Journal of Public Health in Africa
Received 14 Mar 2022 | Accepted 29 May 2022 | Published Online 20 Oct 2022

DOI: https://doi.org/10.4081/jphia.2022.2183
JPHIA 13 (3), 2183 (2022)

ISSN (O) 2038-9930 IF:0.0

ORIGINAL ARTICLE

Effect of healthcare quality initiative on maternal healthcare service utilization: a case study of the SPRING Ghana project

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Abstract

Background: Between 2014 and 2017, Strengthening Partnerships, Results, and Innovations in Nutrition Globally (SPRING), Ghana implemented a nutrition project in two regions of the country using a quality improvement approach. The quality improvement approach focused on improving antenatal care attendance and institutional births.

Objectives: This study examines the effect of the quality improvement initiative on maternal healthcare service utilization in Ghana and whether the services provided were of quality.

Method: We use the 2014 and the 2008 Ghana Demographic and Health Survey dataset, which is a cross sectional survey and the difference-in-difference approach.

Results: We find strong positive association of the project impact on the probability of antenatal care attendance during the first trimester by 12% points while institutional births were seen to be 8% points. We also find a statistically significant impact of the care rendered by the nurse/midwife to be 13% points and the community health officer/nurse by 4.5% points.

Conclusion: The findings indicate that pregnant women in the intervention regions were more likely to deliver at the health facilities than in the non-intervention regions. It is therefore recommended that Ghana and other low resource countries can better improve maternal health care service uptake with the incorporation of quality improvement tools in maternal health care policy designs.

Keywords: Spring, antenatal, delivery, difference-indifference, Ghana.

INTRODUCTION

Maternal and child mortality is still a major public health challenge in low resource countries. Despite the global efforts made over years to reduce maternal and child mortality, the rates are still unacceptably high. It is particularly unacceptable that pregnant women and children still die mainly of preventable or treatable diseases or during childbirth when there are means to prevent these deaths. The continued burden of maternal and child deaths calls for countries, especially developing countries, to redouble efforts to realize the sustainable development goal of reducing maternal mortality ratio and ending preventable child deaths by 2030 (1). Lack or inadequate uptake of maternal healthcare services especially antenatal care (ANC) and delivery care services is the principal contributing factor increasing maternal, neonatal and infant mortality rates.

Studies have shown a positive association between antenatal care and child health (2–6) and pregnancy outcome (7–12). Joyce, (13) study the impact of augmented prenatal care and show a positive relationship on the utilization of prenatal services and birth outcomes. Reichman and Florio (14) assess the impact of HealthStart program, an augmented prenatal care on birth outcomes and confirms a positive effect for blacks but no evidence of its effect for whites. Despite the evidence of the effectiveness of prenatal care, not all pregnant women still access prenatal and health care services. For instance, between 2007 and 2014, only 64% of pregnant women attended the recommended minimum four ANC visits globally (15), suggesting the need to intensify efforts to address utilization of ANC.

Pregnant women in Ghana have been exempted from paying for healthcare services since July 2008. However, not all women still meet the recommended minimum of four ANC visits in Ghana (16). While the percentage of pregnant women who visited ANC four or more times improved by 12 percentage points from 77% to 89% in 2007 to 2017 respectively, with correspondent increased in health Institutional delivery from 54% in 2007 to 79% in 2017 (16), much still needs to be done in order to maintain and further improve ANC visit during the first trimester and four plus visits.

Quality improvement approach is one of the main drivers of enhanced health outcomes. Despite the vital role of healthcare quality in strengthening healthcare systems, there exist few studies on quality initiatives and its impact in developing countries (17–20). While these studies on the health quality improvement approaches suggest assurance, they also show a need for further modification, improvement and assessment of new quality initiatives, especially in low-resource countries setting. This paper examines the health care quality improvement initiative implemented by Spring Ghana and its impact on maternal health service utilization and whether the services provided to pregnant women were of quality.

The Spring Ghana project was introduced in 2014 in two regions of the country, the northern and upper east regions of Ghana with the main aim of reducing the high rate of stunting in children within a thousand days of life. The project operated for four years, from January 2014 to December 2017 in households with pregnant women and children under two years of age (21). Spring implemented a quality improvement (QI) initiative at the health facilities and community levels as part of its measures to improve nutrition during pregnancy. The QI initiatives employed an improvement process approach that implements change ideas to solve nutrition issues. The initiative established health facilities and community level quality improvement teams. The health facilities quality improvement teams were made of frontline health workers such as nurses and medical doctors and the community level quality improvement teams were community health volunteers (21).

The QI teams focused on improving ANC attendance as a measure to improve nutritional status

Supplementary information The online version of this article (Tables/Figures) contains supplementary material, which is available to authorized users.

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during pregnancy since messages on nutrition in pregnancy are given during ANC sessions. The QI teams identified a number of change ideas, including community durbars, household meetings, and counseling of husbands and couples, to improve ANC attendance and Institutional delivery (22). Specific activities to increase ANC include: Regular health education sessions both at the health facilities and the communities on the significance of ANC attendance, engaging community health volunteers to increase coverage of antenatal care attendance, increasing the number of ANC counseling sessions and improving record-keeping to increase coverage and quality of ANC services, communities' sensitization and male involvement in ANC services and homes visiting to increase ANC visits four or more times (22).

Evaluation of the project focuses on the project effect on child malnutrition (22), however, there are rare empirical studies that investigate the causal effect of the project on maternal health care service uptake. This study examines the Spring Ghana quality improvement imitative and its effects on maternal health services uptake. The study also examines the project effect on the quality of services rendered during ANC and delivery care. To the best of our knowledge, this is the first paper that studies the project effect on facility utilization using a robust research design. We hypothesize that the Spring-Ghana quality improvement initiative will improve antenatal attendance, institutional delivery and quality of health service rendered during ANC and delivery care. To test these hypotheses, we use the difference-in-difference approach.

We have demonstrated in our paper that quality improvement approaches that employ proactive health workers and involvement of community health workers are cost-effective ways to adapt in low resource countries in order to increase maternal health service uptake. The study contributes to the strand of literature on the effect of quality improvement initiatives on health service uptake. It also contributes to literature on the effects of maternal health care projects on maternal service utilization.

MATERIALS AND METHODS

Data source and description

We use the Ghana demographic and health survey (GDHS) data set to estimate the project effect on maternal health service uptake. Is a national survey conducted every five years. The Survey is designed to provide data to monitor the population and health situation of the country. There are about six waves of the dataset, that is 1988, 1993, 1998, 2003, 2008 and 2014 waves. The 2008 and 2014 waves are used for the study. About 412 households were selected from each cluster for this survey and a household listing operation was carried out from June to July 2014 in the selected clusters. The second stage involves a systematic sampling of 30 households each from the selected clusters in phase one. In total, a sample of over 12,831 households were selected for the interview in the second phase and 11,778 households were successfully interviewed, yielding a household response rate of 99%. Women of reproductive age (15-49 years) who permanently reside in the selected households or visitors who had stayed in the selected households the night before the survey were eligible for the interview (23).

The dataset contains several measures of maternal antenatal and delivery usage. The survey obtained information on women antenatal visits during pregnancy and their first month of antenatal care of the youngest under-five year child. The widely used antenatal care measures discussed by Kotelchuck, (24) are; the month of antenatal initiation and the number of antenatal visits during pregnancy. We use the month of first initiation (timing of first antenatal check imputed in months) to create the variable, first trimester antenatal visit and the number of antenatal care visits during pregnancy to generate the variable antenatal care four plus visits. The survey also collected Information on the woman's place of delivery of her youngest under-five child. We use this information to create another outcome variable of interest, facility delivery.

In Table 1, we present the description of variables and summary statistics for the main variables used for our analysis. A total of 5,419 (2,121 for treatment regions and 3,298 for control regions) sample

size was used for this study. The main dependent variables are antenatal attendance four plus with a mean of 78% for the treatment region and 84% for the control regions. The mean average of antenatal attendance during the first trimester is 55% for the treatment regions and 65% for the control regions, Institutional delivery with a mean of 48% for the treatment regions and 73% for control regions. The independent variables we use include education, with the majority of the mothers having no education, 69% from the treatment region, and the least being higher education 3.3%. Woman age ranges from 15 to 49 years. Women between the ages of 25-29 were the majority in our sample (22%). Most of the women were Christians with a majority, 84% from the control region and majority of them being rural dwellers (62%).

Empirical strategy

The nature of the implementation (two regions benefited, and six regions did not benefit) of the program is a natural experiment setting that we can rely on to estimate the causal impact using the difference-in-difference approach. We estimate the program effect using the regions that benefited from the project implementation, Upper East and Northern region as treatment regions and the comparison group being four other regions, Greater Accra, Ashanti, Eastern and the Volta regions. Ghana had ten regions as of 2014, but we could not consider the entire eight regions as the comparison group in that the excluded regions had similar projects that promoted antenatal attendance and institutional delivery during the spring project implementation period. Using the difference-indifference (DiD) approach, thus comparing pre-program difference with the post-program difference, we estimate the short-run effect of the project using the 2014 GDHS data set as the post year and 2008 GDHS as the base year. Although the program began in January 2014 and ended in 2017, the available post data set is GDHS 2014. We expect that project could have an immediate impact since the quality improvement initiative employed, involving community volunteers and health workers is rigorous and may not necessarily have long term effect but short-term effect as well.

See at the end of this article the equation MHEALTH.

$MHEALTH_{ijt}$ represents maternal health service utilization. Maternal health service indicators: 1. Antenatal care attendance during the first trimester (ANC first trimester), which denotes 1 if pregnant woman i in region j at time t visited ANC during the first three months of her pregnancy and 0 otherwise. 2. *Antenatal care, a fourth visit and above* (ANC4 plus visits) is a binary variable indicating 1 if woman i in region j at time t had visited antenatal clinic four times and above and 0 otherwise. 3. Institutional delivery is a dummy variable which represents 1 if woman i in region j at time t gave birth at the health facility and 0 otherwise. $Treatment_t$ takes the value of 1 if regions are the Northern and Upper east regions and 0 if Greater Accra Ashanti, Eastern and the Volta regions. $Post_t$ represents 1 if the childbirth year is 2014, and 0 otherwise. $Treatment_j * post_t$ is the Interaction of treatment and post. δ is the difference-in-difference estimator - program impact. X'_{ijt} represents vectors of variables. Individual variables: religion, age, education, marital status, and ethnicity, multiple birth (multiple pregnancy). The household level variables are wealth index, place of residence. We also control for region and childbirth year fixed effects. $\beta_5 region_j$ refers to region fixed effects to control for time-invariant, unobserved heterogeneity across regions which may have influenced maternal healthcare service uptake. β_6 $birthyear_t$ refers to birth year fixed effects to control for national health events which may have affected maternal healthcare uptake. E_{ijt} is the error term. We adjusted standard errors by clustering the error term at the primary sampling unit. The Primary sampling is a clustering at the household level consisting of 427 clusters (23), and we cluster the error term at this level.

Empirical results

Main results

Table 2 presents our main results regarding the effect of the spring project on maternal health service utilization. The interaction term 'treatment*post' measures the effect of the project. In column 1, holding all other covariates constant, the project increases the probability of ANC four plus visits in the treatment regions by 5 percentage points albeit statistically insignificant. In column 2, holding all other covariates constant, the project significantly increases

the probability of antenatal visits during the first trimester by 12 percentage points. The results show that pregnant women in the intervention regions were more likely to initiate ANC visits during the first trimester compared to those in the non-intervention regions. In column 3, the coefficient for the project is statistically significant, holding all other control variables constant, the project strongly increases the probability of Institutional delivery by 8.2 percentage points in the treated regions compared to the non-treated regions. This shows that women in the project implementation regions in the intervention years were more likely to give birth at the health facility compared to those in the non-intervention regions.

Robustness checks

For consistent estimates, we had to ensure that the common trend assumption required for the validity of our estimates holds. We use the 2003 and the 2008 GDHS datasets to estimate the results of the parallel trend. We adopted the method by Lechner (25) creating fake treatment for regions destined to be treated and pseudo-post for the survey year 2008 and 2003 as the baseline year, then interacting it with the fake treatment, estimating using the above equation. In Table 3, we show estimates of the parallel trend assumption. The interaction term which is our coefficient of interest is not significant in all the columns, indicating the existence of the parallel trend in ANC attendance in the first trimester, ANC attendance four plus, Institutional delivery in the intervention and comparison regions before the introduction of the Spring-Ghana project, attesting to the robustness of our results. We support these results with graphical illustration in Figure 1.

Quality of maternal health services

We investigate whether the increase in first trimester ANC utilization translates to quality of antenatal care services rendered. The data set contains variables on the person who rendered prenatal care to the woman for her last birth. Which are binary variables for a specific healthcare provider. We investigate whether a pregnant woman exposed to the spring project received care from a qualified health professional. We present the results in Panel A of Table 4. We find a very strong impact of care rendered by the community health officer or nurse, statistically significant effect by 9.9 percentage points. Although we find a positive effect of the care rendered by the nurse or midwife, 5 percentage points, albeit statistically insignificant. We did not also find the project effect on care provided by the medical doctor and the traditional birth attendant. However, we can conclude that women in the treatment regions received skilled antenatal care during the project implementation period. We also investigate whether a pregnant woman exposed to the spring project received skilled delivery services. We present the results in Panel B of Table 4. We find a statistically significant impact of the care rendered by the nurse/midwife and the community health officer or nurse by 13 and 4.5 percentage points respectively. A reduction in traditional birth attendance deliveries, which were expectations, however, statistically insignificant.

We also examine whether the increase in first trimester ANC utilization translates into an increase in the components of antenatal care activities. Table 5 presents the results of the estimates. The results indicate a statistically significant increase on the probability of blood sample taken for analysis during antenatal visit by 12 percentage points, urine samples for laboratory test by 13 percentage points, iron drug by 14 percentage points, and intestinal worm drug by 22 percentage points. But we do not find the project effect on blood pressure taken and Iron tablets given during pregnancy.

DISCUSSION AND CONCLUSIONS

We use the Ghana demographic and health survey (GDHS) data set to estimate the effect of the project on maternal health service uptake and pregnancy outcome. The GDHS is a nationally representative data making our results generalizable to the entire population of the country. To the best of our knowledge, this paper is the first study that estimates the causal effect of the project on maternal health service utilization. Our results reveal that the Spring Ghana project led to an increase in the likelihood of pregnant women who attended ANC during the first trimester in the intervention regions by 12 percentage points. Our findings are consistent with studies

on maternal health projects or policies and health service utilization (26–29). The study also shows an increase in the probability of health Institutional delivery by 8 percentage points. Larson et al., (30) evaluated the effect of quality improvement initiative on health facility birth and showed an increase in health facility births by 6.7 percentage points, which is in line with our findings. We find no evidence of the project effect on the number of pregnant women who made the first ANC four plus visits.

The mechanisms of the project effect on maternal health service utilization includes community durbars, involvement of the community-based volunteers, male involvement and home visiting (31). For instance, documented evidence shows that male involvement improves women ANC visit and health Institutional delivery (32). We believe these mechanisms translated to an increase in maternal health service utilization, however we could not empirically show it because our dataset does not contain such variables.

Although there exists a free healthcare policy for healthcare utilization by pregnant women in Ghana, which affects the outcome variables of interest thus questioning the validity of our estimates, as of 2008 the fee exemption policy was implemented nationwide and does not affect the outcome variable in the intervention regions only. If our results are picking up the differential trend in our outcome variables, the parallel trend in Table 5, will as well capture the differential trend, making our estimates invalid. However, this was not observed as our results reveal statistically insignificant results. A project that employs a similar approach and could interfere with our results is the project five alive which was implemented in three northern regions of Ghana in 2008, but it was expanded to the entire country as of May 2013 and thus affects both our control and treatment regions equally (19). We have no doubt that our results are valid given that the major assumption, the parallel trend required for validity of the DID estimates is satisfied.

We investigate whether the increase in first trimester ANC utilization translates to quality of antenatal care services rendered. We find a very strong impact of care rendered by the community health officer or nurse, statistically significant effect by 9.9 percentage points. We also find a statistically significant impact of the care rendered by the nurse/midwife and the community health officer/nurse during delivery by 13 and 4.5 percentage points respectively.

Our results show that the Spring Ghana project which incorporates quality improvement methods increases ANC first trimester visits and facility-based deliveries. We find no evidence of the project effect on antenatal attendance four plus visits by pregnant women. We provide complementary investigations on quality of ANC care in Panel A of Table 3. Our analyses show evidence of quality care service rendered. Our results are relevant for the following reasons. First, our findings suggest that care provided by qualified health professionals strongly correlates with a higher probability of a woman's choice of facility delivery. Our findings suggest that policies or projects that promote maternal health services uptake yields desired benefits. Policy makers should also incorporate quality improvement tools in maternal healthcare policies or project designs.

Based on our findings it is evident user fee exemptions are not sufficient to achieve the desired targets of maternal health service utilization but with projects or policies that incorporate quality improvement methods as the Spring Ghana project. The quality improvement initiative employed by Spring for determining barriers to health service uptake has proven to be effective as demonstrated in our study and should be considered a practicable measure for improving maternal health service uptake in developing countries.

Our paper has demonstrated that quality improvement approaches that employ proactive health workers and involvement of community health workers are the cost-effective ways to adapt in low resource countries in order increase maternal health service uptake. The findings suggest that Ghana and other low resource countries can better improve maternal health care service uptake with the incorporation of quality improvement tools into maternal policy designs. The study has also shown that the improvement approaches not only improve service utilization but translate into an increase in the quality of services rendered during ANC and delivery. This paper has

some limitations; the last survey for the GDHS data set was in 2014 but the policy existed until 2017 and thus we could not estimate the long-term effect of the policy but its short-term impact. Future research could focus on its long-term impact.

INFORMATION

Acknowledgements. We acknowledge the valuable suggestions and inputs from Shun Wang, Taejong Kim, Jesun Baek, Chrysostomos Tabakis, and Jinsoo Lee at the KDI School of Public Policy and Management, during the manuscript preparation.

Contributions. BM, Methodology, data analysis and interpretation of results. NOO, Writeup of the introduction and review of the entire of manuscript. AAF, Data search and write up of the background of the study

C onflict of interest. No potential conflict of interest.

Funding. There was no funding for this study.

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Table 1. Description of variables and summary statistics.

	Treatment			Control		
Variable	**Obs**	**Mean**	**Std. Dev.**	**Obs**	**Mean**	**Std. Dev.**
Institutional delivery	2,116	0.475	0.500	3,296	0.732	0.443
First trimester antenatal care visits	1,422	0.537	0.499	2,322	0.645	0.479
antenatal care four plus visits	1,505	0.782	0.413	2,402	0.843	0.363
Post (year 2014)	2,121	0.685	0.465	3,298	0.632	0.482
Treat	2,121	1.000	0.000	3,298	0.000	0.000
Twins (multiple birth)	2,121	0.042	0.201	3,298	0.046	0.209
Religion:						
Christian	2,119	0.398	0.490	3,298	0.837	0.369
Islam	2,119	0.405	0.491	3,298	0.090	0.286
Traditionalist	2,119	0.143	0.351	3,298	0.025	0.157
Other religion	2,119	0.000	0.022	3,298	0.000	0.017
Woman Age	2,121	30.972	7.239	3,298	30.302	6.673
Woman Education:						
No education	2,121	0.686	0.464	3,298	0.159	0.366
Primary	2,121	0.153	0.360	3,298	0.241	0.428
Secondary	2,121	0.140	0.347	3,298	0.550	0.498
Higher	2,121	0.021	0.144	3,298	0.050	0.217
Wealth Index:						
poorest	2,121	0.718	0.450	3,298	0.132	0.338
poorer	2,121	0.110	0.313	3,298	0.220	0.415
middle	2,121	0.081	0.272	3,298	0.209	0.407
richer	2,121	0.062	0.241	3,298	0.219	0.414
richest	2,121	0.029	0.168	3,298	0.220	0.414
Ethnicity:						
Akan	2,120	0.012	0.108	3,298	0.448	0.497
Ga/dangme	2,120	0.001	0.038	3,298	0.109	0.312
Ewe	2,120	0.001	0.031	3,298	0.270	0.444
Guan	2,120	0.048	0.213	3,298	0.017	0.130
Mole-dagbani	2,120	0.559	0.497	3,298	0.058	0.234
Grusi	2,120	0.056	0.230	3,298	0.016	0.125
Gurma	2,120	0.284	0.451	3,298	0.037	0.189
Mande	2,120	0.019	0.136	3,298	0.009	0.093
Other	2,120	0.008	0.092	3,298	0.019	0.132

Table 2. Project effect on maternal healthcare service uptake.

Variables	**(1) Antenatal care visits four plus**	**(4) First trimester Antenatal care visits**	**(3) Institutional delivery**
Post	-0.002	-0.052	-0.023
	(0.088)	(0.131)	(0.069)
Treatment	0.086**	-0.004	0.131**
	(0.040)	(0.054)	(0.052)
Treatment*post	**0.050**	**0.115*** **	**0.082** **
	(0.036)	**(0.041)**	**(0.039)**
Constant	0.574***	0.549***	0.318***
	(0.105)	(0.152)	(0.086)
Observation	3904	3741	5409
R-squared	0.145	0.086	0.344

*Note: this table reports the project effect on maternal health service uptake. Treatment*post' is the difference-in-difference estimator of the project impact. We control for the following in all the modules: Individual variables: religion, age, education, marital status, and ethnicity, multiple birth (multiple pregnancy). The household level variables are wealth index, place of residence. We also control for region and childbirth year fixed effects. Statistical significance is indicated by ***, **, and * at 1%, 5%, and 10%, respectively. Standard errors are clustered at the primary sampling unit and are in the parentheses.*

Table 3. Parallel trend assumption.

Variables	**(1) Antenatal care four Plus, visits**	**(2) First trimester Antenatal care visits**	(3) **Institutional delivery**
Post	0.112	0.186	0.261***
	(0.090)	(0.131)	(0.074)
Treatment	0.007	0.040	0.060
	(0.066)	(0.072)	(0.058)
Fake treatment*Pseudo-post	**0.038**	**-0.061**	**0.032**
	(0.047)	**(0.046)**	**(0.040)**
Constant	0.402***	0.384***	0.097
	(0.116)	(0.138)	(0.100)
Observation	2923	2750	4086
R-squared	0.134	0.077	0.342

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*Note: this table reports the pre-trend for the outcome variables. Fake treatment*pseudo measures the effect. Fake treatment is equal 1 if regions were destined to be treated and 0 otherwise. Pseudo-post is equal 1 if interview year 2008 and 0 if year is 2003. We control for the following in all the modules: Individual variables: religion, age, education, marital status, and ethnicity, multiple birth (multiple pregnancy). The household level variables are wealth index, place of residence. We also control for region and childbirth year fixed effects. Statistical significance is indicated by ***, **, and * at 1%, 5%, and 10%, respectively. Standard errors are clustered at the primary sampling unit and are in the parentheses*

Table 4. Type of assistance received during antenatal care and delivery care.

Variable	**Medical Doctor**	**Nurse/ midwife**	**Community health officer or nurse**	**Traditional birth attendant**
Panel A: Assistance during antenatal care services				
Treatment*post	**-0.026**	**0.049**	**0.100*** **	**0.003**
	(0.034)	**(0.045)**	**(0.031)**	**(0.004)**
Constant	-0.032	0.978***	0.022	0.008
	(0.128)	(0.092)	(0.046)	(0.007)
Observation	3904	3904	3904	3904
R-squared	0.138	0.091	0.071	0.016
Panel B: Assistance during delivery services				
Treatment*post	**0.024**	**0.126*** **	**0.045** **	**-0.047**
	(0.017)	**(0.041)**	**(0.019)**	**(0.053)**
Constant	0.120	0.351***	0.087	0.393***
	(0.074)	(0.088)	(0.056)	(0.072)
Observation	5408	5408	5408	5408
R-squared	0.133	0.251	0.029	0.191

*Note: this table reports skilled care services received. Treatment*post measures the impact. We control for the following in all the modules: Individual variables: religion, age, education, and ethnicity, multiple birth (multiple pregnancy). The household level variables are wealth index, place of residence. We also control for region and childbirth year fixed effects. Statistical significance is indicated by ***, **, and * at 1%, 5%, and 10%, respectively. Standard errors are clustered at the primary sampling unit and are in the parentheses.*

Table 5. Project effect on components of antenatal care.

Variables	(1) Blood sample take	(2) Blood pressure taken	(3) Urine sample taken	(4) Given iron tablet	(5) Given Intestinal worm drug
Post	0.113	0.059	0.031	0.064	-0.158
	(0.097)	(0.070)	(0.077)	(0.103)	(0.132)
Treatment	-0.115***	-0.006	-0.075**	-0.141***	0.234***
	(0.035)	(0.018)	(0.037)	(0.038)	(0.062)
Treatment*post	**0.173*** **	**0.016**	**0.132*** **	**0.143*** **	**0.223*** **
	(0.035)	**(0.020)**	**(0.038)**	**(0.032)**	**(0.046)**
Constant	0.746***	0.831***	0.870***	0.745***	0.253*
	(0.103)	(0.076)	(0.088)	(0.112)	(0.148)
Observation	3746	3746	3746	3881	3808
R-squared	0.157	0.045	0.194	0.055	0.104

*Note: this table reports the project effect on the components of antenatal care. Treatment*post' is the difference-in-difference estimator of the project impact. We control for the following in all the modules: Individual variables: religion, age, education, marital status, and ethnicity, multiple birth (multiple pregnancy). The household level variables are wealth index, place of residence. We also control for region and childbirth year fixed effects. Statistical significance is indicated by ***, **, and * at 1%, 5%, and 10%, respectively. Standard errors are clustered at the primary sampling unit and are in the parentheses.*

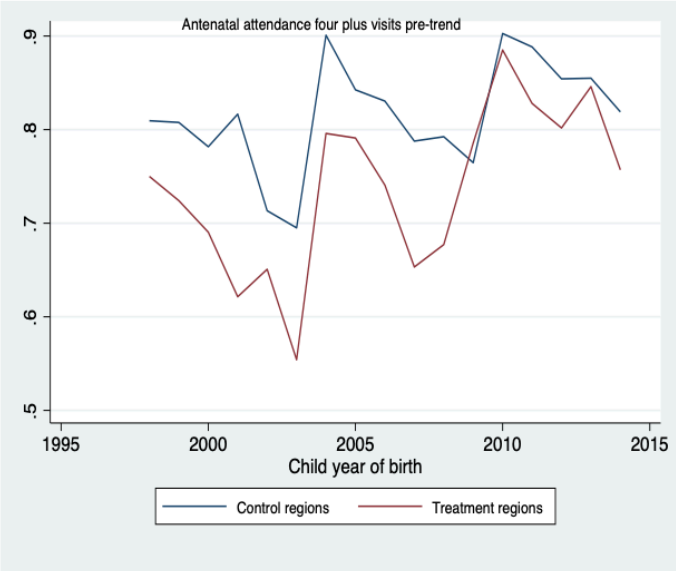

Figure 1A: Antenatal attendance four plus visits pre-trend

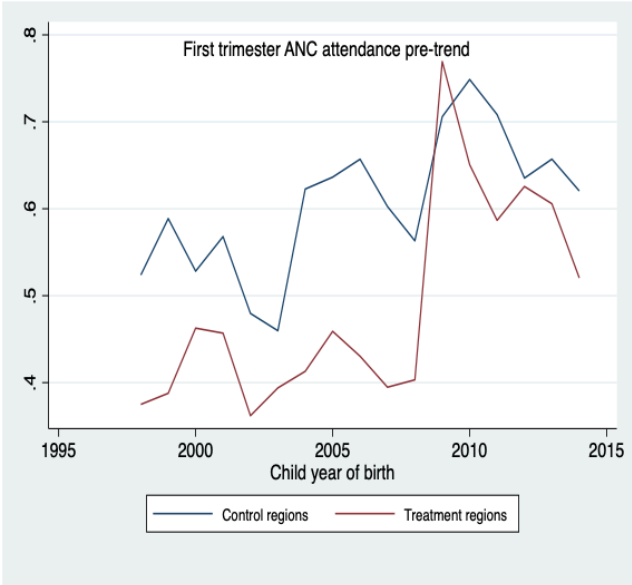

Figure 1B: First trimester antenatal attendance pre-trend

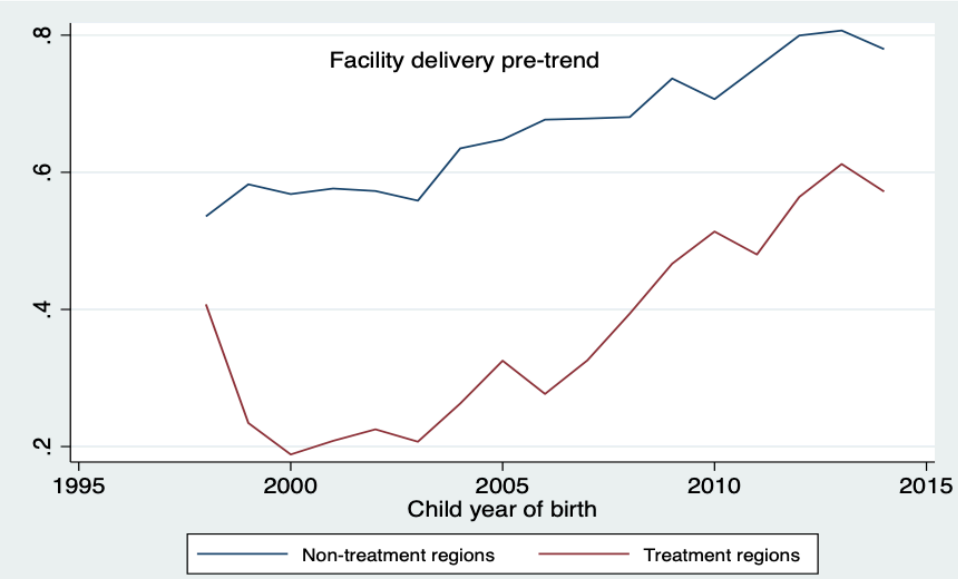

Figure 1C: Institutional delivery pre-trend

FIGURE 1: Graphical pre-trend of the outcome variables. Note: this Figure reports the pre-trend for maternal service uptake and Institutional delivery in Ghana before the project introduction. Figure 1A and 1B report the antenatal visit four plus and first trimester antenatal attendance visits from 1998 to 2010. Both Figures show a parallel trend from 1998 to 2010, it however experienced an overlap in 2011 to 2012 and then a parallel trend resume. Figure 1C is health Institutional delivery pre-trend, showing a parallel trend of delivery for the treatment and control regions from 1998 to 2013.