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Factors Influencing Place of Delivery in Kenya: A Multilevel Analysis.

Research Report in Mathematics, Number ..., 2018

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August 2018

Submitted to the School of Mathematics in partial fulfilment for a degree in Master of Science in Social Statistics

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Master of Science Project
Submitted to the School of Mathematics in partial fulfilment for a degree in Master of Science in Social Statistics

Prepared for The Director
Graduate School
University of Nairobi

Monitored by School of Mathematics

Abstract

Background: Maternal mortality in Kenya increased from 380/100000 live births to 530/100000 live births between 1990 and 2008. Skilled assistance during childbirth is central to reducing maternal mortality yet the proportion of deliveries taking place in health facilities where such assistance can reliably be provided has remained below 50% since the early 1990s. We use the 2014 Kenya Demographic and Health Survey data to describe the factors that determine where women deliver in Kenya and to explore reasons given for home delivery.

Methods: Data from the 2014 Kenya demographic and health survey was used to find out the factors associated with the place of delivery among women who had a live birth during five years preceding the survey. Owing to the fact that the data's structure is nested, multilevel logistic regression analysis has been employed to a nationally representative sample of 20354 women who are nested within 1612 communities.

Results: The outcome showed that woman's level of education, place of residence, wealth index, birth order number, distance to the health facility, and antenatal care visits were significantly associated with place of delivery. The random effects depicted that the variation in institutional delivery service utilization between communities was significant statistically.

Conclusion: In this study it was found out that factors like place of residence, mother's educational level, wealth index, distance to health facility, and number of antenatal care visits (ANC) were found to be having significant influence on place of delivery. It was also established that both community and household levels random intercepts (variances) were large and statistically significant indicating differences that are considerable between communities and between households in the tendency of women's use of health institutions for delivery services. It was also found out that there was existence of unobserved significant variability between communities and between households further to the influence of the measured predictors or rather factors.

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Declaration and Approval

I the undersigned declare that this project report is my original work and to the best of my knowledge, it has not been submitted in support of an award of a degree in any other university or institution of learning.

Signature Date

DAVID MUTISO MUTINDA
Reg No. I56/872233/2016

In my capacity as a supervisor of the candidate, I certify that this report has my approval for submission.

Signature Date

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Dedication

This project is dedicated to my Father; Mr.Jackson Mumina Mutinda, My Mother; Mrs. Rosemary Mumbua Mutinda and to my siblings; Joseph Mumina Mutinda, Florence Mukeli Mutinda, Maureen Katunge Mutinda and Dennis Syondau Mutinda.

Most importantly I dedicate this project to the Almighty God for always guiding and strengthening me.

Contents

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Firstly, I give thanks to Almighty God for his protection and strength to complete this research project.

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Lastly, I also would like to acknowledge my SST discussion group whom have been instrumental in making me understand more concepts in Multilevel analysis ....

David Mutiso Mutinda

Nairobi, 2018.

1 Introduction

1.1 Background

About one thousand women die every day world wide from issues relating to pregnancy, 99% of them reside in developing nations and more than fifty percent come from the Sub-saharan Africa Organization et al. (2010) with majority of deaths occurring during time of giving birth. Approximately 2.63 million still births did occurred during year 2008 Lawn et al. (2011) while three million new-births don't get to live through their first month of life in entire world yearly Neonatal (2006). An accessible care that's proper in event of problems, that may occur inside the twenty four hour period after giving birth are vital plans that may assist the positive outcome of prenatal care for both the child and the mother cite Filippi et al.2006 Koblinsky et al. (2006) Adegoke and Van Den Broek (2009). A major approach towards trying to reduce number of mothers and new born mortality rate is through a care sytem refferered to as intrapertum health center care plan that involves trained healthcare personnel managing labor and complications in an effective manner coupled with the support of referral systems that are effective when specialized care is called in for in addition to a postnatal care package that is also effectiveFilippi et al. (2006) Koblinsky et al. (2006) Adegoke and Van Den Broek (2009) Gabrysch and Campbell (2009).

A notable proportion of women in nations that are developing, still deliver at home with the absense of skilled healthcare practitionersMontagu et al. (2011). In contexts that are diverse, individual circumstances such as a persons marital status, maternal age, status and education, household factors with the inclusion of household wealth, size of the family and communal factors with inclusion of communal health, region, infrastructure, economic and social status or rather socioeconomic status, health facilities' availability, urban or rural residence, and proximity to health centres do dictate the where the mother will deliver and these circumstances interrelate in different ways in every sorrounding to influence the venue where the child birth takes place Stephenson et al. (2006) Say and Raine (2007) Gabrysch et al. (2011). Eijk et al. investigated antepartum care and childbirth care amongst ladies in the west side of Kenya and did demonstrate that old age in women, poverty, low education levels, high parity coupled with long walking distanceof more than an hour to the healthcare facility were related were related to delivery outside an health care facility Van Eijk et al. (2006). Researching on urban dwellers who are poor residing in Nairobi, Fosto et al.using the bivariare analysis established that the residential place, status , wealth and education were related with the venue of delivery Fotso et al. (2009). Ochako has before indicated that these factors along with the mothers age when giving birth to the lastborn and lastly marital status did determine the utilization and the time the mother will go for the first Antenatal Care (ANC) visit and the type of childbirth Ochako et al. (2011). The reasons as to why women opt to give birth at home vary between and within nations Montagu et al. (2011) Mrisho et al. (2007) Osubor et al. (2006) Sobel et al. (2010)

1.2 Statement of Problems

Despite the fact that Kenya has a working public health care system we still have a high number of mothers who deliver at non-facility based institutions instead of going to facility based institutions such as the hospital, therefore our intention is to use the Kenya Demographic and Health Survey (KDHS)2014 statistics to establish predictors of place of delivery.

Most of the analysis that have been done prior have not considered the inclusion of the random effects. Inclusion of the random effects is vital because it helps in producing unbiased estimates.

1.3 Overall Objective

Our overall objective is to identify the predictors that affect the delivery venue for Kenyan mothers using the Kenya Demographic and Health Survey (KDHS)2014 data set.

1.4 Specific Objectives

- To model the predictors for the place of delivery for mothers.
- To do effect of multi-level model on the predictors of the place of delivery both at household and community level clusters.

2 Literature Review

2.0.1 Factors influencing place of delivery for women

Froma research carried out in Ethiopia on analysis of different community and individual level factors associated with childbirth at healt institutions using EDHS data, it was found out that women with an educational level that is high, women from richest households, increased antenatal care attendance, urban residence, living in areas with a high percentage of literate women and in areas with high antenatal care usage rate had a significant influence on delivery at institutions . The apparent effects depicted that the difference results in communities aand giving birth at health institutions was important. This study employed the use of multilevel logistic regression model Mekonnen et al. (2015).

Yebyo et al. (2015) conducted a study on why some women choose home delivery? Multilevel modeling of Ethiopian National Demographic and Health Survey Data (ENDHS). It was found out that minimum education,not undertaking antenatal care visits required , non-exposure to media, high parity and view that the health facilities were far affected delivery. Approximately, seventy five percent of the total difference in giving birth at home in different communities coincided with the different characteristics of the community.With regards to community level tendencies of rural communities, pastoral communities, areas with high poverty levels , low antenatal care utilization levels , the challenge of proximity to a health institution positively made an impact on the decision to deliver at home, this study used the regression model that affects two levels. From a research carried out on autonomy of women and heathcare usage using logistic regression models it was found out that women residing in areas with a higher proportion of viewpoint towards wife battery were the most likely to take advantage of the different types of martenal care and the rate of women amongst the community and had a high power of making their own decisions resulted in a more likelihoood that they would go for more than four antenatal care visits. The association of individual autonomy levels on health care utilization of martenal delivery it was less prominent afterthe control of both individual and community levels characteristics. Tiruneh et al. (2017)

3 Methodology

3.1 Data

Kenya Demographic and Health Surveys 2014 data has been pitched from a master sampling frame, fifth National Sample Survey, and Evaluation program (NASSEPV), this survey is a household-based study with a nationwide narrative , whereby the interviewer administered through the use questionnaires to obtain a comprehensive set of health ,demographic information and putting an emphasis on maternal health and child mortality rate. A sampling approach divided into two stages was utilized to sample 40,300 households that was composed of 1612 community clusters and a total of 20354 women aged between 15-49 years were interviewed. In this research, we have included women that had given birth preceding the five years in which the survey was conducted.

The explanatory inconsistencies used in this study were selected based on literature Mekonnen et al. (2015) Yebyo et al. (2015)

3.2 Study variables

3.2.1 Response variable

The main variable in this research was whether a woman who has delivered at home or at a health facility It is a binary (dichotomous) variable.

3.2.2 Explanatory variables

The independent variables (selected based on literature)

3.3 Logistic Regression

It is a Statistical method utilized in modeling a categorical independent variable. It is used for analyzing information in which one or more variables determine an expected outcome.

3.4 Binomial-logistic Regression

It is regarded as logistic regression and is applied when predicting the chances of an action falling into one or two sets of a dichotomous or rather binary variable that depend on one ore more variables that are independent in which they can be either categorical or continuous.

3.4.1 Model

Lets consider a variable that is random in nature and can be able to take one outcome out of the two outcomes that are possible. In the information in which we already have a a sum of the whole test M and in which every every study has an individualistic nature, Z can be the support vector of M which has variables which are random and binomial to Z. By accord, a value of 1 shows excellence and and a value of either 0 or 2 means it is a fail.In simple terms in order to easily compute details of the estimation, it is better to do an full sum of the data .Each of the column showing a computation defined by values of the variables that are independent. The rows can be cited as populations. Now let us take the upper case N to stand for the sum number of populations the the lower case n to be taken as a column vector with the constituents n1 standing for the examination number in the inhabitants i for i = 1 to N therefore,

$$\sum_{i=}^{N} n_i = M, totalsamplesize$$

Upper case Y will become the pillar vector of span N where every component Y_i is a random variable in nature and shows the number of successes Z for inhabitants i. The column y hold part $y_i$showing the count of the number observed of positive outcome for every community. π will be the support vector of length N having components $[\pi_i = P(Z_i = 1|giveni)]$, implying success probability for whichever surveillance in the i^{th} population.

Linear element of the model has matrix blueprint and parameters of the vector that are to be approximated. The matrix plan of the volatile, X, composes of $K+1$ number of columns and N number of rows, whereby K does represent number of explanatory variables that are laid out in the model. For matrix column , the initial component x_{i0} is equivalent to 1. Which is also the intercept also α. The variable vector, β, is regarded as vector column of $K+1$. There's one boundary or vector matched to every of the K rows of explanatory variable in X, $+1$. β_0, for stands for the intercept. The model of regression logistics sums the transformation logic,the chances that the linear component being successful against the log odds.

$$log(\frac{(\pi_i)}{(1-\pi_i)}) = \sum_{k=0}^{K} x_{ik}\beta_k \tag{1}$$

whereby i=1,2,3,4,...,N

3.4.2 Estimation of parameter

Main objective of one performing logistic regression is being able to approximate $K+1$ framework which are unknown and β in $equation 1$. The above is performed with the maximum likely hood estimation that requires getting the set of variables in which the likelihood of the information that is observed is greatest. The optimum possibility of the equation can be obtained from the probable distribution of the responding parameter or variable. Because every y_i constitutes a count that is binomial in the i^{th} population, joint probability density function (pdf) of Y is given by;

$$f(y|\beta) = \prod_{i=1}^{N} \frac{n_i!}{y_i!(n_i - y_i)!} \pi_i^{y_i} (1-\pi_i)^{n_i - y_i} \tag{2}$$

In every population, there exists $\binom{n_i}{y_i}$ various methods of arranging y_i successes from amid n_i trials. Because the probability of a success for any one of the n_i trials is π_i, the probability of y_i successes is $\pi_i^{y_i}$. Also, the probability of $n_y - y_i$ failures is $(1-\pi_i)^{n_i - y_i}$.

The Joint probability density function in $equation 2$ does express y values as a function of known, β fixed values. (It is important to note that β is associated with π in reference to $equation 1$) The likely hood function has a similar format as that of pdf, apart from fact that the parameters of likely hood function have been arranged in a backward manner: likely hood function manifests $\beta's$ in terms of values of y that are known and also fixed . Therefore,

$$L(\beta|y) = \prod_{i=1}^{N} \frac{n_i!}{y_i!(n_i - y_i)!} \pi_i^{y_i} (1-\pi_i)^{n_i - y_i} \tag{3}$$

Estimates of peak likely hood are the figures for β that maximizes the likely hood function in $equation 3$. Maxima and minima which are the critical points of a function are gotten when the derivative that is the first one is equated to 0. If the second initiative is found at that instance to be less than 0, then the maximum becomes the critical point. Therefore, to compute the estimates of the maximum likelihood we need to find the $1st$ and $2nd$ derivatives of the likely hood function. If we attempt to do the $1st$ of $equation 3$ with respect to β it is a tiresome job ,because of the complex nature of the multiplicative terms. We thus need to simplify the likelihood equation.

One thing to note is that terms that are factorial do not have any of the π_i and because of this they are necessary constants which can be overlooked: maximization of the sum without terms that are factorial in nature would still lead to the similar results as if they were taken into consideration. Another thing to observe is that because $a^{x-y} = a^x/a^y$, after rearranging the equation terms to be at peak can be expressed as

$$L(\beta|y) = \prod_{i=1}^{N} (\frac{\pi_i}{1-\pi_i})^{y_i} (1-\pi_i)^{n_i} \tag{4}$$

After we take e to both sides of the $Equation\ 1$

$$(\frac{\pi_i}{1-\pi_i}) = e^{\sum_{k=0}^{K} x_{ik}\beta_k} \quad \textbf{(5)}$$

of which, after solving for π_i becomes,

$$\pi_i = (\frac{e^{\sum_{k=0}^{K} x_{ik}\beta_k}}{1+e^{\sum_{k=0}^{k} x_{ik}\beta_k}}) \quad \textbf{(6)}$$

Substituting $Equation 5$ for initial term while $Equation 6$ for second term, then $Equation 4$ then becomes:

$$L(\beta|y) = \prod_{i=1}^{N} (e^{\sum_{k=0}^{K} x_{ik}\beta_k})^{y_i} (1 - \frac{e^{\sum_{k=0}^{K} x_{ik}\beta_k}}{1+e^{\sum_{k=0}^{K} x_{ik}\beta_k}})^{n_i} \quad \textbf{(7)}$$

Using $(a^x)^y = a^{xy}$ will simplify the first product and replace the value 1 with $\frac{1+e^{\sum \alpha\beta}}{1+e^{\sum \alpha\beta}}$ to make the second product simpler. $Equation 7$ can now be written down as:

$$L(\beta|y) = \prod_{i=1}^{N} (e^{y_i \sum_{k=0}^{K} x_{ik}\beta_k})(1+e^{\sum_{k=0}^{K} x_{ik}\beta_k})^{-n_i} \quad \textbf{(8)}$$

This is thus the essence of the likelihood function for maximizing. However, it still remains tedious to distinguish and thus can be made easier when we do take it's log. Because log is a job that is monotonic, any maximum of the possible function will also be of the log functioning to maximum and vice versa. Therefore, taking log for $Equation 8$ gives log likelihood function.

$$l(\beta) = \sum_{i=1}^{N} y_i (\sum_{k=0}^{K} x_{ik}\beta_k) - n_i . log(1+e^{\sum_{k=0}^{K} x_{ik}\beta_k}) \quad \textbf{(9)}$$

Getting critical facts of log chances of functioning , put up the derivative with respect to every β equal to 0. When performing differentiation in $Equation 9$, note that

$$\frac{\partial}{\partial \beta_k} \sum_{k=0}^{K} x_{ik}\beta_k = \sum_{k=0}^{K} x_{ik} \quad \textbf{(10)}$$

Owing to the fact that other terms that are in the addition part one cannot rely on β_k and can therefore be taken to be as constants. Differentiating the $second half$ of $Equation 9$, it should be taken into account that the general rule $\frac{\partial}{\partial_x} log y = \frac{1}{y}\frac{\partial_y}{\partial_x}$. Hence, differentiating $Equation 9$ with respect to every β_k, we have;

$$
\begin{aligned}
\frac{\partial l(\beta)}{\partial \beta_k} &= \sum_{i=0}^{N} y_i x_{ik} - n_i . \frac{1}{1+e^{\sum_{k=0}^{K} x_{ik}\beta_k}} . \frac{\partial}{\partial \beta_k}(1+e^{\sum_{k=0}^{K} x_{ik}\beta_k}) \\
&= \sum_{i=0}^{N} y_i x_{ik} - n_i . \frac{1}{1+e^{\sum_{k=0}^{K} x_{ik}\beta_k}} . e^{\sum_{k=0}^{K} x_i k \beta_k} . \frac{\partial}{\partial \beta_k} \sum_{k=0}^{K} x_i k \beta_k \\
&= \sum_{i=0}^{N} y_i x_{ik} - n_i . \frac{1}{1+e^{\sum_{k=0}^{K} x_{ik}\beta_k}} . e^{\sum_{k=0}^{K} x_i k \beta_k} . x_i k \\
&= \sum_{i=0}^{N} y_i x_{ik} - n_i \pi_i x_{ik}
\end{aligned}
\tag{11}
$$

Maximum likelihood estimates for β can be gotten through mounting every $K+1$ equations in $Equation 11$ to be equal to 0 and finding the solutions of each β_k. Every such solution, if there's any that exists, does specify a point which is regarded as "critical"–either maximum or minimum. We will have critical point will as maximum if matrix of second partial derivatives is negative definite; this is to mean, if each element along diagonal of the matrix is < 0. Another property of this matrix that is useful is that it forms the variance-co variance matrix of the estimates of the parameter. It's formed through distinguishing every of $K+1$ sum in $Equation 11$ a second time with respect to each element of β shown by β_k'. Matrix of next derivative that are in part takes the general form Czepiel (2002).

$$
\begin{aligned}
\frac{\partial^2 l(\beta)}{\partial \beta_k \partial \beta_k'} &= \frac{\partial}{\partial \beta_{k'}} \sum_{i=1}^{N} y_i x_{ik} - n_i x_{ik} \pi_i \\
&= \frac{\partial}{\partial \beta_k'} \sum_{i=1}^{N} -n_i x_{ik} \pi_i \\
&= -\sum_{i=1}^{N} n_i x_{ik} \frac{\partial}{\partial \beta_{k'}} \left(\frac{e^{\sum_{k=0}^{K} x_{ik}\beta_k}}{1+e^{\sum_{k=0}^{K} x_{ik}\beta_k}} \right)
\end{aligned}
\tag{12}
$$

To find the solution to $Equation 12$ we utilize 2 differentiation general rules. $1st$, a rule for the differentiation of exponential functions:

$$
\frac{d}{dx} e^{u(x)} = e^{u(x)} . \frac{d}{dx} u(x) \tag{13}
$$

In this case, let $u(x) = \sum_{k=0}^{K} x_{ik}\beta_k$. $2nd$ quotient rule for the differentiation of 2 functions:

$$
\left(\frac{f}{g}\right)'(a) = \frac{g(a).f'(a) - f(a).g'(a)}{[g(a)]^2} \tag{14}
$$

The application of these two rules gives us the chance to solve for $Equation 12$.

$$\begin{aligned}\frac{d}{dx}\frac{e^{u(x)}}{1+e^{u(x)}} &= \frac{(1+e^{u(x)}).e^{u(x)}\frac{d}{dx}u(x) - e^{u(x)}e^{u(x)}\frac{d}{dx}u(x)}{(1+e^{u(x)})^2} \\ &= \frac{e^{u(x)}\frac{d}{dx}u(x)}{(1+e^{u(x)})^2} \\ &= \frac{e^{u(x)}}{1+e^{u(x)}}.\frac{1}{1+e^{u(x)}}.\frac{d}{dx}u(x)\end{aligned} \tag{15}$$

Therefore, $Equation 12$ can be written as:

$$\frac{\partial^2 l(\beta)}{\partial\beta_k\partial\beta_k'} = -\sum_{i-1}^{N} n_i x_{ik}\pi_i(1-\pi_i)x_{ik'} \tag{16}$$

3.5 Adjusting for cluster effect

One way to adjust for cluster effect (u_j) is to introduce it as a variable in the model. This cluster effect (u_j) is introduced to the model as a commonly disseminated random variable with an average of zero and a constant variance. This is given by the model:

$$logit(\frac{p_{ij}}{1-p_{ij}}) = \alpha + \beta_i^A + u_j$$

where, $u_j \sim N(0, \sigma_u^2)$. This is a generalized linear mixed model where A is a fixed effect and u is a random effect.

3.6 Intraclass Correlation Coefficient (ICC)

Since we are also doing multi-level there is need for us to compute intra-class correlation coefficient ρ, for each model with cluster term. The Intraclass Correlation Coefficient (ICC) refers to the part of variance in the response variable that is set out by the structured grouping of the model in a hierarchical manner. It is computed as a ratio of error variance in the group level over the total error variance.

$$\rho = \frac{\sigma_{u_o}^2}{\sigma_{u_o}^2 + \sigma_e^2}$$

Whereby $\sigma_{u_o}^2$ represents the variance of the intercept (level-2 residuals) and σ_e^2 represents the variance of the residual (level-2 residual). This is to say, the intraclass correlation coefficient (ICC) reports on the amount of variability unexplained by any explanatory variables in the model that can be accredited to the grouping/cluster variable, as compared to the overall unexplained variance.

4 Results

Table 1. Bivariate analysis of institutional delivery for every factor level, KDHS-2014

	Place of Delivery		
Predictors	Non-facility	Facility Based	Total
Age groups			
15-19	398(37.94 %)	651(62.06%)	Total 1,049(100%)
20-24	2,090(42.18%)	2,865(57.82%)	Total 4,955 (100%)
25-29	2,842(44.65%)	3,523(55.35%)	Total 6,365(100%)
30-34	1,967(47.30%)	2,192(52.70%)	Total 4,159(100%)
35-39	1,424 (51.46%)	1,343(48.54 %)	Total 2,767(100%)
40-44	674(55.25%)	546(44.75 %)	Total 1,220(100%)
45-49	220(65.67 %)	115(34.33 %)	Total 335 (100%)
Region			
Coast	1,323(50.25%)	1,310(49.75%)	Total 2,633(100%)
North Eastern	1,024(64.97%)	552(35.03%)	Total 1,576(100%)
Eastern	1,380(45.91%)	1,626(54.09 %)	Total 3,006(100%)
Central	158(11.15%)	1,259(88.85%)	Total 1,417(100%)
Rift valley	3,712(54.45%)	3,105(45.55%)	Total 6,817(100%)
Western	980(49.75%)	990(50.25 %)	Total 1,970(100%)
Nyanza	977(33.69%)	1,923(66.31%)	Total 2,900(100%)
Nairobi	61(11.49%)	470(88.51%)	Total 531(100%)
Residence			
Urban	1,676 (24.64%)	5,126(75.36 %)	Total 6,802(100%)
Rural	7,939(56.51 %)	6,109 (43.49 %)	Total 14,048(100%)
Edu Attainment			
No Education	3,545(77.91%)	1,005(22.09%)	Total 4,550(100%)
Primary	5,145(46.77%)	5,856(53.23 %)	Total 11,001(100%)
Secondary	843(21.16%)	3,141 (78.84 %)	Total 3,984 (100%)
Higher	82(6.24%)	1,233(93.76%)	Total 1,315(100%)

Table 2. Bivariate analysis of institutional delivery for every factor level, KDHS-2014

	Place of Delivery		
Predictors	Non-facility	Facility Based	Total
Sex of H.Head			
Male	6,655 (45.50%)	7,972(54.50 %)	Total 14,627(100%)
Female	2,960(47.57%)	3,263(52.43 %)	Total 6,223 (100%)
Wealth Index			
Poor	7,441(64.97%)	4,012(35.03 %)	Total 11,453(100%)
Middle	1,278(36.73%)	2,201(63.27 %)	Total 3,479 (100%)
Rich	896(15.14%)	5,022 (84.86 %)	Total 5,918 (100%)
Distance from facility			
Big problem	1,974(62.08 %)	1,206(37.92 %)	Total 3,180 (100%)
not a big problem	2,679(38.98%)	4,193(61.02 %)	Total 6,872 (100%)
Marital Status			
Single	407(31.40 %)	889(68.60%)	Total 1,296 (100%)
Married	8,315(47.05 %)	9,357 (52.95%)	Total 17,672 (100%)
Widowed	301(60.93%)	193 (39.07%)	Total 494(100%)
Divorced	592(42.65%)	796 (57.35 %)	Total 1,388(100%)
Partner's edu			
no edu	1,402(81.32%)	322(18.68 %)	Total 1,724 (100%)
Primary	2,214(48.95%)	2,309(51.05%)	Total 4,523(100%)
Secondary	665(29.58%)	1,583 (70.42%)	Total 2,248(100%)
Higher	131(15.67%)	705(84.33%)	Total 836(100%)
don't know	30(42.86%)	40 (57.14%)	Total 70(100%)
No. of ANC visits			
no visit	815(89.17%)	99(10.83 %)	Total 914 (100%)
1-10 visits	5,352(38.42%)	8,578(61.58%)	Total 13,930(100%)
11/20 visits	2 (8.00%)	23 (92.00%)	Total 25(100%)
Don't know	14(29.79%)	33(70.21%)	Total 47(100%)

Table 3. Multilevel logistic regression analysis of predictive factors associated with institutional delivery

	Model I		Model II		Model III		Model IV		Model V	
Parameters	Coef	P-value	Coef	P-value	Coef	P-value	Coef	P-value	Coef	P-value
Intercept	0.633	0.000	0.608	0.000	-3.000	0.000	-3.550	0.000	0.0485	0.000
Age groups										
15-19	Ref		Ref		Ref		Ref		Ref	
20-24					0.008	0.965	0.008	0.969	0.014	0.933
25-29					0.012	0.911	0.052	0.790	0.056	0.730
30-34					0.154	0.424	0.193	0.363	0.169	0.338
35-39					0.199	0.346	0.271	0.245	0.232	0.232
40-44					0.299	0.223	0.345	0.202	0.302	0.180
45-49					0.512	0.119	0.593	0.102	0.519	0.085
Region										
coast	Ref		Ref		Ref		Ref		Ref	
N.eastern					0.593	0.006	0.809	0.000	0.667	0.000
Eastern					0.226	0.129	0.231	0.113	0.185	0.121
Central					1.517	0.000	1.594	0.000	1.370	0.000
R.valley					-0.244	0.085	-0.286	0.040	-0.251	0.029
Western					-0.398	0.018	-0.471	0.005	-0.394	0.004
Nyanza					0.533	0.001	0.555	0.001	0.462	0.000
Nairobi					-0.181	0.537	-0.244	0.409	-0.215	0.396
Residence										
Urban	Ref		Ref		Ref		Ref		Ref	
Rural					-0.562	0.000	-0.589	0.000	-0.4870	0.000
Religion										
Catholic	Ref		Ref		Ref		Ref		Ref	
Protestant					-0.0267	0.770	-0.030	0.762	-0.027	0.747
Muslim					-0.0734	0.658	-0.112	0.509	-0.093	0.510
N.religion					-0.352	0.125	-0.357	0.157	-0.282	0.175
Other					-0.695	0.279	-0.557	0.435	-0.513	0.379

	Model I		Model II		Model III		Model IV		Model V	
Parameters	Coef	P-value	Coef	P-value	Coef	P-value	Coef	P-value	Coef	P-value
Education										
No Edu	Ref		Ref		Ref		Ref		Ref	
Primary					0.680	0.000	0.750	0.000	0.626	0.000
Secondary					1.199	0.000	1.309	0.000	1.098	0.000
Higher					2.385	0.000	2.603	0.000	2.247	0.000
House Head										
Male	Ref		Ref		Ref		Ref		Ref	
Female					0.100	0.203	0.107	0.217	0.0796	0.267
W. Index										
P.poorer	Ref		Ref		Ref		Ref		Ref	
Middle					0.439	0.000	0.518	0.000	0.421	0.000
R.Richer					1.173	0.000	1.339	0.000	1.117	0.000
Distance										
big prob	Ref		Ref		Ref		Ref		Ref	
No prob					.396	0.000	0.47	0.000	0.388	0.000
Status										
Single	Ref		Ref		Ref		Ref		Ref	
Widowed					-0.376	0.071	-0.394	0.089	-0.318	0.097
Divorced					-0.214	0.089	-0.217	0.130	-0.153	0.188
Partner edu										
No. Edu	Ref		Ref		Ref		Ref		Ref	
Primary					0.599	0.000	0.776	0.000	0.635	0.000
Secondary					0.795	0.000	0.988	0.000	0.815	0.000
Higher					0.878	0.000	1.081	0.000	0.896	0.000
Don’t know					0.230	0.534	0.346	0.393	0.282	0.405
ANC visits										
no visit	Ref		Ref		Ref		Ref		Ref	
1-10 v					2.377	0.000	2.702	0.000	2.330	0.000
11/20 v					3.610	0.004	3.970	0.003	3.456	0.004
Don’t know					2.025	0.005	2.261	0.006	1.929	0.004
Bord					-0.180	0.000	-0.202	0.000	0.845	0.000

Random effects	Model I		Model II		Model III		Model IV	
	Est(var)	C.I	Est(var)	C.I	Est(var)	C.I	Est(var)	C.I
Community	3.27	-1.90,1.72			0.51	-0.84,0.60		
Household			11.019	-3.49,3.15			1.129	-1.99,0.57
ICC(%)	34.15		59.93		8.69		14.58	

Table 4. Checking for fitness of the models

Mode Fitness	Model I	Model II	Model III	Model IV	Model V
Log Likelihood	-11563.624	-13024.741	-3207.6938	-3238.353	-3240.6745
AIC	23131.25	26053.48	6489.388	6550.707	6553.349
BIC	23147.14	26069.37	6740.74	6802.059	6797.908

Table 3 displays results from a total of five models which contains variables of interest (selected based on literature) that were included by using the xtmelogit and logistic commands in STATA version 13.

Model I(Empty model) was included without independent variables to do test for random effects at community level clustering in the intercept and to estimate the intra class correlation coefficient. **Model II**(Empty model) was fitted minus the independent variables to experiment for random effects at household level clustering in the intercept and to estimate the intra class correlation coefficient. **Model III** It has looked at the results of the predictors /explanatory variables on place of delivery with inclusion of the community cluster term. **Model IV** It has investigated the outcome of the predictors descriptive variables on place of delivery with inclusion of the household cluster term. **Model V** It has evaluated the causes of predictors /explanatory variables on place of delivery without inclusion of the cluster term.

Multilevel logistic regression analysis

The solid outcome which is a measure of association and instant obstruction for usage of the facility childbirth facility have been displayed in table 2. The outcome of model I which is an empty model with inclusion of only community cluster, showed that there was a statistically important variation/discrepancy in relation to place of giving birth between communities ($p-value < 0.05, C.I = -1.906, 1.716$),the estimated variance for community cluster in this model was 3.271.

In model II which is also an empty model with inclusion of only household cluster, the results showed that there was a significant variation in relation to place of delivery between households ($p-value < 0.05, C.I = -3.493, 3.1.54$),the estimated variance for household cluster in this model was 11.019.

In model III we considered all the predictors in the presence of community level cluster. The outcome showed that a woman's place of dwelling ,education level,wealth index, birth sequence number, distance from health facility, and lastly visits to an anti natal care were importantly linked with place of giving birth. The community cluster effect in model III was found to be having a statistically significant variability in relation to place of delivery for the mothers between different communities ($p-value < 0.05, C.I = -0.842, 0.602$), the estimated variance for community cluster in this model was 0.507.

In model IV we considered all the predictors in the presence of household cluster.The outcome revealed that the level of education, residing place wealth index, birth order number, distance from health facility, and antenatal care visits were closely linked with place of delivery. The household cluster effect in this model in particular was found to be having a statistically significant variation related to place of delivery for the mothers between different households ($p-value < 0.05, C.I = -1.992, 0.566$), the approximated variance for household cluster in the model was 1.129.

Model V which is the final model, included strictly the predictors for the place of childbirth for the mothers without inclusion of a cluster variable (household or community). The results revealed that woman's education level, residential area, wealth index, birth order number, proximity to the place of delivery and the number of antenatal visits made had a huge impact on the place of delivery. Test for model fitness was performed to find out which of the five models had the best fit in terms of Log-likelihood, Akaike information criterion (AIC), and Bayesian information criterion (BIC) statistics. The information obtained revealed that Model III had the best fit out of all the models since it had the least statistics in all categories, effects of the predictors on place of delivery have been explained based on model III.

From **Model III**; After making changes for other factors, the log likelihood of childbirth in a facility based institution in relation to women who come from rural parts of Kenya compared to those women who come from urban parts of the country decreases by 0.562 (coef=-0.562, p-value=0.000). After taking charge for other predictors, the delivering of log odds at a facility based institution for women whose measure of education is primary in contrast to those who are uneducated increases by 0.680 (coef=0.680, p-value=0.000), the log odds of delivering at a facility based institution for those whose education level is secondary compared to those who have no education increases by 1.199 (coef=1.199, p-value=0.000), and finally the log likelihood of giving birth at a facility based institution for those mothers whose education level is higher in comparison to those mothers who have no education increases by 2.385 (coef=2.385, p-value=0.000).

In reference to wealth index, likelihood o giving birth at a health institution for middle class women in comparison to poor women increases by 0.439 (coef=0.439, p-value=0.000), and those who are rich the recorded likelihood of giving birth at a facility in comparison to the poor increases by 1.173 (coef=1.173, p-value=0.000).After holding other predictors at a constant, the log probability of giving birth at a facility based institution for those who don't see distance to the health facility as a big hindrance in comparison with those who see the long distance to the health facility as a setback increases by (coef=0.396, p-value=0.000). The log odds of giving birth at a facility based institution for women who have $1-10$ visited the antenatal clinics compared to those go for antenatal care visits increases by 2.377 (coef=2.377, p-value=0.000), the log odds of delivering at a facility based institution for women who have $11-20$ have visited antenatal clinics in contrast to those who haven't increases by 3.610 (coef=3.610, p-value=0.004), and those who don't have clarity on the number of times they have visited antenatal clinics compared to those who haven't visited the clinic at all increases 2.025 (coef=2.025, p-value=0.005). As birth order number increases the log likelihood of childbirth at a an institution decreases by -0.180 (coef=-0.180, p-value=0.000).

From **Model III**; Explanatory variables such as age group, region, religion, head of household, marital status, and companion's degree of education were established as not significant predictors for the place of childbirth.

As revealed by the approximated Intra-Class correlation coefficient, 8.69% of variation in facility based to service delivery use of service to difference in communities in the presence of predictors, and 14.58% of variation in facility based delivery service utilization was owed to difference between households in the presence of the predictors, 34.15% of variation in facility based delivery service utilization was owed to difference between communities without inclusion of predictors, and finally 59.93% of variation in facility based delivery utilization was attributable to difference between households without inclusion of predictors.

5 Discussion

This research was premised on the information gathered in 2014 demographic and health survey which took place in Kenya. The research pinpointed numerous reasons that do have a huge effect on making use of facility when giving birth. Results of thE research showed that womans schooling level significantly influenced the use of facility based institution. This finding do agree with results gotten from Thind et al. (2008)Aremu et al. (2011) Aremu et al. (2012) Babalola and Fatusi (2009) Abera et al. (2011) Tura et al. (2008) Teferra et al. (2012) Amano et al. (2012) Worku et al. (2013). The possible reason behind this could be, women who have been educated do have a higher degree of confidence and capabilities to take measures as far as their own well being is concerned, and also are more than willing to travel to where they will be able to seek quality health care services . Also, another reason could be that women who are educated do have more exposure as far as accessing the relevant information on health especially relating to services related to maternal health hence, helping them seek for the right medical care.

Findings from this research confirmed thhat women hailing from rich backgrounds had higher log odds of facility based delivery than their counterparts from poor backgrounds which agrees with the results that have been reported in the studies conducted prior Mekonnen and Mekonnen (2003) Aremu et al. (2011) Aremu et al. (2012) Babalola and Fatusi (2009) Ahmed et al. (2010) Muchabaiwa et al. (2012). The reason behind this may be due to the high costs that is needed to get health care access to services.

Concerning birth order, the results of our research revealed that the log odds of facility based childbirth decreases as the order of child birth increases. This result agrees with findings gotten from numerous results of researh carried out Agha and Carton (2011) Begum et al. (2012) Mahapatro (2012) Amponsah and Moses (2009) Nair et al. (2012) Saini and Walia (2009) Kamal (2013). The reason behind this could be that after the woman has had uneventful birth of her 1st child at a non-facility based institution say home, successive births are regarded to be having low risk, therefore, increasing the probability of giving birth to successive children at a non-facility based institution.

This research has also shown that women visited atleast one antenatal care (ANC) clinic for their birth had a higher likelihood of delivering at a facility based institution than those women who had no antenatal care (ANC)visits. A number of prior Abera et al. (2011) Tura et al. (2008) Teferra et al. (2012) Amano et al. (2012) Muchabaiwa et al. (2012) Lwelamira and Safari (2012) Kabakyenga et al. (2012) Barber (2006) Hadi et al. (2007) studies have also indicated that antenatal care (ANC) attendance increases the chances of a woman to deliver at a facility based institution. Antenatal care (ANC) attendance attendance helps a woman to familiarize herself with maternal health services. Analysis from demographic health surveys (DHS) data from six nations in Africa and a research carried out in India revealed the attributes that make women susceptible to look for care when pregnant are also more probable to look for care when giving birth Stephenson et al. (2006) Stephenson et al. (2006). Also, antenatal care (ANC) could be an opening for the medical officials to diseminate facts related to health and to talk about the place of delivery and the essence of delivery at facilities. In a research carried out in Tanzania, those women informed o possible complications during ANC were more likely to give birth at a facility based institution Mpembeni et al. (2007). This proofs that the information given to women who are pregnant during antenatal care (ANC) is crucial towards promoting facility based delivery service.

Rural residence was established to be having a negative significant influence with place of delivery. The results of the research are si,ilar toprior research carried out in the developing nations Jat et al. (2011) Amponsah and Moses (2009) Kamal (2013) Kabakyenga et al. (2012) Fikre and Demissie (2012) Sharma et al. (2007) Johnson et al. (2009) Doctor and Dahiru (2010).The importance of residential place in influencing the place the woman decides to deliver can be an influencing factor in a womans use of health facilities to give birth.It can also be enumerated by a another distict research , women from urban parts of Ethiopia have a tendency of benefiting from the increased awareness and martenal health care access. Mekonnen and Mekonnen (2003). Also, another separate research showed that rural areas in general do have poor infrastructure, inadequate number of health institutions , and insufficient health services as opposed to urban centres, thus, affecting women who come from rural parts who are less likely to utilize health facility for care as far as delivery is concerned Gabrysch and Campbell (2009). However, women from urban parts could be having a higher degree of open-mindedness to new information pertaining health and familiar with the modern health care.

In this research distance to health facility was negatively related with facility based delivery service. A research carried out in Tanzania also found similar findings where the health facility is located far then that was associated with home delivery Mpembeni et al. (2007). This finding also agrees with the results from numerous studies in developing nations where distance to health facilities plays a crucial role as far as facility based delivery services is concerned Lwelamira and Safari (2012) Varma et al. (2010) Danforth et al. (2009) Stekelenburg et al. (2004) Joharifard et al. (2012) Moore et al. (2011) De Allegri et al. (2011) Adei et al. (2012) Adei et al. (2012) Gabrysch et al. (2011). Long distanceand its effect on use of health services has been ascribed to the schedule , poor conditions of the roads, and travelling cost that lessens health seeking habit and become real hindrance towards accessing care after the person decides to seek care Stekelenburg et al. (2004) Kruk et al. (2009).

As hypothesized, findings of this research revealed that both community and household levels random intercepts (variances) were large and important in showing differences between different communites and between households in the tendency of women using healthcare facilitiews for delivery. This aids application of multi-level modeling for this study Goldstein (2011) Rabe-Hesketh and Skrondal (2008) Hox et al. (2017) Tom et al. (1999).

This research has also shown the the presence of important unseen variability between communities and between households above the effect of the factors measured . Researches carried out in Congo, Nigeria, Indonesia, and six African nations also found similar findings though this involved only community level, with a significant unobserved variability in the odds of institutional delivery across communities Stephenson et al. (2006) Aremu et al. (2011) Aremu et al. (2012). These unobserved effects could show the contrast among communities and among households when it comes to cultural beliefs, social standards , and factors related to health care service like access to quality health care which impacts people's point of view and whether they will seek health care services.

5.1 Conclusion

In this study it was established that factors like place of residence, mother's educational level, wealth index, proximity to a health institution and times one visits an antenatal clinic (ANC) were important influences on place of delivery. It was also established that both community and household levels random variance were large and statistically important demonstrating differences between communities and between households' tendency of women and their use of health facilities for delivery. It was also found out that there was existence of important unobserved variability among communities and between households above the interference of the tested predictors.

5.2 Future research

Researching further on the predictors is essential to get a clear understanding of how they affect the decision to seek a place for delivery.

5.3 Limitation of the study

This information would have been useful to the research if information related to the quality of health services and factors such as the availability of quality health care were collected before conducting the research.

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6 Appendix

The following was the STATA do file codes used for computations.

```
keep m15 v013 v501 v130 v149 v701 v151 v743a v190 bord m14 v024 v025 v467d v001 v002
drop v743a

egen hhid= concat(v001 v002)
drop v002
rename hhid v002
destring v002,replace

*place of delivery
recode m15 11/12=0 21/33=1 36/96=0
label define m15 0 "Non-facility" 1"Facility based"
label values m15 m15

*Mother's education
recode v149 0=0 1/2=1 3/4=2 5=3
label define v149 0 "No education" 1 "Primary" 2 "Secondary" 3 "Higher"
label values v149 v149

*wealth index
recode v190 1/2=1 3=2 3=2 4/5=3
label define v190 1 "poorerest/poorer" 2 "middle" 3 "richer/richest"
label values v190 v190

/*Marital status*/
recode v501 0=1 1/2=2 3=3 4/5=4
label define v501 1 "single" 2 "married" 3 "widowed" 4 "seperated/divorced"
label values v501 v501

*number of antenatal visits during pregnancy
recode m14 0=1 1/11=2 11/20=3 98=4
label define m14 1 "no visit" 2 "1-10 visits" 3 "11/20 visits" 4 "Don't know number of visits"
label values m14 m14
```

```
xtmelogit m15 || v001:
estat ic

xtmelogit m15 || v002:
estat ic

xtmelogit m15 i.v013 i.v024 i.v025 i.v130 i.v149 i.v151 i.v190 i.v467d i.v501 i.v701 bord i.m14
|| v001:
estat ic

xtmelogit m15 i.v013 i.v024 i.v025 i.v130 i.v149 i.v151 i.v190 i.v467d i.v501 i.v701 bord i.m14
|| v002:
estat ic

xtmelogit m15 i.v013 i.v024 i.v025 i.v130 i.v149 i.v151 i.v190 i.v467d i.v501 i.v701 bord i.m14
estat ic
```