Effect of Community Health Strategy on Focused Antenatal Care Coverage: A Pretest-Posttest Experimental Study in Rural Mwingi West Sub-County; Kenya

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Abstract Globally, Maternal Mortality Rate (MMR) fell by nearly 44% over the past 25 years, to an estimated 216 maternal deaths per 100 000 live births in 2015 from MMR of 385 per 100 000 live births in 1990. Similarly, the number of under-five deaths worldwide has declined from 12.7 million in 1990 to 5.9 million in 2015. Despite these gains, sub-Saharan Africa remains the region with the highest MMR (99% of global maternal deaths) and under- five mortality rate (1 child in 12 die before their fifth birthday). In Kenya, maternal and child mortality rates are still high despite government efforts aimed at improving Maternal and Child Health (MCH). Studies have acknowledged that Focused Antenatal Care (FANC) is an important element of health care with the potential of reducing maternal and child mortality rates. Though the proportion of women in Kenya seeking ANC services from skilled attendants (for at least 1 visit) is high at 95.5%, FANC coverage remains low at 57.6%. This study sought to determine the effect of a community health worker led primary health care intervention (Community Health Strategy) on FANC in Mwingi West sub-county. A pretest -posttest experimental study design with 1 pretest and 2 post-test surveys in intervention and control sites was employed. Data was collected from a sample size of 422 households in each survey. Women with a child aged 9-12 months were main respondents. CHS significantly increased FANC coverage by 9.5% (Z=2.7528, P<005) within six months after implementation, and by 20.1% (Z= 5.7881, P<0.05) within 18 months of implementation. In intervention site, FANC coverage significantly increased to 59% from 38.9%**.** Women in intervention site were 1.7 times more likely to seek ANC services for at least 4 times compared to women in control site (95%CI: 1.464-2.014, P<0.0001). CHS was effective in increasing FANC coverage in intervention site. To improve MCH outcomes in Kenya the government should fast-track national implementation of CHS.

Keywords: community health strategy, community health workers, focused antenatal care

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1. Introduction

Globally, Maternal Mortality Rate (MMR) fell by nearly 44% over the past 25 years, to an estimated 216 (80% Uncertainty Interval [UI] (207 to 249) maternal deaths per 100 000 live births in 2015, from a MMR of 385 (UI 359 to 427) in 1990 [1]. This is attributed to global efforts aimed at realization of the Millennium Development Goals (MDGs). The annual number of maternal deaths decreased by 43% from approximately 532 000 (UI 496 000 to 590 000) in 1990 to an estimated 303 000 (UI 291 000 to 349 000) in 2015. Despite this, developing countries remained behind in reducing MMR. By 2015 developing countries accounted for approximately 99% (302 000) of the global maternal deaths, with sub-Saharan Africa alone accounting for roughly 66% (201 000), followed by Southern Asia (66 000) [1]. In Kenya MMR is high (510 per 100 000 live births: UI 344 to 754) [1]. Similarly, substantial global progress has been made in reducing child deaths since 1990. The number of under-five deaths worldwide has declined from 12.7 million in 1990 to 5.9 million in 2015 [2]. Despite these gains, progress remained insufficient in reducing child mortality globally to meet MDG 4 by year 2015 [2]. Sub-Saharan Africa remains the region with the highest under- five mortality rate in all regions in the world, with 1 child in 12 dying

before his or her fifth birthday. In Kenya, child mortality rates are still high despite the efforts made by the government and other development partners in an attempt to meet MDG four. Infant mortality rate as reported by 2014 Kenya Demographic Health Survey (KDHS) is 39 per 1000 live births while under-five mortality is 52 deaths per 1,000 births [3]. Achieving the SDG target of a global MMR below 70 per 100,000 live births and SDG target of a neonatal mortality rate of 12 or fewer deaths per 1,000 live births [1,2] will require innovative interventions to help accelerate improvement in MCH outcomes especially in sub-Saharan Africa.

Routine antenatal care visits for healthy pregnant women were introduced in Europe and North America almost a century ago on the unproven assumption that they would improve outcomes for mother and baby [4]. Since then studies have shown that Antenatal Care (ANC) is a critical element for reducing maternal and child mortality, through provision of a broad range of health promotion services to expectant women [4,5]. Studies acknowledge that reducing maternal and child mortality depends on an operational continuum of care which should be accessible and of high quality and provided before and during pregnancy, childbirth, and the postnatal period. An important element in this continuum of care is effective ANC [5].

Efforts to monitor progress in coverage of antenatal care generally focus on quantifiable issues such as the number and timing of visits and the characteristics of users and non-users of antenatal care services [6]. Though these indicators provide no information on the content or quality of the ANC services provided, there is a broad consensus to use these indicators as a measure of ANC service utilization [6]. Therefore ANC care is measured through a standard referred to as ANC coverage [6]. World Health Organization (WHO) measures ANC coverage in two broad ways; ANC coverage in which an expectant woman makes at least one visit which is defined as; the percentage of women aged 15–49 with a live birth in a given time period that received ANC service from a skilled health personnel at least once during their pregnancy, and ANC coverage in which an expectant woman makes at least four visits which is defined as; the percentage of women aged 15–49 with a live birth in a given time period that received ANC service from a skilled health personnel four or more times during their pregnancy [7]. The later which is referred to as Focused Antenatal Care (FANC) is more preferred and recommended by WHO than the former.

FANC Policy as recommended by WHO ensures that providers focus on assessment and actions needed to make decisions, and provides care for each individual woman's situation. In this model, four ANC visits are recommended for women whose pregnancies are progressing normally, with the first visit in the first trimester [5]. Essential services provided in the FANC health package include early identification of pre-existing health conditions (e.g., check for weight and nutrition status, anemia, hypertension, syphilis, HIV status), early detection of complications arising during pregnancy (e.g., check for pre-eclampsia, gestational diabetes), Health promotion and disease prevention (e.g., tetanus vaccine, prevention and treatment of malaria, nutritional support and counseling, micronutrient supplementation, family planning counseling), and birth preparedness and complication planning (e.g., birth and emergency plan, breastfeeding counseling, antiretroviral for HIV positive women and reducing mother-to- child transmission of HIV and child spacing) [8].

In the developing world, Community Health Workers (CHWs) are increasingly recognized as a critical link in improving access to health services at the community level [9]. There is no doubt that CHW led interventions have improved Maternal and Child Health (MCH) outcomes in low and middle level countries. In Nepal, a study conducted to assess performance CHWs established that they provided obstetric services, including antenatal care, birth attendance and postnatal and newborn care, at community level and identified complications for referral. The study however observed that, their productivity levels were very low, particularly in the remote hill areas, where they were most needed [10]. In rural Bangladesh, a study conducted to establish the impact of a community health intervention on utilization and equity of access to maternal health services established that the intervention increased ANC service utilization [11]. A review of 34 studies from low and middle income countries associated community interventions with marginal improvements in ANC coverage [12]. In Nigeria, a deployed team of resident female Community Health Extension Workers (CHEWs) working in a remote rural community led to major and sustained increases in ANC coverage [13].

Community Health Strategy (CHS) also commonly referred to as Community Health Strategy (CHS) is a Community Health Worker (CHW) led Primary Health Care (PHC) intervention in Kenya. The PHC intervention was designed in 2006 to support the delivery of Kenya Essential Package for Health (KEPH) at level one (community level)[14]. Since inception of the CHS in the year 2007, the Government of Kenya (GoK) guided by the 2008-2012 Ministry of Public Health and Sanitation (MoPHS) Strategic Plan and with the help of development partners initiated implementation of CHS pilot programs in various districts in the Country[15]. In Mwingi west sub county, the intervention was initiated by the Ministry of Public Health and Sanitation (MoPHS) in partnership with the African Medical and Research Foundation (AMREF) in March 2011 as a component of *Aphia plus Kamili* project [16].

Kenya has a unique problem in regard to FANC coverage. Whereas the women reported by 2008/09 Kenya Demographic and Health Survey (KDHS) to have sought ANC services (for at least 1 visit) from a medical staff is 92%, FANC coverage (these who sought ANC services as recommended (at least 4 times)) was low at 47% [17]. In the 2014 KDHS, expectant women who sought ANC services from a skilled attendant for at least 1 visit was 95.5% while FANC coverage was only 57.6% [3]. This pattern indicates a unique problem in that though majority of women in reproductive age are seeking ANC services from trained personnel, only a half of these women are seeking ANC services as recommended by WHO. In Kitui county where Mwingi west sub county is located, a similar pattern is observed in the 2014 KDHS. The proportion of women in reproductive age who sought ANC services (for at least 1 time) from a skilled provider is 98%, but FANC coverage 62% [3]. These statistics draw a pattern indicating that skilled service providers

may be the solution to increasing the low levels of FANC coverage in Kenya. Perhaps the solution could be from CHW led interventions. What is the effect of a CHW led Primary Health Care intervention (Community Health Strategy) on FANC in Kenya? This is the question this study sought to answer.

Since CHS inception in Mwingi west sub county, the program has not been assessed to establish the effect it has on FANC coverage. This knowledge gap justified the need to conduct this study. The main objective of this study was to assess the effect of the CHS on FANC coverage in Mwingi west sub county.

2. Materials and Methods

2.1. The Study Area

This was an experimental study with intervention and control site. The intervention site was Mwingi west sub county and the control site was Mwingi North sub county. Both sub counties are located in Kitui county. The intervention was under implementation in Mwingi west sub county. Mwingi north sub county did not benefit from the CHS. This was the criteria used to identify Mwingi west sub county as intervention site and Mwingi north sub county as control site. Mwingi West sub county had a total population of 103,774 people in the 2009 population census with a projection of 111,346 people by 2015. While Mwingi north sub county was reported to have a total population of 139,967 in 2009 population census with a projection of 150,179 persons by 2015 [18]. The two sub counties have many similarities. In regard to climatic conditions and ecological zones the sub counties are located in a rural arid and semi-arid area characterized by hot and dry climate with unreliable rainfall. Infrastructure in the two sub counties is poor. The roads are poor and rendered impassable during the rainy season hindering development and access to market centers, schools and health facilities. Most households in the two sub counties are small scale farmers and are prone to food insecurity due to the unreliable rainfall patterns in the region [18].

2.2. The Intervention

As indicated in the background, CHS was implemented in Mwingi west sub county through a partnership between the MoPHS Kenya and AMREF. The key elements of the CHS intervention in Mwingi west sub county were not different from the original design of the CHS intervention as designed by MoPHS in Kenya [14]. The key elements include the following;

2.2.1. Community Mobilization

This was done through organizing community meetings led by local chiefs (popularly referred to as chief *barazas*). The aim was to create awareness of the new intervention and mobilize community members to select potential volunteer CHWs for training.

2.2.2. Identification and Training of Volunteer CHWs

After community members identified volunteer CHWs for training, MoPHS and AMREF trained the CHWs.

Their training entailed going through a MoPHS Primary Health Care (PHC) CHS curriculum. The curriculum was developed to capacity build CHWs on PHC service provision. The curriculum further trained CHWs on formation and maintenance of Community Units (CUs) and supporting households in PHC initiatives.

2.2.3. Enumeration, Mapping of Households and Creating Community Units (CUs)

Enumeration of the community members was conducted at household level. This led to creation of household registers with demographic data as the main content in the register. A total of 10 CUs were created namely; *Kisovo, Waita, Kyethani, Kairungu, Nzeluni, Kea, Kalanga, Mutyangome, Munyun*i, and *Wikithuki* CUs.

2.2.4. Recruitment and Training of Community Health Extension Workers (CHEWs)

CHEWs are trained health professionals (Nurses and Public health officers trained at certificate and/or diploma levels and working for the Ministry of Health). These professionals were identified from dispensaries and health centers within the CUs, trained and recruited to work in the CHS intervention. Their role was to support, supervise and coordinate CHWs with each CHEW supervising up to 25 CHWs. CHEWs also facilitated health education sessions in the community and provided a linkage between CHWs and health facilities.

2.2.5. Health Service Provision

Health services provided in the CHS were classified into three categories namely; disease prevention and control, family health services which included family planning, maternal, child and youth health services, and promotion of community hygiene and environmental sanitation. The services were provided at both the household level and dispensary or health center level. The responsibility of CHWs was to provide day to day health services at the household level. These services included; promotion of community hygiene and environmental sanitation, provision of Insect Treated Mosquito Nets (ITNs), child immunization services, provision of essential drugs, and health education and counselling. Other MCH services provided by CHWs include; provision of family planning services (Pills and Condom distribution) and counselling, identification and tracking of newly expectant women to ensure that; they received ANC services at the dispensaries and health centers, they delivered under care of skilled medical professionals, they went through postnatal care, and that their infants received the vaccines in the child immunization program in time. CHWs also played a role in detecting complications related to pregnancy and child birth at an early stage and providing referral services to mothers involved for treatment at dispensaries and health centers. CHWs further monitored the health of newborn babies within their CUs and provided referrals for any sick child for treatment at the local dispensaries and health centers.

2.3. The Research Design

This was a non-randomized prospective experimental study in which 1 pre- test and 2 post-test time series

household surveys were conducted in both intervention and control sites. Data was collected at 3 time points; a pre-intervention survey (baseline survey) was used to collect baseline data before implementation of CHS in both intervention site and control site. First post intervention survey data was collected 9 months after implementation of the CHS in intervention site. At the same time data was also collected in the control site. For the purpose of this study, this survey was defined as mid-term evaluation. The 2nd post intervention survey data was collected in both intervention and control sites 18 months after implementation of the CHS. This is defined as end term evaluation. The main respondents were women of reproductive age with a child aged 9-12 months. The time series samples were independent of each other in that data was collected from different participants in all the three surveys.

2.4. Sample Size Determination

Reference [19] provides the Fisher's formula for calculating a representative sample size of a population with more than 10000 participants. As indicated in the study area section, total number of households in each site (intervention and control sites) was more than 10,000. After employing this formula, a representative sample size of 384 households was established. An extra 10 percent of 384 (38 households) were added into this sample in order to carter for non-response. A total sample size of 422 households was determined. In each survey, data was collected from women in 422 households in both intervention and control site.

2.5. Sampling Procedure

Purposive and simple random sampling were employed. Purposive sampling was used to identify intervention and control sites. Mwingi west sub county was purposively selected as intervention site based on the fact that the CHS program was to be implemented in the sub county. Mwingi north sub county was also purposively sampled as the control site based on the following; CHS was not under implementation in the sub county, the sub county borders Mwingi West and both have many similarities which include similar ecological and climatic characteristics [18]. Based on this, the communities living in Mwingi north sub county and Mwingi west sub county were assumed to be homogeneous.

Simple Radom Sampling was applied in all the pre-and post-intervention surveys in the study and control sites. The first step was to develop a sampling frame for each of the three surveys conducted in the study site and the control site. In Mwingi west sub county, a sampling frame was developed using household registers which were developed during creation of CUs. Using the household registers (which had sociodemographic data in each household), CHWs in Waita CU identified and enumerated households with children aged between 9 months to 12 months. The total number of households identified with a child/child aged 9-12 months in *Waita* CU was 1243. These households were allocated a unique code each to allow simple random sampling using a computer application (SPSS). The same procedure was

repeated during the first and second post intervention surveys in *Kyethani* CU and *Wikithuki* CU. This was done shortly before the surveys were conducted i.e. February 2013 and March 2014 respectively (9 months and 18 months after implementation of the CHS in Kyethani CU and Wikithuki CU respectively). Number of households with a child/child between 9-12 months in Kyethani CU and Wikithuki CU was found to be 927 and 1107 respectively. These households made the sampling frame for the intervention site.

In the control site, the researchers together with village elders and local chiefs conducted a series of community meetings locally referred to as *barazas* to help in identification of households with a child or children aged between 9-12 months. This was done in *Kyuso, Ngomeni* and *Mumoni* wards. In *Kyuso* Ward where the baseline survey was conducted, the exercise took place in the second week of March 2012 at *Kamuwongo, Ngaie*, and *Kimangao* villages while in *Ngomen*i Ward where the first survey following the baseline survey (matching first post intervention survey in the intervention site) was conducted community barazas were held in *Kimela, Mitamisyi,* and *Ikime* villages in the first week of February 2013. In *Mumoni* Ward, where the 2nd survey (after baseline survey) was conducted (to match with the 2nd post intervention survey in in the intervention site) community barazas were held on the first week of March 2014 in *Mutanda, Nguuka*, and *Kakuyu* villages. Households found to have a child or children aged between 9-12 months old in *Kyuso, Ngomeni* and *Mumoni* wards were 971, 1032 and 1208 respectively. These households made the sampling frame for the surveys conducted in the control site in which a sample size of 422 households was drawn from each sampling frame.

2.6. Data Collection Process

The first step in data collection was to conduct a pre-intervention survey to collect baseline data in both intervention and control sites. The aim was to obtain pretest measurements on both intervention and control groups to allow assessment of initial comparability of the two groups as suggested by Olayo *et al*. [20]. In the intervention site, baseline data was collected in three villages namely *Mwambui* (161 households*), Ikuusya* (131 households), and *Thonoa,* (124 households) (total:416 households) of *Waita* Community CU while in the control site baseline data was also collected in 3 villages namely *Kamuwongo*, (142 households) *Ngaie*, ,(130 households) and *Kimangao*, (139 households) (total: 411 households) in control site. This exercise took place from March 2012 to June 2012. Baseline survey was followed by two post intervention surveys in both intervention and control sites. Data for first post intervention survey (mid-term survey) was conducted 9 months (from March 2013 to June 2013) after implementation of the CU in Mwingi west sub county. In the intervention site data was collected in *Kyethani,* (108 households), *Kavuvwani*, (135 households), and *Kairungu* (170 households) (total:413 households) of *Kyethani* CU and in the control site data collection took place in three villages too namely *Kimela,* (127 households), *Mitamisyi*, (126 households), and *Ikime* (160 households*)* (total:413 households). The second post intervention

survey took place 18 months (from March 2014 to June 2014) after implementation of the CHS. In this survey, data collection in intervention site was done in two villages namely; *Mbondoni* (185 households) and *Wikithuki* (233 households) (total: 417 households) of *Wikithuki* CU and in the control site, data was collected in three villages namely; *Mutanda* (119 households), *Nguuka* (175 households) and *Kakuyu* (126 households) (total:420 households).

2.7. Variables in the Study

The independent variable is this study was CHS intervention while the dependent variable was FANC coverage (at least 4 ANC visits).

2.8. Study Validity and Reliability

A pilot study was conducted in Nzeluni in Mwingi west sub-county before the main study. The objective of the pilot was to test the reliability of data collection tool. Data was collected in a randomly selected sample of 45 households (slightly above 10 per cent of the sample size) in three villages in Nzeluni sub location. Upon testing the data on reliability, the coefficient of internal consistency (Cronbach's alpha) was 0.864. This value was within the recommended range of 0.70-0.95 [21] and therefore we were assured that the data collection tool (questionnaire) was reliable. Internal validity of the study was ensured by applying a sound methodology while external validity was ensured by use of a representative sample size.

2.9. Data Analysis and Presentation

Frequencies and percentages were used to provide descriptive statistics in this study. Z score tests were used to determine if proportions of FANC coverage before and after the intervention were significantly different. Binary logistic regression was used to control for potential confounders (socio-demographic characteristics) and to establish whether the odds of women seeking ANC services for ≥ 4 times before the intervention were different from the odds of women seeking ANC services for ≥ 4 times after the intervention. Data was presented using tables.

2.10. Study Limitations

The study had several important limitations; the most important of these was selection of intervention and control sites. Since the implementation of the CHS was a partnership between MoPHS and AMREF-Kenya project which was designed to be implemented in Mwingi West sub county as a whole, it was not feasible to randomly assign the CHS intervention to community members in Mwingi west sub county. This is the reason why a non-randomized pre-test and post-test experimental study design was deemed appropriate. Though this method has been employed in other similar studies [11,20] the design is weaker compared to a Randomized Controlled Trial. Secondly, researchers were also not able to account for possibility of other programs that could influence MCH outcomes of interest in the intervention site. However, there was an attempt to reduce the effect of confounding factors through, treating socio-demographic factors of both intervention and control sties as potential confounders and having them controlled in the binary logistic regression model used in data analysis, and by matching the control to the intervention sites by geographical location and infrastructural characteristics.

Data collection involved collecting data from a Mother and Child Health (MCH) booklet at the household level. In the event that this booklet was not available, respondents were requested to remember the MCH events that happened in a span of 12 months. Though this method has been successfully used in other studies including Demographic and Health Surveys (DHS) [3], the method introduced a retrospective data collection aspect that required respondents to recall past events. Though this was limited only to respondents who could not produce their mother and child booklets, it was a potential source of recall bias error.

2.11. Ethical Considerations

Ethical clearance for this study was provided by the National Council of Science and Technology (NCST) of the Government of Kenya (GoK). Respondents were informed about the survey and consent was taken for their participation. Voluntary participation was ensured in all interviews.

3. Results

3.1. Sociodemographic Characteristic of Respondents

Table 1, Sociodemographic Characteristics.

3.2. Antenatal Care (ANC) Coverage (≥ 1 Visit) vs FANC (≥ 4 Visits)

Proportion of women who sought ANC services for ≥ 1 visit in the intervention site was 96.1%, 97.8% and 96.9% at baseline, midterm and end term surveys respectively. In the control site, proportion of women who sought ANC services for ≥ 1 visit was 95.4%, 96.6% and 95.7% at baseline, midterm and end term surveys respectively. As indicated in Table 2, the proportion of women who sought ANC services for ≥ 4 visits in the intervention site was 38.9 %, 48.4%, and 59.0% in baseline, midterm and end term surveys respectively. In the control site, expectant women who sought ANC services for ≥ 4 visits at baseline, midterm and end-term surveys was 34.8%, 29.1% and 38.8% respectively.

3.3. Z Score Tests Testing Difference in Proportions of FANC in Intervention and Control Site

As indicated in Table 2, proportion of FANC coverage from baseline to midterm in the intervention site (9 months after CHS implementation) increased by 9.5%, (48.4%-38.9%) and the proportion of FANC coverage at baseline increased by 20.1 % in end term evaluation (59%-38.9%) (18 months after implementation of the

CHS). In the control site, the proportion of FANC coverage at baseline reduced by 5.7% compared to the midterm survey, (34.8%-29.1%) and the proportion of FANC coverage at baseline increased by 4% at end term evaluation survey (38.8%-34.8%). We sought to establish if the observed difference in proportions in intervention and control sites are significantly different by use of Z score tests for comparing proportions.

Table 1. Socio-demographic Characteristics of Respondents

Variable	Categories	Baseline Survey				Midterm Survey (9 Months)				End term Survey (18 months)			
		Mwingi West		Mwingi North		Mwingi.West		Mwingi North		Mwingi West		Mwingi North	
		F	%	F	%	F	%	F	%	F	%	F	%
Age	16-20 years	8	1.9	12	2.9	14	3.4	18	4.4	29	7.0	20	4.8
	21-25 years	35	8.4	63	15.3	61	14.8	59	14.3	64	15.3	76	18.1
	26-30 years	106	25.5	134	32.6	141	34.1	127	30.8	112	26.9	117	27.9
	31-35 years	149	35.8	139	33.8	126	30.5	143	34.6	132	31.7	138	32.9
	36-40 years	113	27.2	57	13.9	69	16.7	59	14.3	80	19.2	63	15.0
	41-45 years	5	1.2	6	1.5	2	0.5	7	1.7	0	0	6	1.4
	Total	**416**	**100**	**411**	**100**	**413**	**100**	**413**	**100**	**417**	**100**	**420**	**100**
Parity	1 Child	20	4.8	23	5.6	25	6.1	22	5.3	13	3.1	30	7.1
	2 children	19	4.6	22	5.4	28	6.8	15	3.6	26	6.2	13	3.1
	3 children	60	14.4	58	14.1	74	17.9	64	15.5	65	15.6	67	16.0
	4 children	105	25.2	124	30.2	93	22.5	93	22.5	122	29.3	89	21.2
	5 children	93	22.4	89	21.7	95	23.0	113	27.4	99	23.7	100	23.8
	6 children	63	15.1	74	18.0	66	16.0	82	19.9	65	15.6	88	21.0
	6 and above	56	13.5	21	5.1	32	7.7	24	5.8	27	6.5	33	7.9
	Total	**416**	**100**	**411**	**100**	**413**	**100**	**413**	**100**	**417**	**100**	**420**	**100**
Education Level	No education	33	7.9	12	2.9	25	6.1	16	3.9	27	6.5	8	1.9
	Primary level	141	33.9	86	20.9	127	30.8	108	26.2	102	24.5	124	29.5
	Secondary level	149	35.8	228	55.5	167	40.4	187	45.3	208	49.9	167	39.8
	College/University	93	22.4	85	20.7	94	22.8	102	24.7	80	19.2	121	28.8
	Total	**416**	**100**	**411**	**100**	**413**	**100**	**413**	**100**	**417**	**100**	**420**	**100**
Occupation	Not working	8	1.9	10	2.4	13	3.1	15	3.6	34	8.2	15	3.6
	Peasant Farmer	206	49.5	233	56.7	225	54.5	247	59.8	226	54.2	230	54.8
	Business	105	25.2	117	28.5	91	22.0	92	22.3	99	23.7	108	25.7
	employment	97	23.3	51	12.4	84	20.3	59	14.3	58	13.9	67	16.0
	Total	**416**	**100**	**411**	**100**	**413**	**100**	**413**	**100**	**417**	**100**	**420**	**100**
Marital Status	Single	21	5.0	31	7.5	30	7.3	44	10.7	40	9.6	34	8.1
	Married	306	73.6	350	85.2	299	72.4	328	79.4	311	74.6	337	80.2
	Windowed	24	5.8	12	2.9	16	3.9	15	3.6	18	4.3	18	4.3
	Separated/ Divorced	65	15.6	18	4.4	68	16.5	26	6.3	48	11.5	31	7.4
	Total	**416**	**100**	**411**	**100**	**413**	**100**	**413**	**100**	**417**	**100**	**420**	**100**
Monthly Income	≤2500	118	28.4	219	53.3	153	37.0	221	53.5	161	38.6	242	57.6
	2501 - 5000	129	31.0	109	26.5	122	29.5	94	22.8	133	31.9	86	20.5
	5001 - 7500	45	10.8	32	7.8	53	12.8	29	7.0	47	11.3	22	5.2
	7501 - 10000	66	15.9	12	2.9	14	3.4	18	4.4	15	3.6	19	4.5
	> 10000	58	13.9	39	9.5	71	17.2	51	12.3	61	14.6	51	12.1
	Total	**416**	**100**	**411**	**100**	**413**	**100**	**413**	**100**	**417**	**100**	**420**	**100**

Table 2. ANC Coverage in intervention and Control sites

Study sites		Women who sought ANC services for ≥ 4 times		Women who sought ANC services for < 4 times	
		Freq.	%	Freq.	%
Intervention	Baseline	162	**38.9**	238	57.2
	Midterm (9 months)	200	**48.4**	204	49.4
	End term (18 months)	246	**59.0**	158	37.9
Control	Baseline	143	**34.8**	249	60.6
	Midterm (9 months)	120	**29.1**	279	67.6
	End term (18 months)	163	**38.8**	239	56.9

Table 3. Z score test for difference in Proportions of ANC coverage.

Site	Baseline	Mid-term	End term	Mid-Term *Vs.* Baseline	End-term *Vs* Baseline
Intervention	162/416	200/413	246/417	**Z=2.7528, P=0.00596***	**Z= 5.7881, p=0.0001***
Control	143/411	120/413	163/420	**Z=-1.7665, P=0.07672**	**Z=1.2002, p=0.23014**
Z score	**1.2365**	**5.7139**	**5.8407**		
P value	**0.21498.**	**0.0001***	**0.0001***		

Table 4. Odds Ratios of ANC Coverage

			Sig	OR	95%CI
Intervention site	Midterm vs Baseline	Crude OR	**0.006***	**1.472**	1.117-1.940
		Adj. OR	**0.008***	**1.512**	1.112-2.057
	End term Vs Baseline	Crude OR	**0.0001***	**1.502**	1.307-1.725
		Adj. OR	**0.0001***	**1.717**	1.464-2.014
Control Site	Midterm vs Baseline	Crude OR	0.078	0.768	0.572-1.030
		Adj. OR	0.052	0.723	0.521-1.002
	End term Vs Baseline	Crude OR	0.216	1.095	0.948-1.264
		Adj. OR	0.535	1.050	0.899-1.227

We first compared difference in proportions across intervention and control sites from baseline to end term survey. As shown in Table 3, initial comparability at baseline showed no significance difference in the proportions of FANC coverage between intervention and control site (Z=1.2365, p>0.05). A comparison between intervention and control at midterm and end term surveys indicated that the proportions of FANC coverage (48.4% and 29.4% at midterm and 59% and 38.8% at end term) were significantly different (Z=5.713, P<0.05) and (Z=5.8407, P<0.05) respectively. Again, as shown in Table 3, we compared the difference in proportions of FANC coverage along each site based on the time series surveys) (baseline, midterm and end term). At the intervention site, the proportion of FANC coverage at baseline (38.9%) was found to be significantly different compared to the proportion of FANC coverage at midterm (48.4%) (Z=2.7528, P<005). The proportion of FANC coverage at baseline (38.9%) was also found to be significantly different compared to proportion of FANC coverage at end term (59. %) (Z= 5.7881, P<0.05). In the control site, it was observed that the proportion of FANC coverage at baseline (34.8) was not different from the proportion of FANC coverage at midterm survey (29.1) (Z=1.7665, P<0.05) and that the proportion of FANC coverage at baseline (34.8) was also not different from the proportion of FANC coverage at end term survey (38.8) (Z=. Z=1.2002, P<0.05). These results are summarized in Table 3.

3.4. Odds of women seeking ANC services for at least 4 visits in intervention and control sites

We established the odds of ANC service utilization (for at least 4 visits) among expectant women within the intervention site and within the control sites based on the time series surveys. In the intervention site, expectant women in the midterm were found to be 1.5 times more likely to seek ANC services from skilled attendants for at least 4 visits compared to these at baseline [(Crude OR: 1.472, 95%CI:1.117-1.940, P<0.01) (*Adj*. OR 1.512,95%CI: 1.112-2.057, P<0.01)]. A comparison between end term survey and baseline survey established

that women at the end term survey were 1.7 times more likely to seek ANC services for at least 4 visits compared to women at baseline [(Crude OR: 1.502, 95%CI: 1.307-1.725, P<0.0001) (*Adj.* OR 1.717,95%CI: 1.464-2.014, P<0.0001)].

In the control site, we observed no significant difference in the odds of FANC service utilization among expectant women between midterm and baseline surveys [(Crude OR: 0.768, 95%CI: 0.521-1.030, P>0.05) (Adj.OR:0.723,95%CI: 0.521-1.002, P> 0.05)]. We also did not observe any significant difference in the odds of FANC service utilization among expectant women between end term survey and baseline survey [(Crude OR: 1.095, 95%CI: 0.948-1.264, P>0.05) (Adj. OR: 1.050,95%CI: 0.899-1.227, P> 0.05)]. These results are summarized in Table 4.

4. Discussion

4.1. ANC Coverage in Mwingi West and Mwingi North Sub-counties

As indicated in results section, proportion of women who sought ANC services for ≥ 1 visit in the intervention site was 96.1%, 97.8% and 96.9% at baseline, midterm and end term surveys respectively. In the control site, proportion of women who sought ANC services for ≥ 1 times was 95.4%, 96.6% and 95.7% at baseline, midterm and end term surveys respectively. These proportions are within range compared to the KDHS 2014 indicator survey which posts ANC coverage (≥ 1 visit) as 97.5% in Kutui County [3] and slightly high compared to the 2008/2009 KDHS which posts ANC coverage (≥ 1 visit) for Eastern Kenya (where current Kitui county is located) at 93.4% [17]. The slight increment, in this category of ANC coverage (≥ 1 visit) (though not tested to establish if it was significant or not) could probably be attributed to the efforts done by the government of Kenya in the process of trying to meet the Millennium Development Goals (MDGs) which were due in 2015.

In regard to FANC coverage (≥4 ANC visits) at baseline, FANC coverage was at 38.9% and 34.9% in intervention and control sites respectively. Z score test

revealed that the two proportions were not significantly different. This could be interpreted to mean the two sites were homogenous in regard to FANC at baseline. A comparison of observed FANC coverage with the 2008/2009 FANC coverage (44%) [17] indicates that the observed FANC coverage was slightly lower in the intervention and control sites compared to FANC coverage of 2008/2009 KDHS. Two things could explain this variation; one, data for baseline survey in this study was collected 3 years after the 2008/2009 survey and perhaps no intervention had been implemented in Mwingi west sub-county to help improve FANC coverage in the region, and two, Mwingi west sub-county is not only a rural area, but also a semi-arid area which is food insecure and where majority of people live in abject poverty [18]. Challenges associated with these conditions could have led to a reduction in the number of women adhering to the WHO recommended number of ANC visits (≥4 ANC visits). Comparison of the observed FANC coverage with the 2014 KDHS (62.2%) [3] indicates that FANC coverage for Kitui county far much higher than observed FANC coverage in both intervention and control sites. Though FANC coverage for Kitui county is high as reported by KDHS 2014 is 62.2% [3], the report further states that socio demographic characteristics influenced significantly influence FANC coverage in Kenya [3]. The report indicates only 44 % of women in the lower wealth quantile sought ANC services for at least 4 times [3]. Socio demographic characteristics in Table 1 indicates that majority of women in Mwingi west sub county (over 50%) are poor. This could be the reason for the observed low FANC coverage in intervention and control site compared to the 2014KDHS FANC coverage.

4.2. Effect of CHS Intervention on FANC Coverage

In the intervention site, data reveals a sharp increase in the proportion of women seeking ANC coverage for at least 4 times from baseline to midterm survey (38.9% to 48.4%), and from baseline to end-term evaluation survey) (38.9% to 59%). While in the control site, a minimal reduction in the proportion of women seeking ANC services for at least 4 times was observed between base line and midterm surveys (34.8% to 29.1%) and a minimal increase was also observed between baseline survey and end term survey (34.8% to 38.8%). After subjecting the differences in the proportions of FANC coverage into a test to establish if they were significantly different from each other, Z score tests in the intervention site indicated that, baseline FANC coverage (38.9%) was different from midterm FANC coverage (48.4%) and that baseline FANC coverage (38.9%) was also different from end term FANC coverage (59%). In the control site, Z score tests for proportions in the control site revealed that ANC coverage at baseline (34.8%) was not different from ANC coverage at midterm (29.1%) and ANC coverage at end term (38.8%). This can only point out to one thing; that the intervention was effective in increasing FANC coverage in the intervention site by 9.5% (48.4%-38.9%) between baseline and midturn surveys and by 20.1% (59%-38.9%) between baseline and end term surveys. This is further confirmed by a binary logistic regression

analysis which controlled for sociodemographic characteristics as potential confounders. Binary logistic regression model indicates that in the intervention site, women in the at midterm survey were 1.5 times more likely to seek ANC services for at least 4 times compared to women at baseline survey (*Adj.* OR 1.512,95% CI: 1.112-2.057, P<0.01)]. At the same site (intervention), women at the end term survey were 1.7 times more likely to seek ANC services for at least 4 times compared to baseline (*Adj.* OR 1.717,95%CI: 1.464-2.014, P<0.0001)]. In the control site, no significant difference was observed in both the proportions of FANC coverage and the odds of women seeking ANC services for at least 4 times between baseline and midterm and baseline and end term. This further strengthens our observation that the observed increment of FANC coverage, and the observed odds of FANC service utilization in the intervention site could only be associated with the intervention.

These findings have been corroborated by other studies. In Kenya, a study conducted in Busia Kenya indicates that CHS increased FANC coverage in Busia-Kenya from 39% to 62 % [15]. Another study conducted in parts of Nyanza, Western Kenya and Garissa also revealed that CHS increased FANC coverage significantly [20]. In other parts of the world, a review of 77 studies from low and middle income countries associated community interventions with marginal improvements in ANC coverage (at least four visits) [12,13]. Studies conducted in Bangladesh and Nepal on effectiveness of CHW led interventions on MCH have also been associated with increase in FANC coverage [10,11].

5. Conclusion

The CHS intervention had a positive effect on FANC coverage in Mwingi west sub county. CHS significantly increased FANC coverage by 9.5% (Z=2.7528, P<005) within six months after implementation of the intervention, and by 20.1% (Z= 5.7881, P<0.05) within 18 months of implementation. In Mwingi west sub county FANC coverage significantly increased to 59% from 38.9% (Z=5.7881, P<0.05). Within 18 months of implementation, the CHS increased the odds of women seeking ANC services for at least 4 visits by 1.7 times (95%CI: 1.464-2.014, P<0.0001) in intervention site compared to control site.

6. Recommendation

To improve MCH outcomes and meet Kenya's vision 2030 and the global Sustainable Development Goals (SDGs) on health, the government of Kenya should support implementation of CHS and other CHW led interventions in the country.

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Competing Interests

The authors hereby declare that there was no competing interest in this study.

List of Abbreviations

ANC: Antenatal Care
CHW: Community Health Worker
CI: Confidence Interval
CHS: Community Health Strategy
FANC: Focused Antenatal Care
GoK: Government of Kenya
KDHS: Kenya Demographic and Health Survey
MCH: Maternal and Child Health
MDGs: Millennium Development Goals
NCST: National Council of Science and Technology
OR: Odds Ratio
WHO: World health Organization.

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