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**The Impact of Ethiopian Health Services Extension Program on
Maternal and Child Health Outcomes: The Case of Tigray Region**

By

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Master of Public Health

GEORGIA STATE UNIVERSITY

A Thesis Submitted to the Graduate Faculty

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of the

Requirements for the Degree

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Abstract

Background: The Health Extension Program (HEP) is one of the most innovative community-based health programs launched by the Ethiopian Federal Ministry of Health (FMOH) to make health services accessible to rural communities by setting out women health extension workers (HEWs) in rural health posts. The program was officially rolled out in 2003 and became operational in 2004. Its approach is based on the assumption that access to and quality of primary health care in rural communities can be improved through transfer of health knowledge and skills to households. Deployed as pairs, the HEWs are premised to provide basic, largely preventive, primary health services to rural villages and empower families to take charge of their own health. Primarily, the program gives special attention to children and mothers.

Objectives: The primary objective of this study was to evaluate the short and medium-term impact of the HEP on maternal and child health outcomes in Tigray region and analyze if the impact suggests that the region is moving in a direction towards achieving the 4th and 5th Millennium Development Goals (MDGs). Additionally, the study sought to provide some policy relevant insights into the performance of the program in the region.

Methods: Using administrative data, the study estimated the impact of the HEP on child health variables (ex., child vaccines:-DPT3, BCG, OPV3 & measles and full immunization) and on maternal health (ex., tetanus toxoid injection and attended delivery). Two empirical models were estimated. Using these models, the study estimated multiple regression equations for each outcome of interest against the predictor variable (HEW coverage) controlling for confounding factors such as electricity, telephone etc. and year to capture variations over time.

Results: Since it became operational in 2004, the program has had a tangible effect on child health outcomes. Results showed that a 10% increase in the program (HEWs coverage) increased full immunization rates by 1.85%, BCG vaccination by 2.6%, DPT3 by 2.4% and OPV3 by 2.7%, all of which were statistically significant. However, the impact on measles was found statistically insignificant. For maternal health outcomes, results showed that a 10% increase in the program coverage increased TT2 uptake of pregnant women by only 0.5%, TT2 by non-pregnant women 0.08%, and attended delivery by 1.06%--all statistically insignificant.

Conclusion: Result of the estimation indicated that there is significant impact on child health indicators which could be attributable to the presence of the HEP in the districts. Particularly, the program has statistically significant effect on BCG, OPV3, DPT3 and full immunizations. Although the impact on measles was positive, it was not statistically significant. No effect of the program on maternal health indicators was found. Therefore, federal, regional and local governments should put collaborative efforts to increase the utilization of maternal health services as well as support and strengthen the outreach effort of the health extension workers to reach the targeted goal.

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Lists of Acronyms

ANC= Antenatal Care

BCG= Bacille-Calmette-Guerin (Tuberculosis Vaccine)

CBRHA= Community Based Reproductive Health Agent

DPT= Diphtheria Pertussis Tetanus vaccine

EDHS= Ethiopian Demographic Health Survey

FMOH=Federal Ministry of Health

HEP= Health Extension Program

HEWs= Health Extension Workers

HIV= Human Immunodeficiency Virus

HSDP= Health Sector Development Program

MDGs= Millennium Development Goals

OPV= Oral Polio Vaccine

ORT= Oral Rehydration Therapy

PNC= Postnatal Care

TBA= Traditional Birth Attendant

TT2= Tetanus-Toxoid Vaccine (second)

WHO= World Health Organization

vCHWs = Voluntary Community Health Workers

Executive Summary

I. INTRODUCTION

Ethiopia is one of the poorest countries in the world with a US \$370 per capita Gross National Income (World Bank, 2012). The health sector is characterized by weak infrastructure, poor supply chain management, inadequacy of essential drugs and shortage of human resources. Nearly 60-80% of disease burden in the country are due to preventable communicable diseases such as diarrhea, pneumonia, malaria and HIV. Health care utilization in the country is very low resulting in poor health outcomes particularly among children and mothers. The rate of child and maternal mortality are among the highest in the world with 88 deaths per 1,000 live births and 676 deaths per 100,000 live births respectively. The Ethiopian government launched the HEP in 2003 to make health services accessible to the rural communities by deploying women HEWs. This paper seeks to examine the impact that the program has brought on its primary beneficiaries i.e., mothers and children.

II. PROGRAM DESCRIPTION

The HEP is a community based health care delivery program with a defined package of basic and essential promotive, preventive and curative health services. The program has four health subprograms; Disease Prevention, Family Health; Environmental Hygiene & Sanitation; and Health Education. It gives special attention to mothers and children and operates from a health post.

At the heart of the program is a taskforce of young women trained in HEP modules for one year, after which they return home as salaried frontline health care staff. Deployed as pairs, the HEWs provide basic, largely preventive, primary health services to rural villages and empower families to take charge of their own health.

III. PROGRAM OBJECTIVE

The primary purpose of the HEP is to improve access to and utilization of health care services especially by children and mothers at national level. Generally, the program seeks to improve access and equity to preventive essential health interventions at the village and household levels, to ensure ownership and participation by increasing health awareness, knowledge, and skills among community members, to improve the utilization of peripheral health services by bridging the gap between the communities and health facilities through HEWs and to promote healthy life style. The objective of the current study is to evaluate the impact of the program on two maternal health outcomes namely, TT2 injection and delivery assisted by the HEWs; whereas for child health, the impact on most recommended child vaccines including DPT3, OPV3, BCG, measles and full immunizations.

IV. METHODOLOGY

Using administrative data, the study estimated the impact of the HEP on child health variables (DPT3, BCG, OPV3 & measles and full immunization) and on maternal health (TT2 and attended delivery). Two empirical models, Ordinary Least Square and Fixed Effect, were estimated. Using these models, the study executed multiple regressions for each outcome of interest against the predictor variable (HEW coverage). The OLS model controlled for confounding factors such as electricity, telephone and year to capture time-varying regional factors (ex., region-wide vaccine campaigns). In the FE estimate, all time-invariant district level variables (ex., ethnicity) were also eliminated out of the model.

V. MAIN FINDINGS

The program had a positive effect on child health outcomes. FE estimates suggested that a 10% increase in the program (HEWs) coverage increased full immunization coverage by 1.85%, BCG vaccination by 2.6%, DPT3 by 2.4% and OPV3 by 2.7%, all of which were statistically significant. For maternal health outcomes the FE estimate found that a 10% increase in the program coverage resulted in only 0.5% increase in TT2 uptake of pregnant women, 0.08% increase in TT2 by non-pregnant women, and 1.06% in attended delivery by HEWS. This implied that the program has no significant impact on these selected maternal health outcomes.

VI. CONCLUSION

Result of the estimation indicates that there is significant impact on child health indicators which could be attributable to the presence of the HEP in the districts. Particularly, the program has statistically significant effect on BCG, OPV and DPT3. The impact of measles is positive but was not statistically significant. Also, the effect of the program on maternal health indicators was not favorable. Therefore, all concerned bodies including federal, regional and local governments should put collaborative efforts to increase the utilization of maternal health services as well as support and strengthen the outreach effort of health extension workers to reach the targeted goal.

1. INTRODUCTION

Ethiopia is one of the poorest countries in the world with a US \$370 per capita Gross National Income (World Bank, 2012). The country's health delivery system is organized into four tiers: Primary health care unit (PHCU), district hospital, zonal hospital and specialized hospital. The health system is often characterized by weak infrastructure, poor supply chain management, inadequacy of essential drugs and shortage of human resources (FMOH, 2010a).

The country has been plagued by a heavy burden of disease. This disease burden is mainly attributed to preventable and communicable diseases which constitute 60 – 80% of the burden. Nearly 90% of child mortality is caused by pneumonia, diarrhea, malaria, neonatal problems, malnutrition and HIV/AIDS (FMOH, 2010a). The rate of child and maternal mortality are among the highest in the world with 88 deaths per 1,000 live births and 676 deaths per 100,000 live births respectively Literature on maternal health also indicates that each year in Ethiopia, an estimated 22,000 women die from complications related to childbirth and most of these deaths occur at home because of lack of basic health care services (Hadley C et al, 2011). The leading causes of maternal mortality are infection, obstructed labor, eclampsia / preeclampsia, and postpartum hemorrhage (Gaym A, 2009).

A concerted effort by the government to expand the primary health care system and emphasize on preventive, promotional, and basic curative health services resulted in positive improvements in the health coverage and utilization (USAID, 2012).

Ethiopia is one of the 189 countries that signed the Millennium Declaration. The UN Millennium Development Goals (MDG #4 and #5) calls for Ethiopia to reduce child and maternal mortality by a two-third and three-fourth respectively by the year 2015. Pursuant of these goals, the Ethiopian Ministry of Health has undertaken a number of important public health initiatives aimed at improving the health outcomes of women and children (FMOH, 2010a). One of these initiatives is the launching of the Health Services Extension Program (HEP) in 2003; an innovative way of scaling up the delivery of essential health interventions targeting the household and community level.

The primary purpose of HEP is to improve access and utilization of health care particularly by children and mothers at a national level. It is designed based on the philosophy that “If the right knowledge and skill is transferred to households they can take responsibility for producing and maintaining their own health” (Health Extension and Education Center & FMOH, 2007, p. 2). The HEP is also regarded as a principal means of implementing the Health Sector Development Program (HSDP) by bringing key maternal, neonatal and child health interventions to the community.

The objective of the present study is to evaluate the short and medium-term impact of the HEP on maternal and child health outcomes in Tigray region using administrative data extracted from Tigray Regional Health Bureau. It specifically seeks to assess the effect on the immunization coverage in the region against the six major childhood diseases: diphtheria, whooping cough (pertussis) and tetanus (DPT), tuberculosis, polio & measles.

The study also evaluates the impact of the program on maternal health measures such as receipt of Tetanus Toxoid Injection (TT2) by pregnant and non-pregnant women and assisted delivery by HEWs.

2. PROGRAM DESCRIPTION

2.1. Structure and Philosophy

The HEP is a community based health care delivery program with a defined package of basic and essential promotive, preventive and curative health services. The program was officially rolled out by the Ethiopian Federal Ministry of Health in 2003 and it becomes operational following the 2004-2005 graduation of 7,136 health extension workers (HEWs), trained to work mainly in disease prevention and health promotion in rural villages. The program has four health subprograms; Disease prevention, Family Health; Environmental Hygiene & Sanitation; and Health Education. The main aim of the program is to help accelerate the country's progress in meeting Millennium Development Goals (MDG) 4, 5 and 6 -to reduce child mortality; improve maternal health; combat HIV/AIDS, malaria and other diseases respectively (UN, 2012).

The program approach is based on the widely influential model known as the diffusion model, which holds that community behavior can be changed step by step; training early adopters first, and then moving to the next group that is ready to change (Ulin, P. R., et al, 2005). Similarly, the HEP is designed to improve the health status of families, with their full participation, using local technologies and the community's skill and knowledge.

At the heart of the program is a fleet of young women trained in HEP modules for one year, after which they return home as salaried frontline health care staff. Deployed as pairs, the HEWs provide basic, largely preventive, primary health services to rural villages and empower families to take charge of their own health.

Additionally, the HEWs are required to recruit voluntary community health workers (vCHW) who have had experience in community-based health services, to help implement the HEP. Voluntary community health workers support the HEWs by conducting regular rounds to check on neighbors and encourage practices like latrine building, proper hand washing, completing immunization schedules by eligible mothers and children etc.

In conjunction with vCHWs and local government administration, the HEWs identify and train “model families” that have been involved in other development work, and /or that have acceptance and credibility by the community, as early adopters of better health practices in line with health extension packages. Graduated model families are then surmised to follow suit of disseminating their health knowledge to next door households, friends and communities.

The HEP operate like a countrywide referral system, rippling up from its base at rural health posts, which is the locus of extension workers’ operation serving a population of 5,000 people, to the larger, better-equipped health centers, each serving around 25,000 people (FMOH, 2007).

At the Health Posts HEWs provide antenatal care, delivery, immunization, growth monitoring, nutritional advice, and family planning to the general population of the Kebele¹. Additionally, Health Centers serve as a logistic hub for HEWs to provide them technical support and to serve as a referral center for HEW referred patients.

The HEP deployed the HEWs in a stepwise manner and in fact the speed and intensity of the program implementation varies across Kebeles. This is partly because the initial rollout of the program was largely influenced by several factors including the availability of essential inputs for the implementation of the program, readiness to raise resources for the construction of health post as well as the presence of secondary school female graduates in the village or other villages in the same districts (FMOH, 2007).

2.2. Program Stakeholders

The design of the HEP requires the support of various domestic stakeholders. The communities (model families) are expected to collaborate and disseminate health information and practices. The local village administration supports HEP by providing political leadership, mobilizing the communities, and monitoring the performance of HEWs based on an agreed plan. The district government collaborates with villagers in constructing health posts for every 5,000 people.

¹ Kebele is the lowest administrative unit in Ethiopia. It usually has an estimated average population of about 5000 people.

The Federal Ministry of Health (FMOH) provides the curriculum and guidance on the recruitment of HEWs and mobilizes resources from development partners for procurement and distribution of medical equipment and supplies for the health posts. The regional health bureaus and zonal health departments provide strategic leadership as well as technical support to the districts in implementing HEP. They also cover the stipend and salaries of HEWs during training and deployment, respectively.

There are also a large group of donors, such as the U.S. Agency for International Development (USAID) to provide both technical and logistical support – refresher training, distribution of supplies, etc. to HEWs through the various implementing partners.

2.3. Program Objectives

The overall objective of the HEP is to create a healthy society and reduce maternal and child morbidity and mortality and to help accelerate the country’s progress in meeting the 4th and 5th Millennium Development goals i.e., reduce child mortality and improve maternal health respectively (FMOH, 2007).

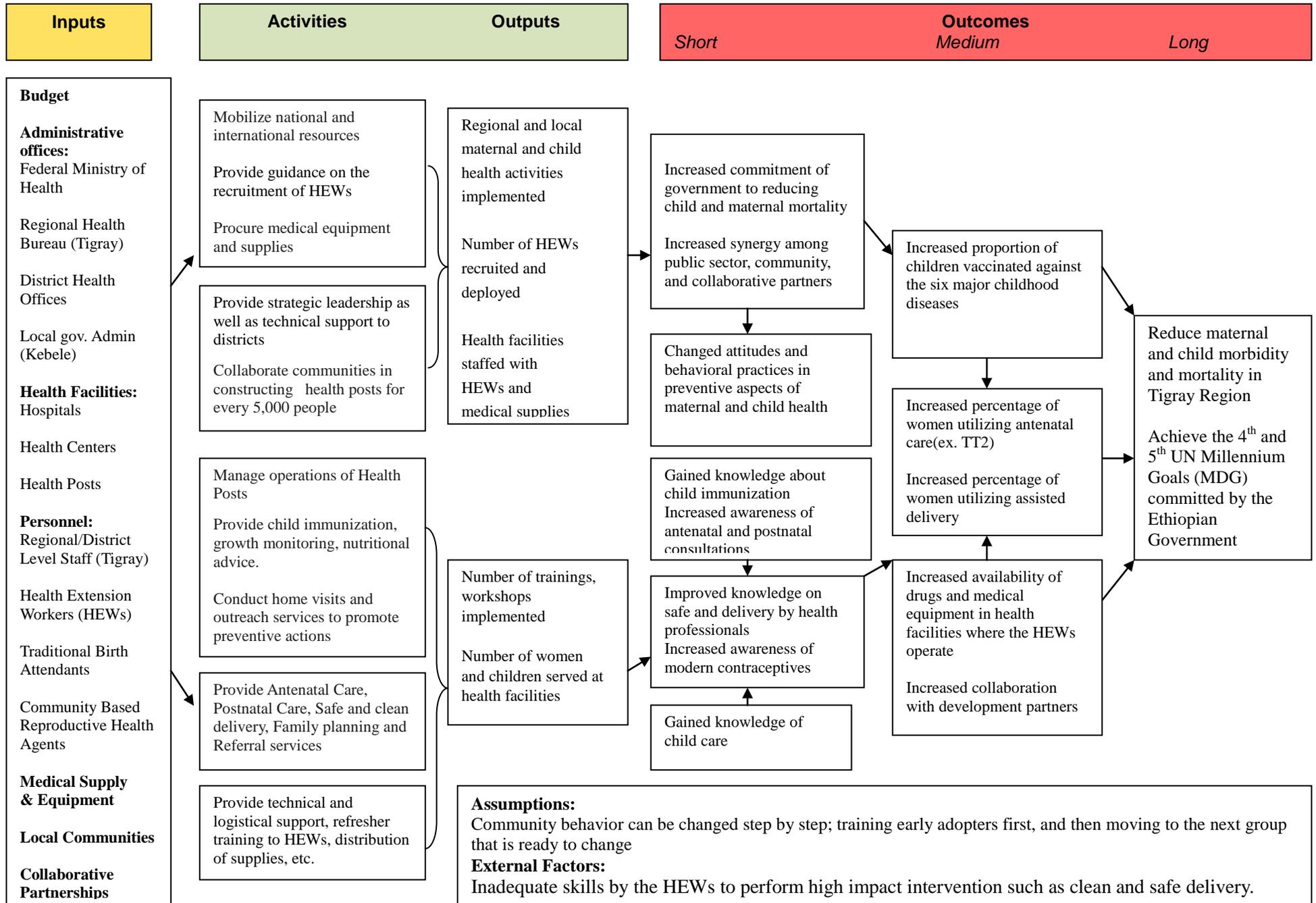
The following program objectives were taken from of the “Health Services Extension Program Guideline”;

- To improve access and equity to preventive essential health interventions at the village and household levels in line with the decentralization process to ensure health care coverage to the rural areas.

- To ensure ownership and participation by increasing health awareness, knowledge, and skills among community members.
- To promote gender equality in accessing health services.
- To improve the utilization of peripheral health services by bridging the gap between the communities and health facilities through HEWs.
- To reduce maternal and child mortality.
- To promote healthy life style.

2.3.1. Logic Model

Program: Program: The Health Extension Program (HEP) on Maternal and Child Health in Tigray Region: Logic Model



3. LITERATURE REVIEW

3.1. Review of Child Health in Ethiopia

Ethiopia is among the six countries that account for 50% of children under-five mortality² globally, with 194,000 deaths every year (UNICEF, 2012). More than one third of the deaths are largely due to communicable diseases that could easily be prevented and treated using affordable and low-technology interventions (WHO, 2012). Nearly 28% of under-five deaths are attributed to pneumonia (21%); diarrhea (14%); neonatal conditions such as prematurity (15%) and birth asphyxia (10%); measles (4%); malaria (2%) and HIV (2%) (UNICEF, 2012).

Factors that indirectly attribute to the high tolls of under-five death include; socioeconomic factors (maternal education & household income); bio-demographic factors (maternal age & marital status); access to maternal health care & fertility characteristics; as well as environmental factors such as sanitation, hygiene & access to clean water (Kumar et al, 2010; Hailemariam et al, 1997). For example, in their study, Kumar and Gemechis (2010) indicated that mothers' standard of living index, birth interval and education have significant impact on child mortality in Ethiopia. Results of their study suggest that children born to mothers with second and medium standard of living index (SLI) experienced highest rate of deaths (9.4% and 10.6% respectively), and those children whose mothers belong to high SLI group had the lowest child mortality rate (5.6%).

² Under-five mortality is defined as the probability of a child born in a specific year or period dying before reaching the age of five, if subject to age-specific mortality rates of that period (WHO, 2012).

Birth interval³ has long been demonstrated as an important determinant of child mortality in many developing countries including Ethiopia (Becher et al, 2004; Ikamari, 1998). For example, the under-five mortality rate in infants born less than 36 months subsequent to a previous birth is indicated to be high i.e., 179 deaths/1,000 live births compared to 72 deaths/1,000 live births for infants born 48 months after the previous birth (EDHS, 2011). This is exacerbated by the limited access to reliable maternal health care in the country with only of 44% women utilizing antenatal care(4+ visits) and 44% of births attended by skilled health personnel (WHO,2012).

Additionally, comparing children who were born to mothers with and without higher education, a recent demographic survey shows that, those who were born to mothers with no education have higher likelihood to die before their 5th birthday i.e.,121 deaths per 1,000 , than children whose mothers have higher education i.e., 24 deaths per 1,000 live births (EDHS, 2011). Also, vaccination coverage significantly varies by maternal education, where approximately 57% of children whose mothers have secondary education were fully vaccinated compared to only 20% of children whose mothers have no education (EDHS, 2011).

The other underlying problem with child mortality in Ethiopia is malnutrition, with some of the highest rates of stunting and underweight in the world; 44% and 29% respectively (SCUK, 2009). Although the role of malnutrition in child mortality is not revealed by the conventional methods of classifying causes of death, it influences primarily through the exacerbation of other causes of death, such as diarrhea, respiratory infections and malaria (FMOH, 2005; EDHS, 2005).

³ The recent median birth interval in Ethiopia is 34 months (DHS, 2011).

The results from the Ethiopian National Child Survival Strategy (2005) also indicated that nearly 57% of under-five deaths were attributable to malnutrition's potentiating effects. In recent years however, Ethiopia has registered a steady reduction of under-five mortality rate. For example, between 2000 and 2011, infant mortality has declined from 99 deaths per 1,000 live births to 59 deaths per 1,000 live births and under-five mortality from 166 deaths per 1,000 live births to 88 deaths per 1,000 live births. Even then, the current death toll is relatively elevated compared to neighboring countries such as Kenya (73 deaths/1,000), Eritrea (68 deaths/1,000), and Rwanda (54 deaths /1,000 live births)(Abebaw D., 2011).

In general, despite major progresses that have been made to improve the health status of under-five children in the last one and half decades, these children still face a high rate of morbidity and mortality and the health status remains relatively poor. Putting it in a nut shell, reaching the fourth Millennium Development Goal (MDG) of reducing two-third of under-five child mortality by the target year of 2015(68 deaths/100, 000 live births) seems difficult with the current phase of progress.

3.2. Review of Maternal Health in Ethiopia

Maternal mortality⁴ is one of the important indicators of overall health and development status in Ethiopia. Although literature finds maternal mortality figures in the country to vary by source, the best estimates to date suggest Ethiopia ranks among the highest in the world, estimated at 676 deaths per 100,000 live births (EDHS, 2011).

As in the other developing countries, pregnancy remains to be the leading cause of death of women in their reproductive years. Each year an estimated 22,000 women and 100,000 newborns die from complications related to childbirth mostly because the vast majority of the deliveries (93%) occur at home (Hadley C., et al 2010; L10K, 2009). Abortion complications, ruptured uterus, puerperal sepsis, postpartum hemorrhage and preeclampsia/ eclampsia were the five major causes of maternal mortality in the country (Gaym A, 2009; Ahmed A, 2010).

Major constraints that prevent the utilization of maternal health services from the supply side comprise shortage of skilled midwives and emergency obstetric care, weak referral system at health center levels, inadequate availability of medical equipment, and under financing (Mekonnen Y. et al, 2003; Shiferaw et al, 2013). Particularly, services targeted at women have an even lower coverage. For instance, antenatal care (ANC) is only 34% ; less than 10% of births occur in health facilities, primarily in public sector facilities; and only 7% of women received a postnatal checkup within two days of delivery(EDHS,2011).

⁴Defined as the death of a woman 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, 1993)

From the demand side, maternal education, cultural norms and societal emotional support bestowed to mothers, distance to functioning health centers and high cost were found to have significant impact on women's utilization of health care services (Mekonnen Y. et al, 2003; Shiferaw et al, 2013). Added to these problems, in some parts of the country, over half the girls are married by the age of 15 and are expected to bear children the following year. Because their bodies are not fully developed, they run a high risk of experiencing complications, which often leads to maternal death (CARE, 2010).

As in many sub-Saharan African countries the income disparity between men and women in Ethiopia is wide, and women in general are not empowered having little access to resources as well as control over their reproductive and health care decisions. Family laws restrict the right of women to regulate their fertility and discourage the use of modern birth control methods. Consequently, the contraceptive prevalence rate in Ethiopia is very low (Berhane, et al (2001).

Over the past few years, the Ethiopian government took hold of action to prioritize women's access to maternal health care as a key target by moving service deliveries out from facilities to community and household level (Alemayehu et al, 2012). Consequently, maternal mortality ratio has shown a decreasing trend from the year 2000 estimate of 871 deaths per 100,000 live births to 676 deaths per 100,000 live births in 2011(EDHS, 2011). In spite of the steady decline, Ethiopia is still far from meeting the fifth target of Millennium Development Goal (MDG5) of less than 218 maternal deaths per 100,000 live births by 2015 (UN & Inter Agency and Group, 2012).

3.3. Review of Impact of HEP on Maternal and Child Health

Access to health services in Ethiopia was substantially limited before the government embarked on an innovative way of extending affordable primary health care services to its population through the HEP (Admassiea et al, 2009). Substantial investments in human resources, health infrastructure, pharmaceutical supplies and operational costs have been made for the successful implementation of the program (FMOH, 2010). An important policy question regarding the program is whether the program has brought impact to its target beneficiaries since it has become operational in 2004.

Recent evidence shows that the HEP has enabled the country to enhance primary health care coverage from 76.9% in 2005 to 90% in 2010 (Hailom B. 2011; FMOH, 2010b).

Analyzing the impact of the HEP on child and maternal health, Admassiea et al (2009) found that significant proportion of children in villages where the HEWs were deployed received vaccination against diphtheria, polio and tetanus (DPT), measles, TB, and main antigens. Their study also estimated a significant increase (22%) in the utilization of insecticide treated bed-net (ITN) by a larger proportion of under-five children in treatment villages to protect against malaria.

Evaluating the impact on child immunization coverage in the program villages where HEWs were deployed, the Ethiopian Ministry of Health observed that 86% of children received Penta 3/DPT 3 vaccine; 82% received measles vaccine and 62% had been fully immunized resulting in average of 15% annual increase since the year 2006 (FMOH, 2010b).

Consistently, results from the Last Ten Kilometers Project (L10K), which examined the impact of health extension program on L10k project villages, found that the percentage of children 12 to 23 months who were fully vaccinated increased from 46% in 2008 to 53% in 2010.

Impact estimates on maternal health indicators also demonstrated that antenatal care (ANC) coverage in the country increased from 67.7% in 2008 - 2009 to 71.4% in 2009-2010 ; and postnatal care increased from 34.3% to 36.2% during the same period of time (FMOH, 2010a).

A number of studies also found that the HEP produced positive impact on maternal health. For example, Ali K .et al (2010) remarked that between the year 2008 and 2010, the HSEP significantly contributed towards observed improvements in the maternal and child health indicators including contraceptive use, antenatal care, postnatal care, and improvements in fully immunized child. Furthermore, survey findings from the Last Ten Kilometer Project indicated that household visits by the HEWs was associated with 1.2 fold increase in the likelihood of contraceptive use; about 1.5 fold increases in antenatal (ANC) and Tetanus Toxoid(TT2+) injection during pregnancy; and 2.5 fold increase in postnatal Care (PNC) (Ali K., 2011).

In support of the above study, Ergano E, et al (2012) noted that the implementation of the health extension outreach program played a major role by increasing the use of ANC, TT immunization, insecticide treated mosquito nets (ITNs) and family planning services in pastoral settings of Ethiopia.

In contrast to these findings, Araya et al (2012) found that HSEP contribution to the improvement in maternal health indicators such as health facility delivery and postnatal checkup were insignificant. Also, evaluating the impact of HEP, Admassiea et al (2009) indicated that the program did not have statistically significant effects on prenatal and PNC indicators.

Overall, findings of impact of the HEP especially on maternal health are mixed. However, it can be noted that the program significantly influenced child health measures.

4. DATA AND METHODS

4.1. Data

The study used administrative panel data extracted from Tigray Regional Health Bureau spanning from 2004 to 2010. The dataset provides information on the total number of HEWs deployed, total number of health posts, and other health facilities available in each district. The region has 34 rural districts and each district comprises a different number of wards (Kebeles). As indicated earlier in the program description, the HEP deploys the HEWs in a stepwise manner; hence, the speed and intensity of the program implementation vary across Kebeles i.e., in the data, some Kebeles were assigned HEWs as early as in 2004 whereas others in 2007. Using this temporal variation in the program implementation, the present study evaluated the impact of the program on maternal health and child health outcomes at the district level.

The outcomes of interest for child health are coverage of DPT3, OPV3, BCG, measles and full immunization at each district. For maternal health outcomes include, coverage of TT2 for pregnant women and non-pregnant women and attended delivery by HEWs.

4.2. Data Analytic Plan

The present study tested two empirical models, Ordinary Least Square (OLS) and Fixed Effects (FE)⁵ to analyze the impact of the HEP on child and maternal health outcomes over 4 years of study period (2004-2007). The OLS method does not control for district level unobserved heterogeneity and hence results are biased. However, the FE method takes advantage of the panel nature of the data and controls for such bias. FE also removes the effect of those time-invariant characteristics (sex, religion, culture) in order to assess the program's net effect. Unlike Random Effects (RE) method, it doesn't impose a restrictive assumption on the correlation of the error term and the covariates to be zero. Besides, it's commonly applied in the literature. However, the disadvantage of using FE is higher standard errors on the coefficients compared to OLS or RE methods. The dependent variables for the analysis at the district level are continuous, therefore, the generic linear regression form is

$$Outcome_{it} = \alpha_i + \beta HEW_{it} + \gamma X_{it} + e_{it},$$

where $Outcome_{it}$ denotes maternal health or child health indicators, HEW_{it} is the proportion of HEWs deployed in district i and year t (i.e., the total number of HEWs deployed in the district divided by the number of Kebeles in the district), X_{it} is a vector of control variables such as availability of electricity and telephone in the districts and year dummies to capture variations over time, e_{it} is error term, α_i is district level intercept, and β and γ are slope parameters. The coefficient β measures the impact of the program on the outcomes.

⁵ “The key insight is that if the unobserved variable does not change over time, then any changes in the dependent variable must be due to influences other than these fixed characteristics.” (Stock and Watson, 2003, p.289-290).

The standard FE regression equation is

$$\Delta Outcome_{it} = \beta \Delta HEW_{it} + \gamma \Delta X_{it} + \Delta e_{it},$$

Where $\Delta Outcome_{it} = Outcome_{it} - \overline{Outcome}_i$, $\Delta HEW_{it} = HEW_{it} - \overline{HEW}_i$, $\Delta X_{it} = X_{it} - \overline{X}_i$, and $\Delta e_{it} = e_{it} - \bar{e}_i$ with $\Delta \alpha_i = \alpha_i - \bar{\alpha}_i = 0$. Note that due to such fixed effect transformation, all time-invariant district level variables (example: ethnicity) are dropped out of the model.

Corresponding child health outcome variables (DPT3, OPV3, BCG, Measles & full immunization) and maternal health outcomes variables (utilization TT2 and delivery attended by HEWs) were regressed against the explanatory variable (HEWs coverage).

5. RESULTS AND DISCUSSION

5.1. Descriptive Statistics

As indicated in the program objectives ensuring robust vaccination coverage is part of the major focus of the HEP in reducing the rate of child mortality in the country. Table (1) exhibited the mean and standard deviations of vaccine coverage and attendance by child health and maternal health indicators in Tigray Region by Year. The descriptive result for the proportion of eligible children fully vaccinated showed a 15% increase from 2007 to 2008 and a 3% average increase (71% vs. 74%) during the four periods of years. Comparing the result with the 2011 EDHS result, the proportion of children fully vaccinated in present study was higher by approximately 15% (74.14% vs. 58.9%).

The result also found a 3% increase in BCG coverage, 11% increase in three doses of DPT and 10% increase in OPV coverage from the year 2007 to 2008. Measles coverage revealed a 9% increase (81% vs. 90%) from 2007 to 2010. The higher coverage of measles and OPV3 vaccination was assumed to be due to the frequent national campaign that focused on these two vaccines. The mean coverage for OPV3 and DPT3 vaccines were close to each other at 97.46% vs. 97.51%.

Table (1) also presented maternal health outcomes in the region. The proportion of pregnant women who received Tetanus Toxoid Injection (TT2) in 2007 was slightly higher than the non-pregnant women (33.51% vs. 30.13%). The average coverage of TT2 among pregnant women has somewhat revealed improvement from 33.51% to 35.73% in 2007 and 2010 respectively. However the proportion of women who attended delivery by the HEWs showed a steady decline (99.5% to 18.86%) 2007 and 2010.

Table 1: Mean and Standard Deviations of Vaccine Coverage and Attendance by Child Health and Maternal Health Indicators in Tigray Region by Year

Indicators	Mean and standard Deviation by Year			
	2007	2008	2009	2010
Child Health				
Full Immunization	71.35(24.47)	85.15(21.31)	77(12.57)	74.14(13.98)
BCG	87.22(24.12)	89.76(27.17)	n.a.	n.a.
DPT3	86.95(23.98)	97.51(27.51)	n.a.	n.a.
OPV3	87.05(24.21)	97.46(28.64)	n.a.	n.a.
Measles	81.3(22.92)	91.38(23.42)	80.11(11.31)	89.78(94.98)
Maternal Health				
TT2 Pregnant	33.51(15.27)	28.46(12.91)	n.a.	35.73(18.38)
TT2 Non-Pregnant	30.13(13.32)	33.6(20.53)	n.a.	30.57(17.99)
Attended delivery	99.55(0.995)	42.55(23.89)	29.89(22.08)	18.86(13.8)

Note: Standard Deviation in parentheses

Table (2) presents descriptive summary of selected district characteristics such as telephone, electricity, health post coverage and health extension worker coverage. The results denoted that, nearly 88.9% and 86.1% of the districts in the region have access to telephone and electricity services respectively. Similarly, close to 82% of the districts have access to health facilities.

Additionally, the descriptive results suggested that the average program coverage (proportion of HEWs deployed at district level) was approximately 67%. Increasing the number and distribution of HEWs in every health posts is part of a larger Tigray regional government's effort since the program become operational. The overall rate was indicated to be lower given the fact that the program's intent was to ensure 100% coverage of HEWs in each Kebeles to achieve the targeted results by the end of 2015.

Table 2: Descriptive Summary of Selected District Characteristics

Variable	Mean	SD
Telephone	88.9	31.6
Electricity	86.1	34.8
Health Post Coverage	81.91	24.17
Health Extension Worker Coverage	67.11	34.36

5.2. Impact Estimates on Child Health

The regression estimates of program impact on child health are reported in Table (4). The estimation was run using STATA 11.2 software and both empirical models, OLS and FE, were estimated for each child health outcomes.

Although, their statistical significance varied, the magnitude of the estimated coefficients in both methods was similar. The estimation included district factors and year as dummy variables in the OLS specification and only year in the FE specification. District dummies controlled all district level characteristics that were not taken into account in the model such as infrastructure, population, culture, religion etc.

As indicated in Table (3), the program had positive impact on child vaccination coverage. It is important to note that the program effect varied by vaccines. For instance, the FE estimates implied that a 10% increase in the program (HEWs) coverage resulted in an increased achievement of full immunization by 1.85%, BCG vaccination by 2.6%, DPT3 by 2.4% and OPV3 by 2.7%, all of which were statistically significant. Although not statistically significant, increased coverage in the program also resulted in a 0.16% increase in measles vaccination. Overall the program was an effective approach to improving child health outcomes in the region. The model in Table (3) also shows that having electricity and telephone services was associated with 4.7% increase in full immunization.

Table 3: Impact of the Program on Children Vaccinated Against Major Diseases Using OLS and Fixed Effect Model (FE)

Variables	<u>Full Immunization</u>		<u>BCG</u>		<u>Measles</u>		<u>DPT3</u>		<u>OPV3</u>	
	(OLS)	(FE)	(OLS)	(FE)	(OLS)	(FE)	(OLS)	(FE)	(OLS)	(FE)
HEWs Coverage	0.189 (0.128)	0.185*** (0.069)	0.239* (0.124)	0.256** (0.121)	0.211 (0.135)	0.0166 (0.209)	0.229* (0.132)	0.237* (0.127)	0.269* (0.143)	0.273* (0.136)
Telephone	4.784 (19.58)		20.97 (18.98)		7.088 (20.68)		17.51 (20.23)		18.84 (21.84)	
Electricity	25.62 (19.77)		-10.29 (19.16)		-9.398 (20.88)		10.48 (20.43)		7.86 (22.05)	
Constant	45.71** (18.01)	56.43*** (6.187)	80.84*** (17.45)	66.57*** (10.24)	86.88*** (19.02)	79.96*** (18.74)	65.08*** (18.61)	67.79*** (10.73)	65.08*** (20.09)	65.05*** (11.56)
Observations	72	148	72	74	72	148	72	74	72	74
R-squared	0.686	0.169	0.745	0.121	0.638	0.014	0.722	0.199	0.692	0.192
District Dummies	YES		YES		YES		YES		YES	
Year Dummies	YES		YES		YES		YES		YES	
No. of Districts		37		37		37		37		37

Note: Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

5.3. Impact Estimates on Maternal Health

Table (4) presents the results from the OLS and FE estimates of the impact of the program on maternal health indicators, namely achievement of TT2 for pregnant women, TT2 for non-pregnant women and attended delivery between 2007 and 2010.

In all specifications, the coefficients on the lagged value of HEWs coverage were lower in magnitude and statistically insignificant. For instance, in the FE estimate a 10% increase in the program coverage lead to the receipt of TT2 in pregnant women by 0.5%, TT2 in non-pregnant women by 0.08%, and attended delivery by 1.06%. The lower effect of the program on the receipt of TT2 could be due to _ as indicated by many researchers_ factors such as traditional beliefs that the injection causes infertility etc.

The estimated results were discouraging and contrary to a *priori* anticipation because of the fact that increasing percentage of women utilizing antenatal care and delivery assisted by health extension workers or trained traditional birth attendants were part of the main targets of the program. The result also implied that maternal health care has gaps and is less than optimum for reducing maternal mortality to reach the MDG target committed by the Ethiopian government.

The above results are similar with other studies. For instance, Araya et al (2012) found that although HEWs have made substantial contribution in several aspects of utilization of maternal health services, their insignificant contribution in improving health facility delivery and skilled birth attendance remains an important problem. Another study by Admassie et al (2009), also found that the program had a negative effect on attendance delivery by HEWs. Therefore, the present study suggests that an increased effort should be made by strengthening the support of HEWs in order to bring real change in maternal health, similar to the program success in child health outcomes.

According to the L10KM survey, the household visits by HEWs mainly focused on providing information on personal hygiene, promotion and use of latrine, and immunization. Although these are important HEP services, they are not enough to reach its maternal mortality reduction goals. The household visits should also provide, extensive health education to alleviate misperceptions and false beliefs such as TT2 causes infertility etc. The survey also indicated that HEWs lack most of the necessary skills expected of a birth attendant to tackle the major causes of maternal mortality in the program villages.

The fact that all the HEWs are female can play a large role in addressing key maternal and child health issues and encourage women to seek health services as they are also in a better position to understand maternal issues. Therefore, the district health office and the Kebele administration need to further sensitize the community about the HEP and the role of HEWs.

Table 4: Impact of the Program on Maternal Health Using OLS Estimate and Fixed Effect Model (FE)

Variables	TT2 Pregnant		TT2 Non-Pregnant		Attended Delivery	
	(OLS)	(FE)	(OLS)	(FE)	(OLS)	(FE)
HEWs Coverage lag	-0.0538 (0.0888)	0.0527 (0.0734)	-0.0187 (0.11)	0.00845 (0.0882)	0.13 (0.113)	0.106 (0.0656)
Telephone	-32.82** (13.57)		-40.92** (16.78)		-15.16 (16.05)	
Electricity	31.08** (13.7)		37.24** (16.94)		5.918 (16.23)	
Constant	27.92** (12.48)	29.26*** (6.405)	22.94 (15.43)	29.45*** (7.689)	87.80*** (15.2)	91.10*** (5.962)
Observations	72	111	72	111	70	146
R-squared	0.566	0.068	0.565	0.012	0.893	0.856
District Dummies	YES		YES		YES	
Year Dummies	YES		YES		YES	YES
No. of Districts		37		37		37

Note: Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

6. RECOMMENDATIONS

Based upon the result from the current evaluation, the following recommendations are suggested.

1. The impact on maternal health outcomes were found unfavorable. There could be many reasons for that including the health-seeking behavior of the mothers. Literature suggested that maternal health care utilization in Tigray depends on many factors. Mothers may not come because of distance, lack of knowledge about the service, responsibilities at home so they don't have time to visit, and problems related to the service provider side. Therefore, these reasons and ways to address them need thorough investigation.
2. Taking into account the overwhelming culture of delay in seeking help after illness onset, health education targeted to break this trend should be undertaken.
3. It is most important for the government to strengthen the local health institutions and the referral system to undertake high impact interventions such as clean and safe delivery that the HEWs are incapable of doing.
4. The government should also strengthen the skill and equipment of HEWs. Also, improve the image by of health facilities where the HEWs operate by providing adequate medical supply and improved patient approach.

7. LIMITATION OF THE STUDY

Several limitations should be noted. First, two of maternal health outcomes [TTs and assisted delivery] were selected in order to represent the broad range of activities of the HEWs regarding mothers' health; however, the selection of other outcomes such as Vitamin A and iron supplement, postnatal consultation, family planning etc. might have produced different impacts. Second, demographic distribution by age, gender, educational level, household income, distance to nearest health posts etc. were not taken into account because of lack of data. The administrative level data obtained did not have household level information. A third limitation is that the study focused only on one component of child health i.e., vaccine and two components on maternal health identified in the logic model due to limited data availability, resources and short timeframes for conducting the evaluation. The effect of the program on maternal health as well as the demand & supply side factors that influence maternal health services utilization should to be explored in greater depth in a future study to enhance and improve program performance continuously.

8. CONCLUSION

The primary purpose of the study was to evaluate the short and intermediate impact of the Ethiopian Health Services Extension Program (HEP) on child and maternal health outcomes. The study estimated two empirical models, OLS and FE. Result of the estimation suggested a greater impact on child health indicators which could be attributable to the presence of the HEP in the districts. Particularly, the program had statistically significant effect on BCG, OPV3, DPT3 and full immunization. The impact of measles is positive but was not statistically significant. No effect of the program on maternal health indicators was found. Therefore, all concerned bodies including federal, regional and local governments should put collaborative efforts to increase the utilization of maternal health services as well as support and strengthen the outreach effort of health extension workers to reach the targeted goal. Overall, this study has demonstrated favorable aspects of the HEP upon which the future child and maternal healthcare programs can be built. There is evidence from this study that large scale community based primary health care program can be effective approach to improve health outcomes.

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