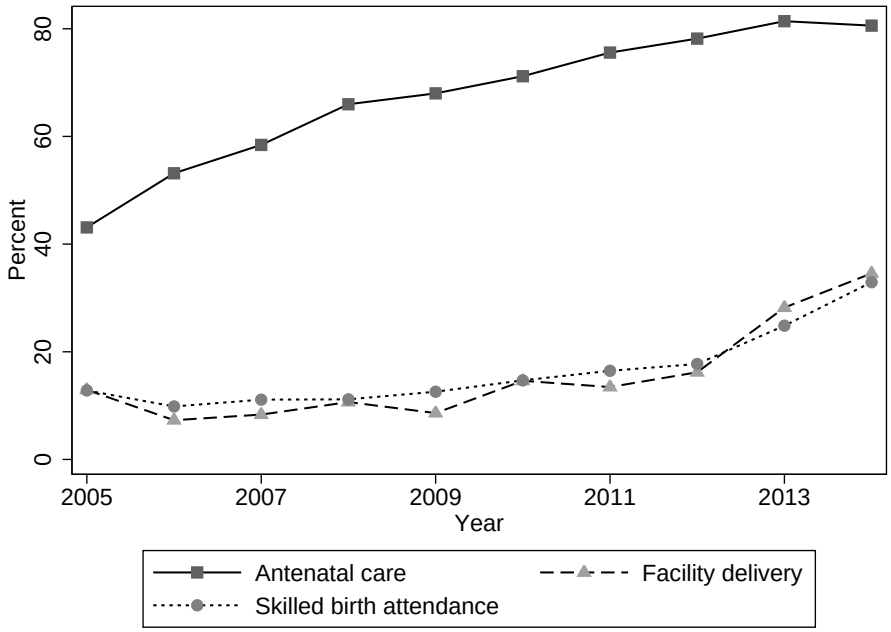


Figure 4: Increasing utilization of maternal care

(1568 cases) mothers made at least one antenatal care visit to a health facility. However in about six percent of the cases, mothers reported visiting a health facility for antenatal care but not receive the care from a skilled practitioner.

The positive trends suggest an improvement in utilization of maternal care overtime. Whether and to what extent this improvement can be attributed to better access to health services is the question that this study is aimed to address.

The RePEAT survey collected historical information about availability of health facilities within the community. Specifically, the community questionnaire asked about health facilities which were available, the year the facilities started providing; general health care, antenatal care and delivery care. This information was provided by the community's development agents[11] or health workers in the community. Additional phone calls were made to other community leaders to insure reliability of the information. Then facilities were categorized into three types depending on the year they started to provide each of the three types of care. Those that provide general health care (general care facilities),

[11]Government employees stationed in the community to oversee agricultural and other development activities.

Table 1: Summary statistics

Variable	Obs	Mean	Std. Dev.
1 if attended antenatal care at a facility	1568	.67	.47
1 if received ANC at facility by a skilled practitioner	1568	.61	.49
Total number of ANC visits	1568	3.36	3.16
1 if visited in the 1st trimester	1568	.4	.49
1 if visited in the 1st trimester and checked by skilled practitioner	1568	.39	.49
1 if deliver at a health facility	1568	.14	.35
1 if deliver at a health facility and assisted by a skilled practitioner	1568	.12	.32
1 if attended by a skilled practitioner	1568	.15	.36
Travel time (walking) to Antenatal care (mins)	837	47.38	39.5
1 if paid for antenatal care at a facility	953	.08	.27
Fee for antenatal care (Birr)	953	9.03	137.46
Travel time (walking) for Delivery care (mins)	45	54.22	58.07
1 if paid for delivery care at a facility	233	.27	.45
Fee for delivery care (Birr)	233	83.58	262.86
1 if suffered compication at birth	1568	.1	.3
1 if child received postnatal care from a skilled person	1542	.48	.5
1 if mother received postnatal care from a skilled person	1563	.45	.5
Years of education	1568	1.83	2.91
No education	1568	.64	.48
Some primary school (grade 1-7)	1568	.3	.46
Completed primary school (grade 8)	1568	.03	.17
Above primary school (grades 8+)	1568	.02	.16
Mother's age at delivery	1568	27.46	6.4
under 19	1568	.07	.26
19-25	1568	.33	.47
26-30	1568	.27	.44
31-35	1568	.21	.41
above 35	1568	.12	.32
Parity of the pregnancy	1568	4.26	2.37
Per capita household landsize (acres per capita)	1568	.89	.95
Value of household assets per capita (Birr)	1568	3968.13	5360.43
1st quartile(poorest)	1568	.26	.44
2nd quartile	1568	.25	.43
3rd quartile	1568	.25	.43
4th quartile(richest)	1568	.25	.43

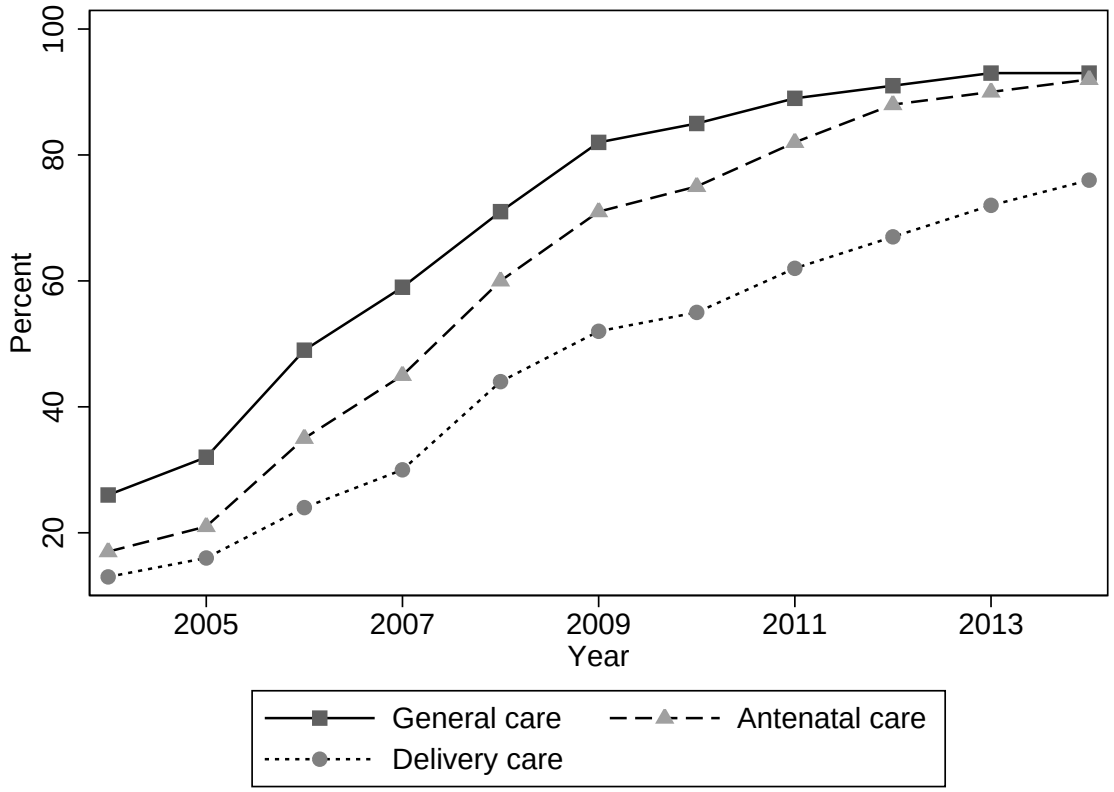
Table 2: Average number of facilities per community(Kebele)

Variable	Obs	Mean	Std. Dev.
General care facilities (numbers per Kebele)	1100	.77	.57
Antenatal care facilities (numbers per Kebele)	1100	.68	.59
Delivery care facilities (numbers per Kebele)	1100	.5	.57

those that provide antenatal care (antenatal care facilities), and those that provide delivery care (delivery care facilities).

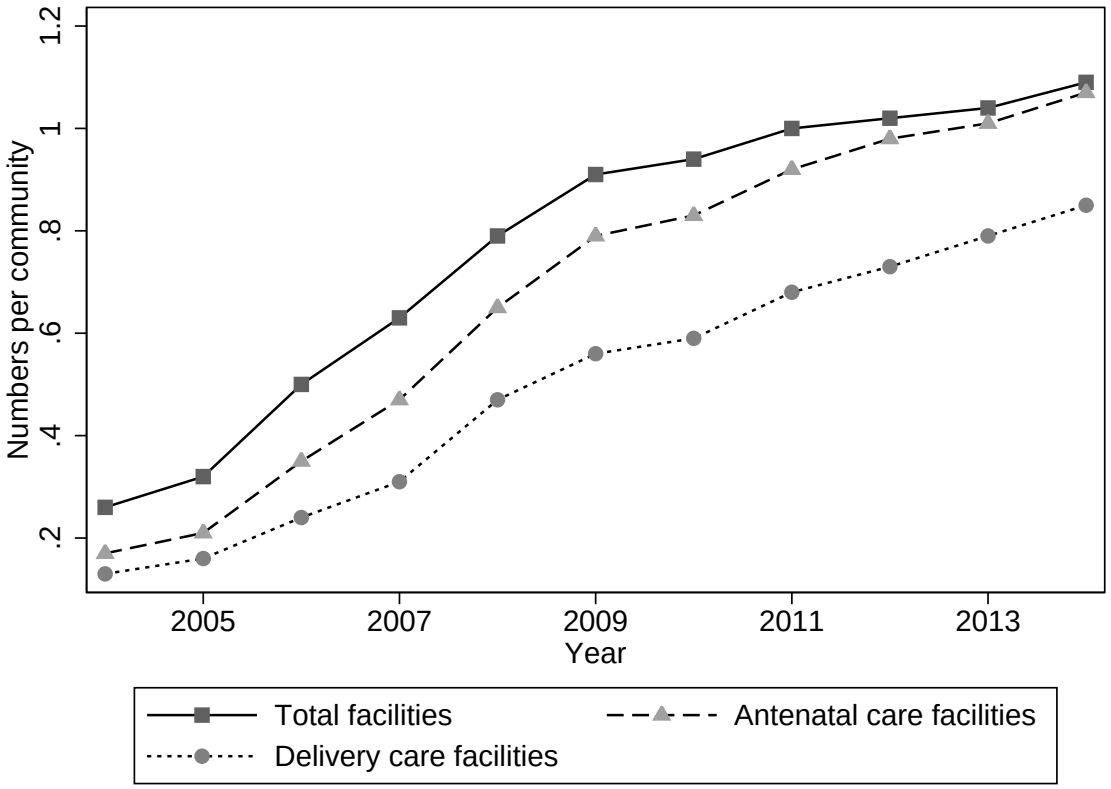
A typical facility in the community started by providing general care, then proceeded to provide antenatal care after two or three years, and initiate delivery care services about two years after starting to provide antenatal care. Therefore these categories are not mutually exclusive. A facility may provide all three types of health services and hence it will be counted in all three categories.

By 2014, over 90 percent of the communities had at least one general and antenatal care facility (figure 5). Less than 20 percent of the communities had a delivery care facility in 2004. That fraction has grown to almost 70 percent by 2014. Figure 6 plots the yearly average number of facilities (of each category) per community from 2004 to 2014. The average number of facilities per community of all three categories has grown rapidly over the ten years period, starting from a low level in the initial years. general and antenatal care. The average number of delivery facilities also rose sharply from less than 0.2 to about 0.8 by 2014. Table 2 indicates that the overall number of general facilities per community was 0.77, while that for antenatal care and delivery care facilities were 0.68 and 0.5 respectively. The empirical model presented in the next section will exploit the changes in availability of health services across pregnancies of a mother to estimate the impact of improvement in access to health care.



Source: Author's computation from the RePEAT data.

Figure 5: Percent of villages with facilities



Source: Author's computation from the RePEAT data.

Figure 6: Increasing number of health facilities

4 Empirical model

To investigate the impact of the increase in number of facilities (access to maternal care) we use the mother fixed effects model. In this model the impact is identified by comparing the health care choice of the mother before and after an increase in the number of facilities. The model control for time-invariant unobserved (community or individual) factors that are correlated with both health facility placement and use of maternal care. A regional time trend is also included to control for time-varying factors at regional level. The following empirical model is estimated:

$$M_{ijhkt} = \beta_1 * Access_{kt} + \beta_2 * Z_{jhkt} + \eta_{jhk} + \mu_k + \lambda_{rt} + \nu_{ijhkt} \quad (4.1)$$

M_{ijhkt} represents the outcome of interest for pregnancy i of mother j in household h, living in community k in year t. $Access$ is the explanatory variable of interest which captures availability of health services within the community in a particular year. Specifically, $Access$ is the number of facilities providing a particular type of maternal care service in the community. $Access$ also includes measures of availability of general care services to account for the fact that these services might influence utilization of maternal maternal care through provision of health education or information about where the mother may go for maternal services.

Z_{jhkt} is a set of control variables consisting of Mother's age in the year of delivery and Parity of the pregnancy. They control for any experience with pregnancy that might comes with age. The age variable also controls for any birth cohort effects. This variable is constructed from all the pregnancies that the mother has experienced in her life and not just in ten years prior to the survey.

Maternal education is the highest grade attended by the mother in the year of the survey. The role of maternal education on reproductive and maternal health has well been documented in the literature . Women who have attended formal schooling have higher

propensity of using modern care including maternal care . Because grade attainment does not change overtime in the data used in this study, the coefficient of this variable is only estimated in the community fixed effect model and not mother fixed effect model.

The household economic wellbeing is controlled using per capita household land size and per capita value of assets. Per capita household land size is computed by dividing the yearly-total household land size by the number of household members. RePEAT data contains information on the year when each of the household land parcel was purchased or sold. We use that information to construct the total household land size available to the household for each particular year. Per capita value of assets variable is generated from the total value of assets (physical assets and livestock) owned by the household at the time of survey. This information does not vary over time and hence not estimable in the mother fixed effects.

η_{jhk} represent unobserved characteristics peculiar to the mother such as mother's innate health. For example, it is possible that mothers with weak innate health, which is not observed by researchers, may be more pro-active in seeking health care merely due to their poor innate health and not improvement in availability of health care. Similarly, μ_k are the unobserved characteristics peculiar the community k which influence allocation of health facilities as well as utilization of health care. They include for instance bargaining power of political leaders and the community. A leader/community which is more "health conscious" and has strong bargaining power is likely to have a higher number of facilities than otherwise. The mother fixed effect model eliminate biases introduced by such individual and community time-invariant factors.

λ_{rt} is the regional-year trend which controls for regional wide changes in factors that may affect both utilization and availability of maternal care such as changes in the quality of transportation, road networks and region's economic performance. ν_{ijhkt} is the error term clustered at community level to take into account intra-community correlation of the error terms. The next section presents results from mother fixed effect model for the outcomes on utilization of maternal care, health status and expenditures.

5 Results

The results from the estimation of the mother fixed effect are presented in tables 3 to 6. Table 3 shows the impact of access to antenatal care facilities on usage of antenatal care.

5.1 Antenatal care use

Overall, the results suggest that improving access to antenatal care facilities leads to an increase in utilization of antenatal care. Column one indicates that an additional antenatal care facility leads to a nine percentage points increase in the share of women who make at least one antenatal care visit. The proportion of those who make at least four antenatal visits[12] increased by 10 percentage points. The share of women who attend facility for antenatal and were received the care from the skilled practitioner also increased although the coefficient is not precisely estimated. The control variables are not significantly associated with use of antenatal care.

5.2 Delivery care use

Unlike the results for antenatal care, there is no evidence to suggest that improvement in access to delivery facilities (Table 4) led to an increase in utilization of delivery care. The coefficients and their respective t-statistics are too small to suggest any meaningful relationship between access to delivery facilities and utilization of delivery care. These results suggest that the increase in delivery care use -though not as large as increase in antenatal care use- was primarily driven by some other factors apart from improvement in access to health facilities.

Parity is the only correlate that is significantly associated with the use of facility delivery. Parity dummies indicate that mothers who had delivery before are less likely to

[12] As recommended by the World Health Organization (WHO)

use delivery care compared to those who were experiencing pregnancy for the first time. For the 2nd birth for example, mothers are about 13 percentage points less likely to use delivery care relative to those who are giving birth for the first time.

5.3 Complications and postnatal care

Similar to the findings on delivery care use, there is no evidence to suggest that access to delivery facilities reduced incidences of pregnancy complications or use of postnatal care (Table 5). These results are not surprising given that there was no improvement in the use of delivery care. Nevertheless, in a separate analysis (results not shown) no significant relationships was found between access to antenatal care, or general care on those outcomes. Thus although the share of women who attended antenatal care increased, these women were still less likely to use postnatal or delivery care. This suggests that while non-availability of services may be a barrier to use of antenatal care, a different set of barrier may be preventing utilization of delivery and postnatal care.

Again, higher parity is associated with less occurrence of complication, less likelihood of the mother or their baby to receive postnatal care. Surprisingly, household wealth in terms of assets is positively associated with reports of occurrence of pregnancy complication.

5.4 Fees and expenditures

The increase in utilization of antenatal care reported in table 3 might be driven by reduction in travel time[13] to the health facilities as they become more available. Moreover, although in Ethiopia maternal care in public facilities is officially ”free”, in practise mothers still reported paying some amount for the care at the facilities. The cost of care may decline if more services become available.

However despite the increase in antenatal care use, there is no evidence to suggest that

[13]The travel time examined is for those who walked to the facilities for antenatal care. Majority of the pregnancy cases (81 percent) mothers walked to the antenatal facilities.

this was driven by the reduction in travel time or fees (Table 6). It is important to note that the sample size in this analysis is reduced by almost 43 percent because it involve a fraction of mothers who have sought some formal antenatal care (typically at a health facility). The small sample size may have led to low statistical power to detect an effect.

6 Discussion and conclusion

This paper looks at the impact of access to health facilities on use of maternal care in rural Ethiopia. The country has one of the lowest usage of formal delivery care in the Sub-Saharan and a high maternal mortality ratio. Since 2003 the government of Ethiopia has embarked on an ambitious program of construction of health posts (HPs) and training and deploying health extension workers(HEW). By 2014 more than 30,000 HEW had been deployed and over 16200 HPs built. Using data from 100 communities in three regions of Ethiopia, I employ mother fixed effect model to study the impact of the program on usage of maternal care and incidences of complications. The results suggest that the program improved the use of antenatal care by about 13 percent for each additional facility. The proportion of mothers who completed the recommended four antenatal care visits increased by about 24 percent. However, no impact was found on use of skilled birth attendants, facilities for delivery or reduction in pregnancy complications.

With over $1.3 billion[14] spent on construction of the HPs and training HEW, these results are not encouraging for a country that is striving to reduce maternal deaths. The findings on use of skilled birth attendants resonates with those of Admassie et al. (2009). It is useful to note that, while there has been massive investment on the health infrastructure and workforce over the last decade, the use of skilled birth attendants rose from six percent in 2000 to only 10 percent in 2011 (CSA and ICF International, 2001, 2012), which low

[14]The cost of constructing one HP is estimated to be about $75,000 (Admassie et al., 2009). The HEW training costs around $3,300, comprising of: 12 months $83 stipend; $234 for three months theoretical training; and $178 nine months practical training (Nejmudin et al., 2011).

by far compared to the government's target of 27 percent skilled attendance by 2011.

Why no impact in the use of formal delivery care? One reason could be that a large proportion of women do not fully comprehend the risks of delivering by unskilled attendants. While I do not have data to check this possibility, the Demographic Health Survey of Ethiopia (CSA and ICF International, 2012) asked mothers who did not deliver at the health facilities - who represent about 90 percent of all delivery cases reported in the nationally representative survey- the reasons behind their choice of delivery care. Sixty one percent of the mothers said that it was not necessary, and 31 percent mentioned that it was not customary.[15]

Given the high prevalence of maternal morbidity in the country, it will be interesting to examine why such a large fraction of mother think that delivering at a facility was not necessary. However, their feedback provides a useful starting point for considering the policy implications and recommendations from the findings of this study. While HEP was to a good degree successful in increasing investment in the health infrastructure, the findings from this study suggest that health policies in Ethiopia will need pay close attention on other barriers to utilization of maternal care. These may include dissemination of knowledge about the importance of using maternal care.

In a setting in which health infrastructure is present but utilization of maternal care is low, small incentives might help to increase demand for the care (World Bank Group, 2013). The incentives can be on both health care providers and users. This policy has been experimented in settings similar to those of Ethiopia -where the infrastructure is available- in: Rwanda (Basinga et al., 2011), Nepal (Powell-Jackson and Hanson, 2012) and India (Sumit et al., 2011).

This study, however, is not without caveats. The measure of access to health facilities used is this study is less precise as it does not take into account the actual distances from the households to the facilities. This error in the measures of access introduces attenuation

[15] In Amhara region, 56 percent said it was not necessary and 36 percent said it was not customary. The figures for Oromiya region were 64 percent and 29 percent respectively. Those of SNNP region were 65 percent and 26 percent respectively.

bias in our coefficients of interest (coefficients of measures of access). It should be noted however that attenuation bias biases our results towards zero and hence the estimated coefficient of the measures of access can be considered as lower bound estimates. Also, although the data indicates which services are available at a facility in a particular year, the quality of that service is not captured by the data. Despite these caveats, the findings of this study may open a policy dialogue about measures that can be taking under the HEP, to improve use of maternal care. Future research may also investigate other interventions that may complement HEP to improve the program's effectiveness in serving mothers.

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Table 3: Impact of improving access to antenatal care facilities

VARIABLES	(1) 1 if attended antenatal care at a facility	(2) 1 if received ANC at facility by a skilled practitioner	(3) Total number of ANC visits	(4) 1 if at least 4 antenatal visits
Antenatal care facilities (numbers in Kebele)	0.09*	0.10	0.42	0.10*
	(1.74)	(1.65)	(1.54)	(1.86)
General care facilities (numbers in Kebele)	0.02	0.01	-0.22	-0.09
	(0.29)	(0.11)	(-0.75)	(-1.48)
19-25	-0.09	-0.09	-0.51	-0.05
	(-1.42)	(-1.63)	(-1.65)	(-0.89)
26-30	-0.07	-0.08	-0.48	-0.06
	(-0.83)	(-1.07)	(-1.21)	(-0.71)
31-35	-0.07	-0.10	-0.40	-0.02
	(-0.61)	(-0.95)	(-0.75)	(-0.22)
above 35	-0.15	-0.16	-0.35	0.07
	(-1.02)	(-1.07)	(-0.47)	(0.43)
Per capita household landsize (acres per capita)	0.02	0.01	0.10	0.05
	(0.45)	(0.28)	(0.54)	(0.98)
2nd parity	-0.01	-0.01	0.07	0.01
	(-0.26)	(-0.27)	(0.33)	(0.26)
3rd parity	-0.02	-0.02	-0.08	0.01
	(-0.40)	(-0.41)	(-0.28)	(0.10)
4th+ parity	-0.05	-0.04	-0.47	-0.06
	(-0.62)	(-0.51)	(-1.10)	(-0.68)
Observations	1,070	1,070	1,070	1,070
R-squared	0.23	0.20	0.20	0.11
Number of Mother	409	409	409	409
Mother fixed effects	Yes	Yes	Yes	Yes
Year × region	Yes	Yes	Yes	Yes
Mean of the outcome	0.678	0.611	3.381	0.422

Notes:
1). Robust t-statistics in parentheses
2). Significance level: *** p<0.01, ** p<0.05, * p<0.1
3). Standard errors clustered at the PA level. All regressions include a constant and region-year interaction.
4). The base category for age in those under 19 years. The base category for education is those with no formal schooling-zero grade.

Table 4: Impact of improving access to delivery care facilities

VARIABLES	(1) 1 if deliver at a health facility	(2) 1 if deliver at a health facility and assisted by a skilled practitioner	(3) 1 if attended by a skilled practitioner
Delivery care facilities (numbers in Kebele)	0.01	-0.01	-0.02
	(0.40)	(-0.28)	(-0.62)
General care facilities (numbers in Kebele)	0.01	0.02	0.00
	(0.34)	(0.58)	(0.10)
19-25	-0.01	-0.01	-0.02
	(-0.09)	(-0.24)	(-0.50)
26-30	0.04	0.02	0.01
	(0.63)	(0.41)	(0.16)
31-35	0.04	0.03	0.00
	(0.42)	(0.34)	(0.01)
above 35	-0.01	-0.01	-0.05
	(-0.08)	(-0.07)	(-0.44)
Per capita household landsize (acres per capita)	0.01	0.01	0.01
	(0.40)	(0.25)	(0.38)
2nd parity	-0.08**	-0.07*	-0.05
	(-2.04)	(-1.94)	(-1.63)
3rd parity	-0.10**	-0.09*	-0.07
	(-2.07)	(-1.95)	(-1.64)
4th+ parity	-0.13**	-0.11**	-0.10**
	(-2.23)	(-2.00)	(-2.01)
Observations	1,050	1,050	1,050
R-squared	0.10	0.09	0.08
Number of Mother	409	409	409
Mother fixed effects	Yes	Yes	Yes
Year × region	Yes	Yes	Yes
Mean of the outcome	0.121	0.104	0.135

Notes:
1). Robust t-statistics in parentheses
2). Significance level: *** p<0.01, ** p<0.05, * p<0.1
3). Standard errors clustered at the PA level. All regressions include a constant and region-year interaction.
4). The base category for age in those under 19 years. The base category for education is those with no formal schooling-zero grades.

Table 5: Impact of improving access on health outcomes

VARIABLES	(1) 1 if suffered compication at birth	(2) 1 if child received postnatal care from a skilled person	(3) 1 if mother received postnatal care from a skilled person
Delivery care facilities (numbers in Kebele)	-0.04	-0.01	-0.01
	(-1.40)	(-0.27)	(-0.16)
General care facilities (numbers in Kebele)	0.02	0.01	0.00
	(0.49)	(0.35)	(0.08)
19-25	0.01	0.03	-0.01
	(0.11)	(0.56)	(-0.09)
26-30	-0.02	0.10	0.00
	(-0.28)	(1.29)	(0.01)
31-35	-0.00	0.12	0.01
	(-0.02)	(1.09)	(0.07)
above 35	-0.08	0.16	-0.01
	(-0.76)	(1.19)	(-0.08)
Per capita household landsize (acres per capita)	0.05**	-0.00	-0.01
	(2.00)	(-0.09)	(-0.29)
2nd parity	-0.06	-0.02	-0.05
	(-1.48)	(-0.69)	(-1.58)
3rd parity	-0.09*	-0.07	-0.09*
	(-1.88)	(-1.33)	(-1.81)
4th+ parity	-0.11*	-0.09	-0.09
	(-1.76)	(-1.13)	(-1.18)
Observations	1,036	1,036	1,036
R-squared	0.08	0.10	0.10
Number of Mother	408	408	408
Mother fixed effects	Yes	Yes	Yes
Year × region	Yes	Yes	Yes
Mean of the outcome	0.0753	0.496	0.460

Notes:
1). Robust t-statistics in parentheses
2). Significance level: *** p<0.01, ** p<0.05, * p<0.1
3). Standard errors clustered at the PA level. All regressions include a constant and region-year interaction.
4). The base category for age in those under 19 years. The base category for education is those with no formal schooling-zero grade.

Table 6: Potential pathways

VARIABLES	(1) Travel time (walking) to Antenatal care (mins)	(2) 1 if paid for antenatal care at a facility	(3) Fee for antenatal care (Birr)
Antenatal care facilities (numbers in Kebele)	0.95	0.01	0.48
	(0.26)	(1.16)	(0.88)
General care facilities (numbers in Kebele)	1.58	0.02	-0.08
	(0.45)	(1.47)	(-0.11)
19-25	8.73**	0.02	-0.13
	(2.03)	(0.84)	(-0.39)
26-30	15.33**	0.02	0.98
	(2.55)	(0.76)	(1.18)
31-35	19.45**	0.05	1.54
	(2.05)	(1.36)	(1.42)
above 35	18.31	0.05	1.60
	(1.28)	(1.18)	(1.33)
Per capita household landsize (acres per capita)	-7.59	0.03	0.89*
	(-1.06)	(1.23)	(1.97)
2nd parity	-5.56	-0.03	0.40
	(-1.35)	(-1.11)	(0.93)
3rd parity	-5.12	-0.04	0.50
	(-0.76)	(-1.23)	(0.99)
4th+ parity	-4.39	-0.04	0.62
	(-0.47)	(-1.13)	(1.09)
Observations	588	588	588
R-squared	0.15	0.15	0.08
Number of Mother	270	270	270
Mother fixed effects	Yes	Yes	Yes
Year × region	Yes	Yes	Yes
Mean of the outcome	47.04	0.0459	1.068

Notes:
1). Robust t-statistics in parentheses
2). Significance level: *** p<0.01, ** p<0.05, * p<0.1
3). Standard errors clustered at the PA level. All regressions include a constant and region-year interaction.
4). The base category for age in those under 19 years. The base category for education is those with no formal schooling-zero grades.