UNIVERSITY OF NAIROBI

MASTERS RESEARCH PROJECT

Difference-in-Differences Evaluation of User Fee Exemption for Maternal Delivery in Kenya

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A research project submitted in partial fulfillment of the requirements for the degree of Master of Science in Social Statistics

School of Mathematics

November 2016

Declaration

This is my original work and has not been presented for any academic award at the University of Nairobi or in any other University.

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This project report has been submitted for examination with my approval as the University Supervisor.

Supervisor: Prof. Patrick G.O. Weke

Signature:……

Date:……

Dedication

To mama and papa, I will always love you.

To my loving sisters, Debbie, Linda, and Vidah, like Hillary Clinton said, "never doubt that you are valuable, and powerful, and deserving of every chance and opportunity in the world to pursue and achieve your own dreams".

Acknowledgements

I wish to thank several people whose support was immense in helping me complete my research project. Firstly, I wish to acknowledge the support and guidance from my supervisor: Professor Patrick G.O. Weke for his valuable guidance, scholarly inputs and consistent encouragement throughout the entire process.

I am also deeply indebted to my lecturers and classmates at the School of Mathematics who worked with me and provided support during my coursework, research project analysis and write up of different sections of this work. I also wish to thank the DHS program for making data publicly available thus enabling me to carry out this analysis.

My gratitude also goes to my family, to my late parents; even in your absence, your guidance have been invaluable in shaping me to a better person each day. To my sisters, Debbie, Linda, and Vidah, thank you for the moral support throughout my graduate studies. God bless you all.

Abbreviations

MMR	Maternal Mortality Ratio
ANC	Antenatal care
KDHS	Kenya Demographic and Health Survey
DHS	Demographic and Health Survey
KMO	Kaiser-Meyer-Olkin
UN	United Nations
SDGs	Sustainable Development Goals
MDGs	Millennium Development Goals
FMC	Free Maternal Care
WHO	World Health Organization
USD	US Dollar
DiD	Difference-in-differences

Abstract

Globally, deaths due to pregnancy and childbirth dropped from 523,000 in 1990 to 216,000 in 2015. Despite this progress, about 800 still women die every day from complications related to pregnancy and childbirth, an equivalent of 33 deaths per hour. Sub-Saharan Africa remains adversely affected with the region accounting for 62% of these global deaths. Most of these maternal deaths are prevented when attended to by skilled assistants who can identify and refer high risk pregnancies during antenatal care and provide skilled assistance during delivery. However, access to skilled assistance, most of the time found at health facilities, is limited by user fee which deny many women from poor households access to these services. Recent evidence now indicates that abolition of user fee generally leads to an increase in utilization of health services. The government of Kenya renewed its commitment of facilitating progress towards universal coverage by removing user fee thereby providing free delivery in all public health facilities. Using difference-in-difference and data from the Kenya Demographic and Health Survey, 2008-09 and 2014, we assess the impact of user fee removal on the utilization of public and private health facilities for delivery. Our findings confirm an increase in utilization of delivery services in both public and private health facilities particularly in the public sector. In conclusion, we recommend further research to understand unintended effects of an increase in utilization of health services to ensure quality of care is maintained in all health facilities.

Table of Contents

List of Tables

CHAPTER 1
INTRODUCTION

1.1 Introduction

Maternal mortality refers to deaths to women while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management but not from accidental or incidental causes (WHO, 2015). On the other hand, maternal mortality ratio (MMR) refers to maternal deaths per 100,000 live births (WHO, 2004). Maternal mortality is an important indicator of a country's development and its reduction has been at the center-stage of the Millennium Development Goals (MDGs) and now the Sustainable Development Goals (SDGs). In 2000, the United Nations (UN) Member States pledged to work towards a series of Millennium Development Goals (MDGs), including the target of a three-quarters reduction in the 1990 maternal mortality ratio (MMR; maternal deaths per 100 000 live births), to be achieved by 2015. Building on the momentum generated by MDG 5, the Sustainable Development Goals (SDGs) establish a transformative new agenda for maternal health towards ending preventable maternal mortality; target 3.1 of SDG 3 is to reduce the global MMR to less than 70 per 100 000 live births by 2030 (WHO, 2015).

Globally, the MMR fell by nearly 44% over the past 25 years, to an estimated 216 maternal deaths per 100,000 live births in 2015, from a MMR of 385 in 1990. The annual number of maternal deaths decreased by 43% from approximately 532,000 in 1990 to an estimated 303,000 in 2015. The approximate global lifetime risk of a maternal death fell considerably from 1 in 73 to 1 in 180 (WHO, 2015). Developing regions account for approximately 99% (302,000) of the global maternal deaths in 2015, with sub-Saharan Africa alone accounting for roughly 66% (201,000), followed by Southern Asia (66,000). Estimated MMR declined across all MDG regions between 1990 and 2015, although the magnitude of the reduction differed substantially between regions. The greatest decline over that period was observed in Eastern Asia (72%). As of 2015, the two regions with the highest MMR were sub-Saharan Africa (546) and Oceania (187).

In Kenya, data from the 2008-09 Kenya Demographic and Health Survey (KDHS) indicated an

increase in maternal mortality from 414 in 2003 to 488 in 2008-09. The most recent KDHS conducted in 2014 shows a slight decrease in maternal mortality from 488 in 2008-09 to 362 per 100,000 live births. These still being well above the MDG target of 147 per 100,000 by 2015. For every maternal death, it is estimated that about 20-30 women suffer serious injury or disability due to complications during pregnancy and childbirth. Despite progress in health indicators, lack of access to quality maternal health services, including ante-natal, delivery and post-natal services remains a challenge to many women.

1.2 Background

Globally, deaths due to pregnancy and childbirth dropped from 523,000 in 1990 to 216,000 in 2015. Despite this progress, about 800 still women die every day from complications related to pregnancy and childbirth, an equivalent of 33 deaths per hour. Sub-Saharan Africa remains adversely affected with the region accounting for 62% of these global deaths [3, 5]. Maternal deaths occur as a results of indirect and direct causes with majority of deaths in Africa being due to direct causes such as haemorrhage (34%), infection (10%), hypertensive disorders (9%) and obstructed labour (4%). On the other hand, indirect causes account for 20% of the total deaths, these not being complications due to pregnancy, but those aggravated by pregnancy (Khan *et al*., 2006).

Most of these maternal deaths are prevented when attended to by skilled assistants who can identify and refer high risk pregnancies during antenatal care and provide skilled assistance during delivery. However, access to skilled assistance, most of the time found at health facilities, is limited by user fee which deny many women from poor households access to these services. User fee were introduced in the 1980s in most African countries, however, studies have demonstrated that this type of payment excludes poor populations from accessing health services thereby exposing them to poor health outcomes (Morestin and Vale'ry, 2009). Recent evidence now indicates that abolition of user fee generally leads to an increase in utilization of health services (McKinnon, B. *et al*., 2014).

Kenya has witnessed a mix of positive and negative gains in the health sector. Access to safe water and sanitation has improved for both rural and urban populations, on the other hand, maternal mortality remains a leading cause of death among women of childbearing age. Overall, only 44%

of births are delivered under the supervision of a skilled birth attendant (nurse, midwife, or doctor), a proportion that is below the target of 90% deliveries by 2015 (Bourbonnais, 2013). The most recent Kenya 2014 DHS report that 28% of births are assisted by traditional birth attendants, 21% by friends and relatives and another 7% of mothers deliver with no assistance at all with the situation being worse in rural areas and among women of lower socio-economic status (Nyakundi, *et al*., 2011). According to the 2014 Kenya DHS, 46% of the woman interviewed mentioned at least one problem in accessing health care. Of these, majority, 37%, reported that getting money for treatment was their biggest challenge in accessing health care while distance to the health facility (23%), not wanting to go alone (11%), and getting permission to go for treatment were the other reasons reported.

It therefore remains important that to improve maternal health, barriers that limit access to quality maternal health services must be identified and addressed at all levels of the health system (WHO, 2014). Financial constraints are one of the major factors contributing to lack of access to quality maternal healthcare services for mothers in Kenya (KDHS 2014 Key Findings). The government introduced Free Maternal Care (FMC) services policy in all public health facilities. The policy is premised on the notion that financial barriers are one of the most important constraints to equitable access and use of skilled maternal and child healthcare (Bourbonnais, 2013). The 2010 constitution of Kenya, Article 43(1) states that, "Every person the right to the highest attainable standard of health, which includes the right to health care services", it is this constitutional objective that provides the basis for health care financing reforms in Kenya (Nyakundi *et al*., 2011). Since the adoption of the free maternity policy, the government allocated Kenya Shillings 95 billion for health which represents 5.7% of the total budget, much below the 15% requirement by the Abuja declaration. In fact, the current allocation represents a decrease from previous rates of 7.2% in 2010, 6.1% in 2010 and 5.9% in 2012. This is also below the 217 billion minimum proposal by the Ministry of Health for a three year health stimulus package (Bourbonnais, 2013).

1.2.1 The history of Health Financing in Kenya

The introduction of user fee created disparities in health care access especially among the poorest socio-economic groups (McPake *et al*., 2011). As a result, agencies including the WHO have passed resolutions encouraging member states to work towards universal coverage of maternal, new-born and child health services by removing user fee as this could improve service coverage and access especially among those from poorest socio-economic groups (WHO, 2010). Universal coverage is the state where an entire population has access to appropriate health care, when they need it and at affordable cost. It seeks to ensure that the needs of the population, both rich and poor are met within the existing health care system by ensuring equitable access and high quality services (WHO, 2010; Kutzin, 2001; and Mills, 2007). Universal access to health features on policy agendas worldwide. As the Millennium Development Goals (MDGs) came to an end, the commencement of the Sustainable Development Goals (SDGs) saw a renewed commitment to achieving universal coverage by 2030 through the provision of quality health services to those in need without causing financial hardship (Bonfrer, 2015).

The *Sessional Paper No. 10 on African Socialism and its Application to Kenya* emphasized the elimination of disease, poverty and illiteracy. This policy saw the abolition of user fee in the post-independence Kenya. The *free health for all policy* led to a rapid expansion of the healthcare infrastructure, in the 1970s and 1980s, and improvements in health and social indicators. This changed in the 1990s as the population continued to grow thereby forcing the government to implement a cost-sharing scheme in 1989. The health financing reforms saw the introduced out-pocket charges for users of health services at all public facilities (Ministry of Health, 1993). Previously, health services were free at the point of use. These charges, referred to as user fees, were advocated as an additional source of revenue for a health sector that was undergoing severe economic difficulties. Thus, patients were required to contribute directly to the cost of providing health care. The negative impact was a decreased demand for health services especially among the poorest population (Chuma and Maina, 2013).

The 1989 cost-sharing scheme failed in the implementation mainly due to reduction in utilization of services, lack of quality and poor revenue collections. In 1990 user fee were suspended but later re-introduced in 1991 for specific services such as drugs, laboratory fee, and injections. The re-introduction of user fee led to wide disparities in utilization of health services between

geographical regions, and urban-rural areas. During this time, services for children under-five and special conditions or services like immunization and tuberculosis were exempted from payment. The government, at the same time encouraged the growth of the private health sector, people opted to go to the private sector which were perceived to offer better quality services than the public sector. Currently, the private health sector comprises of about 49% of health services in Kenya.

In 2014, user fee were abolished at dispensaries and health centers and instead a registration fee of Kenya shillings 10 and 20 were introduced at the dispensary and health centers respectively. Services exempted from payment were those of children under-five and special conditions such as malaria and tuberculosis. These changes led to an increase in utilization of health services by 70% despite the challenges experienced in adherence to this policy. The government in 2007 abolished user fee for delivery in all public health facilities. Further, the government through a health services fund that compensates revenue loss through user fee removal was introduced. Additionally, in 2013, the government abolished the Kenya shillings 10 and 20 registration fee requirement for dispensaries and health facilities and the removal of all related user fee to maternal health care including deliveries in public health facilities (this included hospitals). The impact has been general increase in utilization of health services and an increase in the number of deliveries assisted by skilled attendants and thereby reducing maternal and neonatal mortality.

1.3 Problem statement

The financial cost of seeking formal health care is often the major barrier to accessing health care in poor countries. The government of Kenya renewed its commitment of facilitating progress towards universal coverage by removing user fee thereby providing free delivery in all public health facilities (Chuma and Maina, 2013). Similar initiatives have increased the use of formal health care in several African countries, where it is assumed that this would ultimately increase health care utilization thereby improving health outcomes. This study seeks to investigate the effect of user fee removal in Kenya since the first policy came to effect in 2007, by comparing utilization of health facility for delivery before and after the policy.

1.4 Objectives

The study seeks to estimate the effect delivery fee policy change on facility based delivery services in Kenya. This broad objective will be addressed through the following specific objectives:

i. To estimate facility based delivery among women of reproductive age
ii. To estimate the factors influencing facility based delivery among women of reproductive age
iii. To estimate the main determinants of facility based delivery among women of reproductive age

1.5 Research questions

The study seeks to answer the following research questions:

i. What are the trends in facility based delivery before and after policy change abolishing user fee for delivery?
ii. What factors influence facility based delivery before and after policy change abolishing user fee for delivery?
iii. What are the main determinants facility based delivery before and after policy change abolishing user fee for delivery?

1.6 Justification

Since the adoption of policies that give pregnant women access to skilled delivery, there have been no studies to assess the impact of such policy changes using rigorous statistical methods. This study will provide the much needed evidence to help the Government and other stakeholders understand the contribution of this policy in helping attain the sustainable development goal that seeks to reduce maternal mortality by 2030.

CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

This chapter provides a review of various statistical models and methods used by different scholars and researchers to understand the factors that influence use of institutional delivery. In particular, this section will focus on models that try to evaluate the gains after policy change, in this case, policy change on exception of delivery fee for mothers using public health facilities. The section will also focus on the study objectives, the methods of data collection, data analysis approaches, variables used in the study and the findings and conclusion as per the underlying analysis. Additionally, the chapter provides a comprehensive review of the conceptual framework that guides this study while also providing a summary of the review.

2.2 Literature Review

In a study comparing findings of two national policies exempting women from user fee for deliveries in Ghana and Senegal, Witter *et al*. 2008 used a combination of methods such as key informant interviews, household surveys, financial flows tracking, health worker incentive surveys, community level interviews and focus group discussions. Findings from the two countries demonstrate the potential of delivery fee exemption policy on increasing utilization. Further, the cost per additional assisted delivery was $62 (average) in Ghana and $21 (normal delivery) and $467 (caesarean section) in Senegal. There was also some evidence of reductions in inequalities of access. Despite reducing direct costs for women (from $195 to $153 for caesareans and from $42 to $34 for normal deliveries in Ghana), delivery costs were never reduced to zero in either country. This was linked to a number of important factors, including inadequate budgets (in Ghana) and failure to adequately reimburse lower level providers (in Senegal). The studies also highlight the need to address quality of care and geographical access issues alongside fee exemption. Lessons learnt through the implementation of these policies include the need for more robust analysis of bottlenecks, establishing a better policy consensus, adequate planning among others (Witter *et al*., 2008).

Kalu-Umeh *et al.* in 2013 in their study to understand the demand for health services among a growing population found that access was limited especially to segments of the population that were most in need. They therefore carried out a study to understand to assess maternal health problems, preferred sources of care and patterns of financing in a semi-rural community in North Western part of Nigeria. They conducted a cross-sectional study and interviewed 240 women of reproductive age who had experienced a birth in 12 months or less. The mean age of the woman interviewed was 29 years and while majority reported to having received antenatal care, those who did not receive cited lack of finances. About half of the women reported home deliveries, those who sought care at health facilities reported spending USD 9-99 for a total package of maternal health services. Overall, the study found Nigerian women to be vulnerable to common preventable causes of maternal morbidity and mortality due to lack of access to antenatal health care (Kalu-Umeh *et al*., 2013).

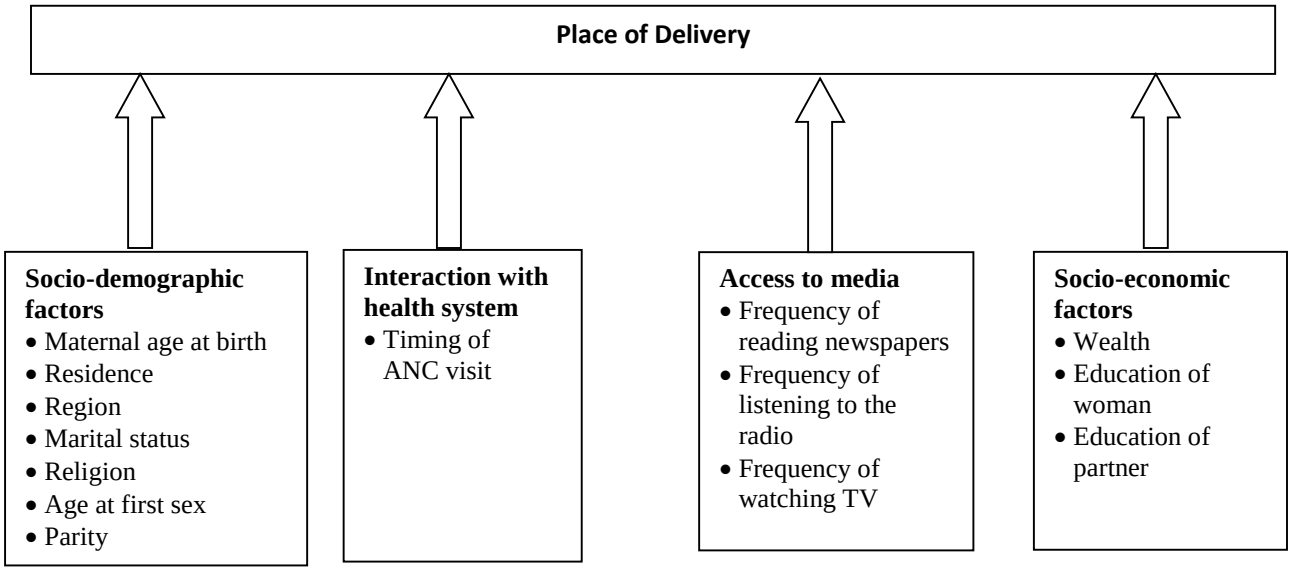
In 2009, a pilot eliminating user fee for delivery was introduced in two districts of Laos. An evaluation was carried out to assess the impact after two years of implementation and the analysis was carried out using heterogeneity adjusted linear probability models. The study results revealed that, even in the presence of the substantial access and cultural barriers, user fees associated with delivery at health facilities act as a serious deterrent to care seeking behavior. Facility based delivery nearly tripled in the intervention areas compared to the control thereby highlighting the impact of the financial burden associated with facility-based delivery. These fees can play an important role in rapidly increasing the uptake of facility delivery to reach the national targets and, ultimately, to improve maternal and child health outcomes. The pilot achieved important gains while relying heavily on capacity and systems already in place (Boudreaux *et al*., 2014).

A study in Nepal that sought to estimate the out-of-pocket expenditure on delivery care to enable them take into account the total health expenditure for health-policy decision making. Using mixed methods approach, interviews were conducted with 234 women who had delivered in the national hospital followed by semi-structured in-depth interviews with a sub-sample of 10 couples and binary logistic regression was carried out on the quantitative data. The results suggested that women incurred various costs during a hospital confinement. On the other hand, qualitative data suggested that some, but not all had started to save prior to the delivery. There is a significant association between making informal payments and whether or not the birth was planned to be in

hospital or whether it was an emergency, ANC visits, woman's occupation, and husband's employment. Logistic regression suggested four factors associated with making informal payments, indicating a possible socio-economic link with ability to make informal payments. The study concluded that while informal payments around birth were not substantial, such payments were very common. Better understanding of informal payments was found to be important as the illegal status of unofficial health care payments means that it is difficult to establish the prevalence of this phenomenon. Moreover it forms a part of the private health expenditure rarely included in the national health statistics, they create perverse incentives, potentially reducing motivation for reform (Simkhada *et al*., 2012).

2.3 Conceptual framework

In order to inform our analysis, we propose to use a customized conceptual framework to understand the factors that influence facility based delivery before and after user fee removal policy. We hypothesize that factors associated with facility based delivery operate at different levels. In our framework, we consider the socio-demographic factors, socio-economic factors, interaction with the health system, and access to media as the main potential influencers of facility based delivery among women of reproductive age. The socio-demographic factors are hypothesized to operate directly to influence facility based delivery or operate through intermediate factors (socio-economic factors, interaction with the health system, and access to media) to influence either the use of health facility for delivery or not. All these factors will be included in our analysis model.



2.4 Summary

Our conceptual framework provide factors that have been hypothesized to influence choice of place of delivery among women of reproductive age. These factors are classified broadly as socio-demographic, interaction with the health care system, access to the media and socio-economic factors. Studies that have considered these factors have provided different recommendations on the extent and level of their influence on the outcome variable, place of delivery based on various factors as influence by the environment among other things. We therefore seek to explore these factors to determine their level of influence on the choice women make for their place of delivery.

CHAPTER 3
METHODOLOGY

3.1 Data source

The study involves the analysis of the publicly available secondary data from the Kenya Demographic and Health Survey (KDHS) for 2008/9 and 2014. KDHS is a nationally representative survey that provides data on demographic and health indicators to promote analysis on the population, health, and nutrition of women and children. The DHS apply multistage probability sampling to provide nationally representative samples of women of reproductive age (i.e., aged 15–49 years). We examine the effect of maternal delivery fee exemption policy on a three outcome variable, delivery at a health facility (measured by delivery at public or private health facility, and non-institutional delivery). Data on births that occurred in the five years preceding each survey period to women in their reproductive age, 15-49 years, will be used.

3.2 Study variables

The statistics was weighted to adjust for differences in probability of selection and non-response. The outcome variable, delivery at a health facility, is a three outcome reflecting whether or not a woman used health facility (public, private or non-institutional service) for delivery in the five years preceding each survey period. Explanatory factors will include demographic and socio-economic factors like timing of the first ANC, education (coded as none, primary and secondary/higher); household wealth; urban-rural residence, ethnicity and region of residence. Since DHS do not collect data on income or expenditures, the economic status of household is proxied by a household wealth variable constructed from household possessions and amenities and dwelling characteristics, using principal component analysis. Our exposure of interest will be a variable indicating whether a live birth occurred before or after the adoption of the policy removing user fee for delivery at a health facility.

3.3 Difference-in-Differences regression

We used the difference-in-differences regression to estimate the effect of policy change eliminating use fee for facility based maternal delivery. This method is used to measure the effect of a policy change before and after its adoption. In Kenya, the policy change abolishing payment of user fee for delivery at Government health facilities was adopted in 2007 (Chuma and Maina, 2013) just slightly before the Kenya DHS 2008-09, which we will refer to as our control and the data collected some years after the policy came into place, Kenya DHS 2014 will be our treatment group. The difference-in-differences allows one to evaluate the impact of an intervention over an outcome, in this case, type of place of delivery. We have two groups, that we will index by treatment status T = 0, 1 where 0 indicates individuals who do not receive treatment (individuals from KDHS 2008-09), i.e. the control group, and 1 indicates individuals who do receive treatment (individuals from KDHS 2014), i.e. the treatment group. Assume that we observe individuals in two time periods, t = 0, 1 where 0 indicates a time period before the treatment group receives treatment, i.e. pre-treatment, and 1 indicates a time period after the treatment group receives treatment, i.e. post-treatment. Every observation is indexed by the letter i = 1, ..., N; individuals will typically have two observations each, one pre-treatment and one post-treatment. For the sake of notation let $\bar{Y}_0^T$ and $\bar{Y}_1^T$ be the sample averages of the outcome for the treatment group before and after treatment, respectively, and let $\bar{Y}_0^C$ and $\bar{Y}_1^{C-}$ be the corresponding sample averages of the outcome for the control group. Subscripts correspond to time period and superscripts to the treatment status.

3.3.1 Modelling the outcome

The outcome Yi (place of delivery) is modelled in this equation:

$$Y_i = \alpha + \beta T_i + \gamma t_i + \delta (T_i \cdot t_i) + \varepsilon_i \qquad \text{(Outcome)}$$

Where the coefficients given by the greek letters α, β, γ, δ, are all unknown parameters and εi is a random, unobserved "error" term which contains all determinants of Yi which our model omits. By inspecting the equation you should be able to see that the coefficients have the following interpretation. Program evaluation seeks to obtain a "good" estimate of δ, ˆδ, given the data that we have available.

α = constant term
β = treatment group specific effect (to account for average permanent differences between treatment and control)
γ = time trend common to control and treatment groups
δ = true effect of treatment

3.3.2 Assumptions for unbiased estimator

A reasonable criterion for a good estimator is that it be unbiased which means that "on average" the estimate will be correct, or mathematically that the expected value of the estimator.

$$E\left[\hat{\delta}_1\right] = \delta$$

The assumptions we need for the difference-in-differences estimator to be correct are given by the following:

1. The model in equation (*Outcome*) is correctly specified. For example, the additive structure imposed is correct.
2. The error term is on average equal to zero: $E[\varepsilon_i] = 0$. This is not a hard assumption with the constant term α put in.
3. The error term is uncorrelated with the other variables in the equation:

$$cov\left(\varepsilon_i, T_i\right) = 0$$
$$cov\left(\varepsilon_i, t_i\right) = 0$$
$$cov\left(\varepsilon_i, T_i \cdot t_i\right) = 0$$

Another assumption, also known as the parallel-trend assumption, is the most essential. We can refer to the equation (*Outcome*) to determine that expected values of the average outcomes are given by

$$E\left[Y_0^T\right] = \alpha + \beta$$
$$E\left[Y_1^T\right] = \alpha + \beta + \gamma + \delta$$
$$E\left[Y_0^C\right] = \alpha$$
$$E\left[Y_1^C\right] = \alpha + \gamma$$

3.3.3 The difference-in-difference estimator

Simple Pre versus Post Estimator

In this case of a simple pre verses post estimator, we consider an estimator based on comparing the average difference in outcome Yi before and after treatment in the treatment group.

$$\hat{\delta}_1 = \bar{Y}_1^T - \bar{Y}_0^T \qquad (D1)$$

The expectation of this estimator gives us:

$$\begin{aligned} E\left[\hat{\delta}_1\right] &= E\left[\bar{Y}_1^T\right] - E\left[\bar{Y}_0^T\right] \\ &= [\alpha + \beta + \gamma + \delta] - [\alpha + \beta] \\ &= \gamma + \delta \end{aligned}$$

This means that the estimator will be biased as long as $\Upsilon \neq 0$, which means that should the outcome Yi have a time trend, then we will confound the time trend as being part of the treatment effect.

Simple Treatment versus Control Estimator

We also have the estimator based on comparing the average difference in outcome Yi post-treatment, between the treatment and control groups, while ignoring the pre-treatment outcomes.

$$\hat{\delta}_2 = \bar{Y}_1^T - \bar{Y}_1^C \qquad (D2)$$

Considering the expectation of the estimator

$$\begin{aligned} E\left[\hat{\delta}_1\right] &= E\left[\bar{Y}_1^T\right] - E\left[\bar{Y}_1^C\right] \\ &= [\alpha + \beta + \gamma + \delta] - [\alpha + \gamma] \\ &= \beta + \delta \end{aligned}$$

This estimator is biased so long as $\beta \neq 0$, that is, there exist permanent average differences in outcome Yi between the treatment groups. The true treatment effect will be confounded by permanent differences in treatment and control groups that existed prior to any treatment. In randomized experiments, where subjects are randomly selected into treatment and control groups, β should be zero as both groups should be nearly identical: in this case this estimator may perform well in a controlled experimental setting typically unavailable in most program evaluation problems.

The Difference in Difference Estimator

The difference in differences (or "double difference") estimator is defined as the difference in average outcome in the treatment group before and after treatment minus the difference in average outcome in the control group before and after treatment[3]: it is literally a "difference of differences."

$$\hat{\delta}_{DD} = \bar{Y}_1^T - \bar{Y}_0^T - \left(\bar{Y}_1^C - \bar{Y}_0^C\right) \qquad (DD)$$

The expectation of this estimator shows that is unbiased

$$\begin{aligned}\hat{\delta}_{DD} &= E\left[\bar{Y}_1^T\right] - E\left[\bar{Y}_0^T\right] - \left(E\left[\bar{Y}_1^C\right] - E\left[\bar{Y}_0^C\right]\right) \\ &= \alpha + \beta + \gamma + \delta - (\alpha + \beta) - (\alpha + \gamma - \gamma) \\ &= (\gamma + \delta) - \gamma \\ &= \delta\end{aligned}$$

This estimator can be seen as taking the difference between two pre-versus-post estimators seen above in (*D1*), subtracting the control group's estimator, which captures the time trend γ, from the treatment group's estimator to get δ. We can also rearrange terms in equation (*DD*) to get $\hat{\delta}_{DD} = \bar{Y}_1^T - \bar{Y}_1^C - \left(\bar{Y}_0^T - \bar{Y}_0^C\right)$ in which can be interpreted as taking the difference of two estimators of the simple treatment versus control type seen in equation *(D2*). The difference estimator for the pre-period is used to estimate the permanent difference β, which is then subtracted away from the post-period estimator to get δ.

Another interpretation of the difference in difference estimator is the simple difference estimator between the actual $\bar{Y}_1^T$ and the $\bar{Y}_1^T$ that would occur in the post treatment period to the treatment group had there been no treatment $\bar{Y}_{cf}^T = \bar{Y}_0^T + \left(\bar{Y}_1^C - \bar{Y}_0^C\right)$, where the subscript "cf" refers to the term "counterfactual," so that $\hat{\delta}_{DD} = \bar{Y}_1^T - \bar{Y}_{cf}^T$. This observation $\bar{Y}_{cf}^T$, which has expectation $E\left[\bar{Y}_{cf}^T\right] = \alpha + \beta + \gamma$, does not exist: it is literally "contrary to fact" since there actually was a treatment in fact. However if our assumption are correct we can construct legitimate estimate of $\bar{Y}_{cf}^T$, taking the pre-treatment average $\bar{Y}_0^T$ and adding to our estimate β using the pre versus post difference for the control group. The difference-in-difference

estimator is presented in a table as follows:

Table 3.1: The difference-in-differences model

	Pre-Treatment Outcome	*Post-Treatment Outcome*	*Difference*
Treated Units	$\alpha+\beta$	$\alpha+\beta+\delta+\gamma$	$\delta+\gamma$
Control Units	α	$\alpha+\delta$	δ
Difference-in-Differences			γ

3.3.4 Extending the difference-in-differences (DiD) Model

Often the simple DiD model may not be sufficient to capture the dynamics that of the real world. The easiest way to include additional factors to account for heterogeneous dynamics in a DiD model is to simply add them linearly to the regression equation. Say, for example, we have an additional demographic variable, X_i, that we wish to include. For the repeated cross section data, the model thus becomes:

$$Y_{i,t} = \alpha + \pi_t X_i + \beta D_{i,t} + \delta t + \gamma D_{i,1} + \varepsilon_{i,t}$$

where π_t are the effects of the new covariate on the outcome for each of the two time points which are practically computed by estimating a separate coefficient for X_i at time 0 and at time 1. As Meyer (1995) points out, however, if the researcher believes that the treatment may actually have different effects on different units depending on these additional variables, then this simple linear model will not be sufficient to capture the heterogeneity of the dynamics [20]. One possible solution that is easy to implement is the inclusion of interactions between the treatment indicator and the additional covariates, yielding:

$$Y_{i,t} = \alpha + \pi_t X_i + \beta D_{i,t} + \delta t + \gamma D_{i,1} + \lambda_t X_i D_{i,1} + \varepsilon_{i,t}$$

for the multiple cross-sections. These models (once again extendable to multiple additional coefficients) allow the modeling of nonlinearity in the treatment effect due to differences in level of the additional covariates.

3.4 Data Analysis

The first stage of the analysis was ***data quality assessment***. This was essential because validity of estimates of demographic parameters from retrospective data depend on the quality of the data used. Data quality assessment checks for errors like omissions of births; incomplete information or misreporting of age at birth among others. Three levels of analysis (univariate, bivariate and multivariate) were conducted for this study using quantitative data from the nationally representative DHS data. Univariate and cross tabulation provided a description of socio-economic and demographic characteristics of the respondents as well as the patterns of association among different regions. Difference-in-differences regression was fitted for the related demographic and socio-economic factors to help us examine the effect of policy change on type of place of delivery.

3.5 Limitations

A number of data limitations exist; these should be considered when interpreting the results. First, the ability to derive reliable measures of place of delivery may be limited by the nature of information reported at the time of the interview. Again, given the cross-sectional nature of the DHS, it is not possible to draw robust conclusions on the influence of the identified factors on place of delivery. For instance, the dependent variable may have preceded an explanatory factor if the index birth of the respondent occurred prior to achievement of her current educational attainment for instance. The cross-sectional nature of DHS data limits causation analysis. Findings will indicate associations rather than causality between outcome variable and independent variables. It is also true that some of the information used in the analysis is collected at the time of the survey rather than the time of delivery or pregnancy (e.g. place of residence, etc.).

In addition, we are not able to provide estimates for small geographic areas due to the sample sizes not being too large enough. This prevents the provision of the much needed evidence for monitoring and evaluating programs in small locations (e.g. districts). Self-reported information

may be subject to memory lapses, probably altering the accuracy of the data used. In particular, the reporting of birth histories that will be used may be affected by memory lapses as they are collected retrospectively over the last 5 years. Data on place of delivery are only collected for live births hence, some pregnancies whose outcome is not a live birth are not considered in analysis. The missed pregnancies could be from mothers who died after delivery and thus are not interviewed or pregnancies that were terminated in stillbirths (in this case mothers may be interviewed but these pregnancies are not considered). In many cases, such births are not delivered at a health facility.

CHAPTER 4

DATA ANALYSIS AND RESULTS

4.1 Exploratory Data Analysis

4.1.1 Kaiser-Meyer-Olkin (KMO) Test for Sampling Adequacy

We carried out the Kaiser-Meyer-Olkin (KMO) Test to measures sampling adequacy for each variable in the model and for the complete model. The statistic is a measure of the proportion of variance among variables that might be common variance. The output from KMO ranges between 0 and 1 and values between 0.8 and 1 indicate that the sampling is adequate. Values less than 0.6 indicate that the sampling is not adequate and remedial action should be taken. The closer the values are to zero, the larger the partial correlations compared to the sum of correlations, meaning there are widespread correlations. The formula for KMO test is given as follows:

$$KMO_j = \frac{\sum_{i \neq j} r_{ij}^2}{\sum_{i \neq j} r_{ij}^2 + \sum_{i \neq j} u_{ij}^2}$$

Where: $R = [r_{ij}]$ is the correlation matrix and

$U = [u_{ij}]$ is the partial covariance matrix.

Table 4.1: Kaiser-Meyer-Olkin Measure of Sampling Adequacy

Kaiser-Meyer-Olkin Measure of Sampling	
KMO	0.837

The MKO value of 0.837 indicates that our sampling is adequate for each variable in the model and the complete model.

4.1.2 Bartlett's test of sphericity

Bartlett's test of sphericity is a test statistic used to examine the hypothesis that the variables are uncorrelated in the population. This means that the population correlation matrix is an identity matrix; each variable correlates perfectly with itself (r = 1) but has no correlation with the other variables (r = 0). Our test statistic shows that the variables are uncorrelated, we therefore reject the null hypothesis.

Table 4.2: Burtlett's test for sphericity

Bartlett's test of sphericity	
Chi-square	25667.09
Degrees of freedom	91
p-value	0.000

H_0: variables are intercorrelated

Additionally, we run the Spearman's rank correlation test to further confirm whether there is multicollinearity between any of the independent variables. Multicollinearity is the extent to which independent variables are highly and significantly correlated, this occurs when the absolute value of correlation coefficient is 0.70 or above in the correlation matrix. When variables are highly correlated, certain mathematical tests cannot be performed and parameter estimates may be inflated meaning that the odds ratios and standard errors can be very high. It is advisable to eliminate the variables that are correlated from the model or combine then to represent a single construct. The output below from our analysis confirms that the variables are not correlated and we can proceed and include them in our model.

Spearman's rank correlation

Table 2.3: Spearman's rank correlation

	Place of delivery	Maternal age at birth	Place of residence	Marital status	Religion	Age at first sex	Parity	ANC timing	Frequency of reading newspapers	Frequency of listening to radio	Frequency of watching TV	wealth	Maternal education	Paternal education
Place of delivery	1													
Maternal age at birth	-0.039	1												
Place of residence	-0.3158	0.0724	1											
Marital status	-0.0303	-0.0077	-0.0141	1										
Religion	-0.105	0.0088	-0.0258	-0.016	1									
Age at first sex	0.1931	0.1044	-0.1215	-0.034	-0.0239	1								
Parity	-0.1472	0.2942	0.1026	-0.012	0.0438	-0.1311	1							
ANC timing	-0.1414	0.0462	0.1027	-0.002	0.0282	-0.0728	0.0665	1						
Frequency of reading newspapers	0.2714	0.0017	-0.1758	-0.021	-0.1174	0.2019	-0.0971	-0.1064	1					
Frequency of listening to radio	0.1689	-0.0492	-0.0707	-0.045	-0.1623	0.0688	-0.0524	-0.019	0.2958	1				
Frequency of watching TV	0.3685	-0.0098	-0.3627	-0.01	-0.0755	0.1884	-0.1105	-0.120	0.3938	0.2965	1			
wealth	0.4764	-0.0399	-0.5082	-0.017	-0.1431	0.2021	-0.1473	-0.129	0.3175	0.2738	0.5495	1		
Maternal education	0.3937	-0.0481	-0.2353	-0.027	-0.2766	0.2609	-0.1618	-0.1147	0.4278	0.3416	0.3921	0.4934	1	
Paternal education	0.3501	-0.0185	-0.2253	0.0046	-0.1963	0.1982	-0.1327	-0.0954	0.3317	0.2903	0.3456	0.4518	0.574	1

4.2 Descriptive Analysis

Sample characteristics for this study were from data pooled from 2008-09 and 2014 Kenya DHS of women who had a live birth and consequently utilized delivery services for the most recent birth. Of the 18,083 women who took part in this study, majority, 45.7%, had used government health facilities for delivery. About two thirds resided in rural areas and 45.1% were aged 25-34. A large proportion (81.5%) of the women were currently married, 70.6% were of protestant faith while majority, 39% each, reported age at first sex at 15-17 years and 18 and above years. Timing for the first antenatal care visit was late, with majority of the women attending their first visit in the second and third trimesters. The full characteristics of the respondents are as shown in Table 5.

Table 4.4: Sample characteristics of women utilizing delivery services, 2008-09 and 2014

Characteristics	Percent (%)	N
Place of delivery		
Home	38.4	6935
Government health facility	45.7	8267
Private health facility	15.9	2880
Socio-demographic factors		
Maternal age at delivery		
15-24	40.6	7340
25-34	45.1	8154
35-54	14.3	2589
Residence		
Urban	34.6	6261
Rural	65.4	11822
Marital status		
Never married	8.9	1612
Currently married	81.5	14741
Formerly married	9.6	1730
Religion		
Catholic	19.3	3482
Protestant	70.6	12779
Muslim	7.4	1339
No religion	2.7	483
Age at first sex		
<15 years	21.5	3878
15-17 years	39.4	7105
18+ years	39.2	7073
Parity		

1-2 children	24.6	4453
3-5 children	36.9	6671
6+ children	38.5	6959
Interaction with health system		
ANC timing		
1st trimester	19.3	3290
2nd trimester	66.6	12386
3rd trimester	14.1	2407
Access to media		
Frequency of reading newspaper/magazine		
Not at all	67.3	11973
Less than once a week	18.5	3551
At least once a week	13.5	2447
Almost everyday	0.6	112
Frequency of listening to radio		
Not at all	18.8	3394
Less than once a week	11.8	2137
At least once a week	56.6	10236
Almost everyday	12.8	2316
Frequency of watching TV		
Not at all	54.8	9896
Less than once a week	12.0	2161
At least once a week	28.9	5220
Almost everyday	4.4	797
Socio-economic factors		
Wealth index		
Poor	21.6	3902
Medium	33.2	6001
Rich	45.2	8180
Maternal education		
None	10.1	1823
Primary	56.2	10171
Secondary/Higher	33.7	6089
Paternal education*		
None	8.8	856
Primary	49.6	4807
Secondary/Higher	41.6	4027
Total (N)	**100.0**	**18083**

*Missing cases

4.3 Bivariate Analysis

Table 4.5 below shows the utilization of the various types of delivery place in relation to selected factors categorized as socio-demographic status, interaction with health care system, media access and socio-economic status. Considering the difference-in-differences estimator, the treatment group were about 2 times more likely to use government health facilities for delivery than deliver at home. Similarly, women in the treatment group were more likely to use private health facilities for delivery than deliver at home. The socio-demographic characteristics showed that there exists a significant positive association between maternal age at delivery and use of government health facility for delivery. Women over 25 years were less likely to use government health facilities for delivery, on the other hand, women aged 25-34 were 1.2 times more likely ($p<0.01$) to use private health facilities for delivery than deliver at home. Women from rural areas were less likely to use both government and private health facilities for delivery, a similar trend is observed among currently and formerly married women who were less likely to use government and private health facilities for delivery. Religion, being in parity 3 and above, and late timing (second and third trimester) for the first antenatal care visit were all negatively associated with delivery in government and private health facilities. On the other hand, an increase in age at first sex, an increase in the frequency of reading magazines, listening to radio and watching were all positively associated with delivery in government and private health facilities. Association with socio-economic factors show that women belonging to medium and high income households were more likely ($p<0.001$) to use both government and private health facilities than deliver at home. Similarly, there was a positive association between maternal and paternal education and delivery in government and private health facilities.

Table 4.5: Odds ratio of the association between place of delivery and various background characteristics

Characteristics	Government Health Facility vs. Home			Private Health Facility vs. Home		
DiD						
Control	1.00			1.00		
Treatment	2.21	***	[1.87-2.63]	2.25	***	[1.78-2.83]
Socio-demographic factors						
Maternal age at delivery						
15-24	1.00			1.00		
25-34	0.81	***	[0.73-0.89]	1.21	**	[1.05-1.40]
35-54	0.53	***	[0.46-0.60]	0.71	***	[0.58-0.87]
Residence						
Urban	1.00			1.00		
Rural	0.25	***	[0.22-0.29]	0.12	***	[0.10-0.14]
Marital status						
Never married	1.00			1.00		
Currently married	0.68	***	[0.58-0.80]	0.87		[0.69-1.10]
Formerly married	0.64	***	[0.53-0.78]	0.70	*	[0.51-0.98]
Religion						
Catholic	1.00			1.00		
Protestant	0.99		[0.87-1.12]	0.83	*	[0.70-0.97]
Muslim	0.51	***	[0.41-0.63]	0.43	***	[0.29-0.62]
No religion	0.31	***	[0.21-0.45]	0.23	***	[0.14-0.38]
Age at first sex						
<15 years	1.00			1.00		
15-17 years	1.22	***	[1.09-1.35]	1.35	**	[1.11-1.63]
18+ years	2.20	***	[1.95-2.49]	4.44	***	[3.63-5.42]
Parity						
1-2 children	1.00			1.00		
3-5 children	0.32	***	[0.28-0.37]	0.26	***	[0.21-0.31]
6+ children	0.31	***	[0.27-0.35]	0.28	***	[0.23-0.34]
Interaction with health system						
ANC timing						
1st trimester	1.00			1.00		
2nd trimester	0.68	***	[0.60-0.76]	0.45	***	[0.38-0.53]
3rd trimester	0.42	***	[0.36-0.49]	0.27	***	[0.21-0.35]
Access to media						
Frequency of reading newspaper/magazine						
Not at all	1.00			1.00		
Less than once a week	1.90	***	[.69-2.14]	2.93	***	[2.45-3.50]

At least once a week	3.50	***	[3.00-4.10]	6.94	***	[5.55-8.68]
Almost everyday	1.69		[0.88-1.00]	10.03	***	[5.05-19.92]
Frequency of listening to radio						
Not at all	1.00			1.00		
Less than once a week	1.95	***	[1.67-2.28]	2.44	***	[1.87-3.18]
At least once a week	2.87	***	[2.55-3.23]	4.04	***	[3.34-4.89]
Almost everyday	1.45	***	[1.18-1.77]	1.88	***	[1.37-2.57]
Frequency of watching TV						
Not at all	1.00			1.00		
Less than once a week	1.93	***	[1.67-2.23]	2.67	***	[2.18-3.28]
At least once a week	5.70	***	[4.94-6.56]	14.77	***	[12.13-17.98]
Almost everyday	2.94	***	[2.16-4.01]	8.97	***	[6.43-12.51]
Socio-economic factors						
Wealth index						
Poor	1.00			1.00		
Medium	2.79	***	[2.46-3.17]	3.99	***	[3.01-5.29]
Rich	9.86	***	[8.40-11.58]	35.65	***	[26.79-47.43]
Maternal education						
None	1.00			1.00		
Primary	3.45	***	[2.84-4.17]	4.44	***	[2.94-6.71]
Secondary/Higher	12.50	***	[10.08-15.50]	32.74	***	[21.79-49.21]
Paternal education*						
None	1.00			1.00		
Primary	3.89	***	[3.08-4.91]	3.41	***	[2.16-5.37]
Secondary/Higher	9.98	***	[7.82-12.72]	18.15	***	[11.57-28.46]

*p<.05; **p<.01; ***p<.001

4.3 Difference-in-Differences Analysis

Multinomial logistic regression was used to assess the effect of policy change, delivery fee removal, on the utilization of health facilities for delivery. We apply the difference-in-difference estimator as one of the covariates in our model to observe the effect of the treatment to women survey in 2014. Our results confirm that women exposed to treatment were 2 times, $p<0.001$, more likely to use government health facilities for delivery, similarly, these women were 1.5 times, $p<0.05$, more likely to use private health facilities for delivery as opposed to delivery at home than those not exposed to treatment. We further control for the effect of socio-demographic factors and

show that women aged 35-49 years were less likely to use government health facilities for delivery as compared to use of home delivery compared to those aged 15-24 years. On the other hand, women aged 25-34 years were 1.3 times ($p<0.05$) more likely to use private health facilities for delivery than use home delivery than women aged 15-24 years. Women from rural areas were both less likely to use public and private health facilities ($p<0.01$) as compared to using home delivery than their counterparts from urban areas. Currently married women were 1.6 times ($p<0.01$) more likely to use private health facilities for delivery than deliver at home than those who were never married. Women whose age at first sex was 18 years and above were 1.4 times ($p<0.05$) more likely to use the private health facilities for delivery than deliver at home compared to those whose age at first sex was less than 15 years. Considering parity, women who had at least three children were less likely ($p<0.001$) to use both public and private health facilities for delivery.

Considering interaction with the health care system, women whose timing for the first antenatal care visit was late (third trimester) were less likely to report use of public and private health facilities for delivery compared to those who made the first ANC visit in the first trimester. Access to the media shows that women who read magazines/newspapers less than once a week more 1.3 times, $p<0.01$ and 1.5 times, $p<0.01$, more likely to use public and private health facilities respectively than deliver at home compared to those who had no access. Similarly, an increase in listening to the radio and watching television both had a positive effect in increasing the use of public and private health facilities for delivery than home delivery. Socio-economic factors such as wealth, confirm that belonging to medium and rich wealth quintile households increased the likelihood of the women to use both public and private health facilities, $p<0.001$, than deliver at home compared to their counterparts from poor households. Women reporting at least primary education were more likely to report use of public health facilities than deliver at home compared to those with no education. On the other hand, women with at least secondary education were 2.6 times more likely, $p<0.001$, to use private health facilities than deliver at home compared to those with no education. Paternal education had a similar influence on choice women made for place of delivery where women whose partners had at least primary education being more likely to report use of either public or private health facilities than deliver at home compared to those whose partners had no education.

Table 4.6: Odds ratio of multinomial regression of the impact of user fee removal on place of delivery

Characteristics	Government Health Facility vs. Home			Private Health Facility vs. Home		
DiD						
Control	1.00			1.00		
Treatment	2.04	***	[1.63-2.56]	1.54	*	[1.07-2.20]
Socio-demographic factors						
Maternal age at delivery						
15-24	1.00			1.00		
25-34	0.98		[0.83-1.16]	1.32	*	[1.03-1.69]
35-54	0.79	*	[0.63-0.99]	1.12		[0.81-1.55]
Residence						
Urban	1.00			1.00		
Rural	0.76	**	0.62-0.93]	0.68	**	[0.51-0.91]
Marital status						
Never married	1.00			1.00		
Currently married	1.04		[0.85-1.29]	1.59	**	[1.13-2.24]
Formerly married	1.00			1.00		
Religion						
Catholic	1.00			1.00		
Protestant	0.99		[0.83-1.18]	0.82		[0.64-1.04]
Muslim	1.35		[1.00-1.82]	1.07		[0.68-1.69]
No religion	0.85		[0.54-1.35]	0.98		[0.51-1.86]
Age at first sex						
<15 years	1.00			1.00		
15-17 years	0.89		[0.75-1.06]	0.87		[0.66-1.16]
18+ years	1.04		[0.86-1.27]	1.39	*	[1.04-1.87]
Parity						
1-2 children	1.00			1.00		
3-5 children	0.46	***	[0.36-0.59]	0.44	***	[0.31-0.61]
6+ children	0.48	***	[0.37-0.61]	0.52	***	[0.38-0.71]
Interaction with health system						
ANC timing						
1st trimester	1.00			1.00		
2nd trimester	0.95		[0.79-1.15]	0.81		[0.63-1.06]
3rd trimester	0.67	***	[0.54-0.84]	0.60	**	[0.42-0.87]
Access to media						
Frequency of reading newspaper/magazine						
Not at all	1.00			1.00		
Less than once a week	1.29	**	[1.07-1.57]	1.53	**	[1.16-2.01]

At least once a week	1.21		[0.95-1.55]	1.42	*	[1.02-1.99]
Almost everyday	1.32		[0.69-2.51]	4.72	***	[2.27-9.82]
Frequency of listening to radio						
Not at all	1.00			1.00		
Less than once a week	1.41	**	[1.09-1.82]	2.02	***	[1.36-3.00]
At least once a week	1.09		[0.90-1.33]	1.29		[0.95-1.75]
Almost everyday	1.35	*	[1.03-1.77]	1.01		[0.65-1.58]
Frequency of watching TV						
Not at all	1.00			1.00		
Less than once a week	1.12		[0.89-1.41]	1.39	*	[1.01-1.91]
At least once a week	1.48	***	[1.17-1.85]	2.14	***	[1.58-2.91]
Almost everyday	1.73	**	[1.21-2.48]	2.67	***	[1.60-4.46]
Socio-economic factors						
Wealth index						
Poor	1.00			1.00		
Medium	1.63	***	[1.38-1.93]	2.13	***	[1.49-3.05]
Rich	2.96	***	[2.34-3.74]	6.29	***	[4.23-9.36]
Maternal education						
None	1.00			1.00		
Primary	1.48	*	[1.09-1.99]	1.40		[0.81-2.41]
Secondary/Higher	2.29	***	[1.59-3.32]	2.60	***	[1.45-4.65]
Paternal education*						
None	1.00			1.00		
Primary	1.89	***	[1.45-2.45]	1.24		[0.75-2.05]
Secondary/Higher	2.61	***	[1.96-3.48]	2.22	**	[1.33-3.69]

*p<.05; **p<.01; ***p<.001

CHAPTER 5
CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

Difference-in-differences was used to assess the impact of user fee removal on choice of place of delivery in the presence of other explanatory factors. The impact of user fee removal is evident by the increase in utilization of delivery services in both public and private health facilities particularly in the public sector. Other factors also significantly associated with an increase in utilization of health services for delivery include: socio-demographic factors (age at delivery, residence, marital status, religion, age at first sex, and parity); interaction with the health care system (timing of the first ANC); access to media (magazines, radio and TV); and socio-economic factors (wealth, maternal and paternal education).

5.2 Recommendations

Our results confirm that the removal of user fees has led to an increase in utilization of delivery services in both the public and private sector. The increase in utilization of health facilities for delivery can health to unpremeditated effects such as worsening health outcomes should existing health facilities, especially the public sector, not being able to cope with the increased demand. Further research to understand similar unintended effects should be carried out and recommendations taken up to ensure quality of care is maintained in all health facilities.

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