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Analysis of Determinants of Antenatal Care Services Utilization in Nairobi County Using Logistic Regression Model

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Abstract: *Objectives*: The aim of this study is to assess antenatal care service utilization and determine the factors associated with antenatal care non attendance in Nairobi County. *Methods:* The study used data that was collected in the county by use of questionnaires in which a total of 306 mothers participated. *Data Analysis:* The data was analyzed using R-software version 3.0.2, and the report was represented in form of tables. Here, Logistic regression model was used to model some of effects of the demographic and socio-economic independent variables. *Results:* The study found out that the independent variables, age, employment status, education level, parity and husband's education level were the determinants of antenatal care service utilization in Nairobi County. The relationship between the covariates and antenatal care service utilization were significant at α=0.05 *Conclusions:* The study suggested that mothers in Nairobi County should be educated or enlightened on matters that concern antenatal health care utilization so as to increase the percentage of those mothers that attend the health facilities.

Keywords: Antenatal Care, Nairobi, Logistic Regression, Variables, Covariates

1. Introduction

Antenatal care is the care a woman receives throughout her pregnancy in order to ensure that woman and newborns survive pregnancy and child birth. (WHO,2003).This care is a key entry point for pregnant woman to receive a broad range of health promotion and preventive health services, including nutritional support and prevention and treatment of anemia; prevention, detection and treatment of malaria, tuberculosis and sexually transmitted infections (particularly prevention of HIV transmission from mother to child); and tetanus toxoid immunization. It's always an opportunity to promote the benefits of skilled attendance at birth and to encourage women to seek postpartum care for themselves and their newborns

Antenatal care, a component of safe motherhood, focuses on birth preparedness and readiness to handle complications.

The primary aim of ANC is ensuring prevention, early detection and prompt management of pregnancy related complications. The antenatal period presents opportunities for reaching pregnant women with a number of interventions that may be vital to their health and well-being and that of their infants. (Koblinsky and Heichelheim, 1999)

Focused Antenatal Care requires four comprehensive ANC visits, (MOH, 2006), delivery in a well-equipped health facility with skilled health care providers or assistance from a skilled professional when giving birth at home, access to emergency obstetric care and a timely postpartum visit (Singh, et al., 2009)

1.1. Statement of the Problem

Most of world's maternal deaths occur in developing world though majority of deaths and are avoidable. Over the years, efforts to reduce maternal mortality and morbidity have included promoting antenatal care, providing family planning services, and improving essential obstetric care. Despite such interventions, maternal mortality rates remain high in Kenya. There is need to assess whether the interventions made are efficient enough to reduce the maternal mortality rates through utilization of the antenatal and delivery care services in Nairobi county.

1.2. Objectives

1.2.1. General Objective

To assess the antenatal care service utilization and factors associated with antenatal care non attendance in Nairobi County.

1.2.2. Specific Objectives

1. Examining the prevalence and factors associated with ANC service utilization in Nairobi County
2. To identify socio-demographic characteristics, knowledge, attitude and accessibility factors related to the utilization of ANC services among pregnant women in Nairobi County

1.3. Strengths and Weaknesses of the Research

The research has a number of strengths. First, data was obtained from women or mothers who had given a live birth 5 years or less before the study. This design provided a clearer understanding on ANC implementation in the study area. The study was also conducted among women who until recently had been using ANC, thus the data was not based on women who had used ANC several years prior to the study. The study managed to recruit all subjects, none of the approached mothers and only a few refused to participate in the study. During the analysis there were also very few missing data as such almost all the variables were analyzed without being affected by missing data. However, the study had some weaknesses, since we used questionnaires, there was a potential for recall bias regarding issues related to early pregnancy

2. Review of Previous Studies

It has been estimated that 25 percent of maternal deaths occur during pregnancy, with variability between countries depending on the prevalence of unsafe abortion, violence, and disease in the area. Between a third and a half of maternal deaths are due to causes such as hypertension (pre eclampsia and eclampsia) and antepartum hemorrhage, which are directly related to inadequate care during pregnancy. In a study conducted in six West African countries, a third of all pregnant women experienced illness during pregnancy, of which three percent required hospitalization (Ronsmans and Graham, 2006)

A study done in Ghana found out that wealth status, age, ownership of health insurance (especially for rural women), educational attainment, birth order, religion and administrative region of residence were the significant predictors of the intensity of antenatal care services utilization. The utilization rate increased in wealth status. The authors also found significant statistical relationship between residence and antenatal care utilization. This finding reinforces the differences in health facilities between the rural and urban areas of Ghana. (Nketiah-Amponsah et al, 2013)

Many studies have focused on family planning component of SM leaving behind ANC and delivery care component among others. This could explain why developing countries report high levels of quality care but still have the highest mortality rate in the world. Kenya, being a component country of SSA, where mortality rate remains high (UNECA/AfDB, 2010) and thus an appropriate case study from Low and Middle Income Countries (LMIC)

Other studies showed that women attended ANC at least once. However, their descriptions of ANC were often vague. General ideas about pregnancy care – checking the fetus' position or monitoring its progress – motivated women to attend ANC; as did, especially in Kenya, obtaining the ANC card to avoid reprimands from health workers. Women's timing of ANC initiation was influenced by reproductive concerns and pregnancy uncertainties, particularly during the first trimester, and how ANC services responded to this uncertainty; age, parity and the associated implications for pregnancy disclosure; interactions with healthcare workers, particularly messages about timing of ANC; and the cost of ANC, including charges levied for ANC procedures – in spite of policies of free ANC – combined with ideas about the compulsory nature of follow-up appointments (Pell et al, 2013)

Introduction of Antenatal Care (ANC), in Kenya significantly increased detection of existing diseases in pregnancy during the first ANC visit, birth planning, counseling of postpartum care and prevention of birth complications (Birungi and Onyango-Ouma, 2006)

ANC in Kenya has reached more than two thirds of pregnant women, with reported increases in the coverage of the recommended four ANC visits and increases in the coverage of a first trimester ANC visit. Multiple vertical programs rely on ANC to deliver their interventions, representing both a challenge and an opportunity. As a critical link in the continuum of care, ANC offers tremendous opportunities to reach a large number of women and communities with effective clinical and health promotion interventions. However, inequity exists, and young, rural, poor, and less educated women may not benefit from ANC services or may drop out due to access barriers and low quality services. (Birungi and Onyango-Ouma, 2006)

3. Methods

3.1. Study Area

Nairobi County is Located in Africa, East Africa, Kenya, Nairobi Province. It borders Kiambu County to the North West, North and North East, Machakos County to the East and South East, Kajiado County to the South, South West and West. It is the most populous city in East Africa, with a current estimated population of about 3 million. According to the 2009 Census, in the administrative area of Nairobi, 3,138,295 inhabitants lived within 696 square kilometers (269 square miles) and it's divided into eight constituencies namely; Makadara, Kamukunji, Starehe, Langata, Dagoretti,

Westlands, Kasarani and Embakasi.

3.2. Design and Data Source

This study used a cross-sectional design that comprised of women in the reproductive age group (15 to 49 years old), residing in Nairobi County, who had a live baby less than 5 years old. A semi-structured questionnaire was designed using the literature on antenatal care. To ensure that the questions were clear and could be understood by both the enumerators and the respondents, the questionnaire were pretested and further refined based on the results.

The questionnaire also collected information on socio-demographic and obstetric characteristics, use of ANC and place of delivery. A total of 306 women were interviewed during the month of May, 2015

3.3. Analysis Variables

The outcome (response) variable in this study was ANC attendance. The explanatory variables which might determine ANC attendance were the mother's age at child birth, education level, parity, husband's education level and the mother's employment status.

3.4. Statistical Analysis Methods

Regression models have become an integral component of any data analysis concerned with describing the relationship between the response variable and one or more explanatory variables. It is often the case that the outcome variable is discrete, taking on two or more possible values. Over the last decade the logistic regression model has become, in many fields, the standard method of analysis in this situation. (Hosmer and Lemeshow, 2000)

If the dependent variable is dichotomous (binary), logistic regression is used. It is also preferred from multiple regression and discriminate analysis as it results in a biologically meaningful interpretation, it is mathematically flexible and easily used distribution and it requires fewer assumptions (Hosmer and Lemeshow, 2000)

According to Tabachnick and Fidel, 1996, logistic regression does not have requirements of the independent variables to be normally distributed linearly neither related nor equal variance with each group.

3.5. Logistic Regression Model Description

In this study the effect of the independent variables on the dependent variables were investigated using logistic regression model since the dependent variable was a dichotomous variable (0=attended ANC services at most 3 times) and (1= attended ANC services more than 3 times)

Let $Y_{n\times 1}$ be a dichotomous outcome random variable with categories 1 (attended ANC services more than 3 times) and 0 (attended ANC services at most 3 times). Let $X_{n\times(p+1)}$ denote the collection of p predictor variables of Y. Then, the conditional probability that a mother attended ANC services given the x_i predictor variables is denoted by $P(Y_i = 1/x_i) = y$

The model will be expressed in the form:.

$$y = \frac{e^{\beta_0+\beta_1 x_1+\beta_2 x_2+\ldots+\beta_p x_{ip}}}{1+e^{\beta_0+\beta_1 x_1+\beta_2 x_2+\ldots+\beta_p x_{ip}}} = \frac{1}{1+e^{-(\beta_0+\beta_1 x_1+\beta_2 x_2+\ldots+\beta_p x_{ip})}} \quad (1)$$

Where

y = probability of a mother either attending full ANC services or not given a set of independent variables

x =the coefficient of the predictor variables

β_0 = the constant of the equation

e = the base of natural logarithms (approximately 2.72)

In logistic regression, logarithmic transformation of the equation normally yields a linear relationship between the independent and the dependent variables. The logit transformation is given as follows;

$$\text{logit}(y) = \log\frac{p(y)}{1-p(y)} = \beta_0+\beta_1 x_1+\ldots+\beta_p x_{ip} \quad (2)$$

3.6. Parameter Estimation and Likelihood Function for the Binary Logistic Regression

In any regression problem the key quantity is the mean value of the outcome variable, given the value of the independent variable. This quantity is called the conditional mean and will be expressed as $"E(Y|x)"$ where Y denotes the outcome variable and x denotes a value of the independent variable. The quantity $"E(Y|x)"$ is read "The expected value of Y given the value x."

In linear regression we assume that the mean may be expressed as an equation linear in x (or some transformation of x or Y), such as

$$E(Y|x) = \beta_0+\beta_1 x$$

This expression implies that it is possible for $E(Y|x)$ to take any value as x ranges between $-\infty$ and $+\infty$. With dichotomous data, the conditional mean must be greater than or equal to zero and less than or equal to 1. $\left[\text{i.e}, 0 \le E(Y|x) \le 1\right]$

The general method of estimation that leads to the least squares function under the linear regression model (when the error terms are normally distributed) is called maximum likelihood. This method will provide the foundation for our approach to estimation with the logistic regression model. This method of likelihood yields values for the unknown parameters which maximize the probability of obtaining the observed set of data. In order to apply this method we must first construct a function, called the likelihood function, which will express the probability of the observed data as a function of the unknown parameters.

Likelihood just means probability. It always means probability under a specified hypothesis. In logistic regression, two hypotheses are of interest:

Null hypothesis, which is when all the coefficients in the

regression equation take the value zero.

Alternative hypothesis, which is, when the model with predictors currently under consideration is accurate and differs significantly from the null of zero, i.e. gives significantly better than the chance or random prediction level of the null hypothesis.

The maximum likelihood estimators of these parameters are chosen to be those which agree most closely with the observed data. We now describe how to find these values from the logistic regression model

If Y is coded as 0 or 1, then the expression for $\pi(x)$ provides (for an arbitrary value of $\beta = (\beta_0, \beta_1)$, the vector of parameters) the conditional probability that Y is equal to 1 given x. This will be denoted as $P(Y = 1|x)$.It follows that the quantity $1-\pi(x)$ gives the conditional probability that Y is equal to zero given x, $P(Y = 0|x)$. Thus, for those pairs (x_i, y_i), where $y_i = 1$, the contribution to the likelihood function is $\pi(x_i)$, and for those pairs where $y_i = 0$, the contribution to the likelihood function is $1-\pi(x_i)$, where the quantity $\pi(x_i)$ denotes the value of $\pi(x)$ computed at x_i. A convenient way to express the contribution to the likelihood function for the pair (x_i, y_i) is through the expression

$$\pi(x_i)^{y_i}\left[1-\pi(x_i)\right]^{1-y_i} \quad (3)$$

Since the observations are assumed to be independent, the likelihood function is obtained as the product of the terms given in the expression (3) as follows

$$l(\beta) = \prod_{i=1}^{n} \pi(x_i)^{y_i}\left[1-\pi(x_i)\right]^{1-y_i} \quad (4)$$

The principle of maximum likelihood states that we use our estimate of β as the value which maximizes the expression in equation (4). However, it is easier mathematically to work with the log of equation (4). This expression, the log likelihood, is defined as

$$L(\beta) = \ln\left[l(\beta)\right] = \sum_{i=1}^{n}\left\{y_i \ln\left[\pi(x_i)\right] + (1-y_i)\ln\left[1-\pi(x_i)\right]\right\} \quad (5)$$

To find the value of β that maximizes $L(\beta)$ we differentiate $L(\beta)$ with respect to β_0 and β_1 and set the resulting expressions equal to zero. The equations, known as the likelihood equations, are:

$$\sum\left[y_i - \pi(x_i)\right] = 0 \quad (6)$$

and

$$\sum x_i\left[y_i - \pi(x_i)\right] = 0 \quad (7)$$

In equation (2.4) and (2.6) it is understood that the summation is over i varying from 1 to n. The value of β given by the solution to equations (6) and (7) is called the maximum likelihood estimate and will be denoted as $\hat{\beta}$. In general, the use of the symbol "^" denotes the maximum likelihood estimate of the respective quantity. (Hosmer and Lemeshow, 2000)

4. Results

4.1. Descriptive Analysis

Data was entered into Microsoft excel, coded, cleaned, and finally imported into R-software version 3.0.2 for analysis. The researcher used both bivariate and multivariate analyses to identify factors associated with ANC service utilization among mothers in Nairobi County.

In this research differences in proportions were compared using the chi-square test whereas the differences in means were compared using the Students t-test, A two-sided p-value<0.05 was considered statistically significant. Odds ratio with 95% confidence intervals were also calculated

Table 1. *Socio-economic and demographic characteristics of ANC services utilization in Nairobi County (N=306).*

Variables	Level	ANC Attendance			
		At most 3 visits		More than 3 visits	
		Frequency(n)	Percent	Frequency(n)	Percent
Age (Years)	16-29	28	25.9	80	74.1
	30-39	100	69.9	43	30.1
	40-49	20	36.4	35	63.6
Employment Status	Unemployed	47	48.0	51	52.0
	Employed	88	42.3	120	57.7
Education Level	No education	29	65.9	15	34.1
	Primary education	38	31.9	81	68.1
	Secondary and above	3	3	98	97
Parity	1-4	132	66.7	66	33.3
	5 and above	39	36.1	69	63.9
Husbands education level	No education	22	59.5	15	40.5
	Primary education	107	55.2	87	44.8
	Secondary and above	16	34.0	31	66.0

From Table 1, mothers who fully attended ANC were 74.1% for young mothers aged 16 to 29 years, 30.1% for those mothers that were 30 to 39 years and 63.6% for the older mothers. Fully attendance of the ANC services was 52.0% and 57.7% for the unemployed and employed mothers respectively.

In this study it can also be seen that those mothers with at most 4 children (66), were almost the same as those who had more than 5 children. Mothers and the husbands education level (for those who had husbands), was categorized into three; no formal education, primary education and secondary and above. And from the summary ANC attendance varies by their educational attainment. Those who attended at least 3 times were 65.9% for no formal education, 31.9% for primary education and 3.0% for secondary and above mothers.

Table 2. *Logistic regression coefficients (N=306).*

Variable	Level	B	S.E	Wald	Df	P-value	Exp(B)
Age (Ref (40-49))				26.431	2	0.000	
	16-29	0.476	0.160	8.900	1	0.003	1.611
	30-39	-1.433	0.145	103.841	1	0.000	0.201
Employment Status (Ref(employed))	Unemployed	-0.233	0.108	5.287	1	0.019	0.699
Education Level (Ref(Secondary and above)				67.131	2	0.000	
	No education	-3.251	0.577	35.391	1	0.000	0.033
	Primary education	-2.639	0.575	17.341	1	0.000	0.086
Parity (ref(1-4))	5 and above	-1.614	0.093	18.331	1	0.000	0.120
Husbands education level (Ref (secondary and above))				13.511	2	0.002	
	No education	-0.471	0.128	12.341	1	0.000	0.634
	Primary education	-0.223	0.161	2.365	1	0.103	0.773
Constant		4.113	0.613	47.731	1	0.000	57.311

*All results are generated at 95% confidence level

4.2. Interpreting Variables in Relation to Antenatal Care Service Utilization

From the results in table 2 above, it shows that relationship between age and the dependent variable was significant at α=0.05. In the study we can see that the mothers' age at 16 to29 years was 1.611 times more likely to fully attend ANC services than those mothers who were aged between 40 to 49 years. Mothers aged 30 to 39 years were 0.201 times less likely to fully attend ANC services than those aged 40 to 49 years.

Mothers' educational attainment was significant at α=0.05 with a p-value of 0.000 there it means it contributed on the ANC service utilization. Mothers whose educational attainment is primary were 0.086 times less likely to attend ANC services whereas those who had secondary and above education and those with no education were 0.033 times less likely to fully attend ANC services than those who have secondary and above education.

The relationship between the husbands' education level and ANC attendance was significant (p-value of 0.002). The odds ratio for mothers whose husbands had no formal education and those with primary education were 0.634 and 0.773 respectively.

The relationship between parity and ANC attendance was also significant. The study showed that mothers with 5 or more children were 0.120 times more likely to utilize the ANC service than those who had at most 4 children.

Unemployed mothers were 0.699 times less likely to utilize ANC services than the employed mothers.

5. Discussions

Using the data that was collected, this study we wanted to identify some of the factors that are associated with antenatal care service utilization in Nairobi County. Logistic regression analysis on the antenatal care service utilization was employed to identify some of the effects of the covariates on this dependent variable.

A total number of 306 mothers were used in this study and the analysis revealed that the independent variables; age of the mother, employment status, mothers education level, husbands education level and parity were the most determinants of antenatal care service utilization in Nairobi county.

In the study, mothers educational attainment had a significant contribution on the utilization of antenatal care services (p-value=0.000). It showed that mothers who had primary education were 0.086 times less likely to utilize the services than those that had secondary education and above. This fact clearly shows that women with less or no education were not able to seek for antenatal care services due to lack of maternal health care knowledge and ignorance.

On the other hand women who were educated were able to fully attend the antenatal care services since they had knowledge and practices of better health attainment. They made good use of the services available since they were empowered and therefore were good in decision making.

The relationship between the mothers' age and ANC service utilization was significant. From the table it showers

that out of the 108 young mothers, 80 (74.1%) were able to utilize the ANC services compared to the older mothers. This finding of young mothers utilizing maternal health services is also in other studies (Ntambue et al, 2012). Experience in pregnancy and child bearing could be the reason behind the low ANC service utilization.

This study also found a strong relationship between employment and ANC service utilization in Nairobi County. Unemployed mothers were 0.699 less likely to attend ANC services than the employed mothers. The fact that employed women in Nairobi County are more likely to utilize antenatal care services indicates that, earning ability is one of the factors for utilization. This fact is also stated in other studies (Asfawosen A et al, 2014).

Ntambue et al, 2012 supported the fact that there was a strong relationship not only between the household indexes but with the husband's education level and antenatal care service utilization. This is because in some cases, the husbands are the ones who provide money in order for the mother to access maternal health services. For the women with husbands that are unemployed, it might be difficult for them to access this services and that's why only those women who can afford to pay are the ones that visit the health facilities.

There was a significant relationship between parity and ANC service utilization, and this is similar to other studies (Kamal, 2009). The study showed that women having their first or second babies were more likely to attend the health facilities for ANC compared to those that had 5 or more children. Having more children is usually associated with increased responsibilities and therefore they lack enough time to attend to health facilities.

6. Summary and Conclusions

Generally this research paper revealed that socio-economic and demographic variables have an effect on the antenatal care service utilization in Nairobi County and therefore the objective of the study were met. Using Logistic regression model the predictors; age, employment status, mother's education level, husbands' education level and parity were the most important determinants.

Mothers that had an education level of secondary and above were more likely to utilize antenatal care service; moreover it also showed that unemployed mothers were less likely to attend the facilities. Furthermore the research showed that younger mothers (16 to 29 years) in Nairobi County are more likely to attend the health facilities for their ANC checkups than the older mothers aged between 40 and 49.

7. Recommendations

7.1. Recommendation for Government and Policy Makers

The study wish to recommend the following

1. Mothers in Nairobi County should be educated or enlightened on matters that concern antenatal health care utilization
2. Job opportunities for mothers should be created in Nairobi County.
3. For pregnant women to fully benefit from ANC services the county government and other development partners in Nairobi should increase health infrastructure so that distance to the health facility can be reduced.
4. Some of the issues to be intensified in some regions of the county should be dispelling myths associated with pregnancy or health facility visits, informing communities that any pregnant woman is at risk and requires medical attention during the entire pregnancy period.

7.2. Recommendations for Further Research

This study focused on one county out of the 47 that we have in Kenya and therefore there is need to conduct larger prospective studies to better understand national level antenatal care service utilization. Such studies will help to establish in-depth qualitative data on demographic and social-cultural issues affecting ANC utilization

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Nomenclature

AfDB: Africa Development Bank
ANC: Antenatal Care
HIV: Human Immuno-Virus
MOH: Ministry of Health
SSA: Sub-Saharan Africa
UNECA: United Nations Economic Commission for Africa
WHO: World Health Organization

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