

Multiple Logistic Regression Model for Determinants of Injectable Contraceptive Uptake Among Women of Reproductive Age in Kenya

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Abstract

Objective: The recent increase in the uptake of injectable contraceptives has occurred at the expense of the other modern contraceptive methods but the knowledge gap still exists on modeling dynamics and determinants associated with the use of the injectable. This study sought to model for injectable contraceptive usage to bridge the knowledge gap on the use of injectable contraceptives among women of childbearing age in Kenya.

Materials and methods: Analytical cross-sectional study design was adopted. Secondary data for women collected during the (Performance Monitoring for Action) PMA2020 survey was used. PMA2020 survey used multistage stratified sampling with urban-rural representation. To establish the factors associated with the uptake of injectable contraceptives, a multiple logistic regression model was fitted using Stata version 13 and R version 3.5.3 statistical software. Hosmer-Lemeshow Test statistic was used to evaluate the goodness of model fit in predicting injectable contraceptive usage.

Results: Multivariable analysis showed that women with post-primary/vocational levels of education were 54% less likely to use an injectable contraceptive compared to those who had no education at all. Hosmer-Lemeshow (HL) goodness of fit test statistic indicated that the model was a good fit for prediction. Education, marital status, wealth quintile, place of residence and number of births were significant predictors of the injectable contraceptive uptake among women of reproductive age in Kenya.

Conclusion: The findings of this study will inform the design of targeted interventions aimed at addressing the increasing demand for injectable devices among women of reproductive age in Kenya.

Keywords: Contraceptive Devices; Reproduction; Kenya

Introduction

Contraceptive use is considered safe and an

affordable way to help couples and individuals prevent themselves from becoming pregnant or planning their families. It can significantly lower cases of maternal and infant mortality resulting from unplanned pregnancies. Despite the promotion and existence of a wide range of contraceptive options,

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the use of contraceptives remains a challenge in Kenya. In East Africa, the rates of contraceptive prevalence are higher in Kenya (58%) and Rwanda (53%) compared to other countries in the region, while Uganda has the lowest rates (30%) (1).

In 2016, the World Bank estimated the contraceptive prevalence rate (CPR) among women who are married or in-union and are within the reproductive age of 15-49 years in Kenya at 62% (2). Further evidence indicates that more than half of the women contraceptive users in Kenya use modern methods comprising of the injectables, diaphragm, female and male sterilization, standard days method, emergency contraception, IUD (Intrauterine Device), pill, male and female condoms, lactational amenorrhea method and implants (3). The 2014 Kenya Demographic and Health Survey (KDHS) also reveals that close to half of all women using modern contraceptives are injectable contraceptive users (4).

The uptake of modern contraceptive methods has been on the rise in Kenya over the last few decades as evidenced by the statistics provided by previous KDHS. Further, among the modern contraceptive users, consumers of injectable contraceptive contribute a higher percentage. Correspondingly, the preference of injectable device among women has increased over time and is by far the most preferred method among women with an intention of using a contraceptive method in future. The preference for the injectable device has also seen a decline in the discontinuation rates among its users compared to the other modern contraceptive options.

A number of factors have been linked to contraceptive usage among women in the past. In their study in Australia, Goldstone et. al. used a binary logistic regression model to assess the determinants of Long-acting Reversible Contraceptives (LARCs) uptake. Among the determinants included in the model, the analysis revealed that age, number of children and wealth quintile were significant predictors of LARCs uptake. However, race, marital status and area of residence were not significantly associated with LARCs uptake. The study concluded with an emphasis on the need to ensure accessibility and affordability of LARCs to enable more women to avoid further unintended pregnancies (5).

In another study, Makau et. al. used multinomial logistic regression to predict Contraceptive Use Among Women in Kenya (6). Predictor variables included were socio-economic factors which

comprised of education and wealth index and socio-demographic factors such as place of residence, religion, age, marital status, number of living children and access to a health facility. The analysis revealed marital status, Wealth quintile, level of education, residence and the number of children alive as significant predictors of contraceptive usage by Kenyan women.

Ross and Agwanda sought to explore factors related to increased use of injectable contraception in the context of alternative methods. The study revealed that injectable contraception usage was significantly associated with wealth quintile, residence and age. In contrast, the analysis showed that marital status and the number of living children a woman had were not significantly associated with the uptake of injectable contraceptives (7).

Based on the above series of arguments, injectable contraceptive usage has not been adequately studied despite evidence pointing at it as the most preferred contraceptive method among women. In their study on modelling determinants of choice of contraceptive methods in Rwanda, Sebuho et. al. featured contraceptive injectables as the most preferred contraceptive method among women with a national prevalence of 50.9%, however, no clear patterns about this selection were provided (8). The little works on the contraceptive have failed to clear on why there is a shift from the other modern contraceptives towards the injectable contraceptive.

The aim of the study, therefore, is to seek a deeper understanding of and determine factors associated with the increased uptake of injectable contraceptive among users of modern contraceptive methods. The insights from this study should be useful in identifying subgroups of the population to target for provision of the injectable contraceptives due to the rising demand and will also inform the design of targeted interventions aimed at addressing the increasing demand of the injectable devices in Kenya.

Materials and methods

Study design and data source: This is an analytical cross-sectional study utilizing secondary data obtained from a nationally representative (Performance Monitoring for Action) PMA2020 Kenya Round 6, Household and Female family planning survey conducted in 2017 (3). The survey covered 11 out of 47 counties selected using probability proportional to size. The counties included Kilifi, Nairobi, Kiambu, Nyamira, Nandi,

Bungoma, Kericho, Siaya, Kitui, Kakamega & West Pokot. The population targeted for this study were all women between the age of 15 and 49 years who resided in the 11 counties at the time of the survey.

Sample size and sampling procedures: The study sample comprised of 2,450 women of reproductive age from sampled households in the 11 counties who reported using any modern contraceptive method at the time of ICRH-PMA2020 Kenya Round 6 annual population-based survey conducted in 2017. The survey was designed to collect data for national mCPR estimates among women of reproductive age in Kenya (9) and adopted a multi-stage sampling with urban-rural representation covering 11 counties selected as strata. A sample of 151 enumeration areas (EAs) was identified from the Kenya National Bureau of Statistics (KNBS) master sampling frame. EAs created during the 2009 Kenya Population and Housing Census were used as the primary sampling units for the survey. Selection of EAs was done systematically using probability proportional to size with urban/rural stratification in the eleven counties. In each enumeration area, all households were enumerated and listed then 42 households were randomly selected. At the household level, all eligible females between 15 and 49 years were contacted and those who consented were interviewed. However, only 2,450 modern contraceptive users were included in the analysis for this specific study.

Study variables: Multiple logistic regression was used to model for factors associated with uptake of injectable contraceptive among women who reported to use modern contraceptive methods for family planning. Response variable for the model was 'use of injectable contraceptive' while explanatory variables hypothesized for consideration were age, education level, wealth status, marital status, area of residence, religion and number of living children. Only significant explanatory variables were included in the model for prediction.

Ethical consideration: Ethical approval to use the data for analysis was sought from KNH-UoN Ethics and Research Committee after authorization to use the de-identified secondary dataset was granted by PMA2020. There was no interaction with the human participants as this study utilized de-identified secondary data for analysis to safeguard the privacy and confidentiality of the participants. As such, the study subjects were not linked to their respective responses.

Data processing and analysis: Secondary data with no identifiers was utilized for analysis using

Stata version 13 & R version 3.5.3 Statistical Software. Apart from the univariable regression analysis, the study also utilized multivariable logistic regression analysis. Univariable analysis was used to explore the association between the outcome variable (use of injectable contraceptive) and one independent variable while multivariable analysis assessed the simultaneous relationship between the outcome and a set of predictor variables while adjusting for potential confounders.

Multiple Logistic Regression Model: Multiple logit model is a type of multi-variable model used when there is one nominal response variable and two or more explanatory variables, and you want to assess how the explanatory variables affect the nominal response variable (10). The model was applied to the prediction of injectable contraceptive uptake based on certain hypothesized socioeconomic and sociodemographic predictors; age, education level, wealth status, religion, marital status, area of residence and parity (number of children born). The fitted regression model is of the form;

$$\ln\left(\frac{p}{1-p}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_k X_k$$

where $\beta_1, \beta_2, \dots, \beta_k$ are k regression coefficients, p is the expected probability of being an injectable contraceptive user and X_1, X_2, \dots, X_k are predictors.

Statistical Significance Tests: The following hypotheses were tested to check for the statistical association between the injectable contraceptive uptake and each predictor while adjusting for all other predictors;

$$H_0: \beta_i = 0, \quad \text{vs.} \quad H_1: \beta_i \neq 0$$

Significance of the predictors was determined using either the confidence intervals for the odds ratios or the Wald test statistic. A significant test result indicated a statistical association between the response and the predictor variables.

Evaluating Goodness of Fit: The adequacy of the model fitted was assessed using Hosmer-Lemeshow (HL) goodness of fit test statistic; which is based on predicted probabilities, or risks of the outcome in the model being evaluated. The HL test statistic is given by:

$$\hat{H}\hat{L} = \sum_{i=1}^K \frac{(O_i - n_i \bar{p}_i)^2}{n_i \bar{p}_i (1 - \bar{p}_i)} \sim \chi_{k-2}^2$$

where n_i is the number of observations in group i ,

, O_i is the observed events' frequency in group i , \bar{p}_i is the probability predicted on average in group i , and K is the sum of the groups. The test statistic approximately follows a chi-square distribution with $K-2$ degrees of freedom. A test statistic which is statistically significant points to a poor model fit for the data. This means there is at least one group which is statistically different in the number of outcomes predicted from the observed (11).

Results

Respondent Background Characteristics: Descriptive statistics of the study subjects are shown in Table 1.

Table 1: Background characteristics of women included in the Modern Contraceptive use analysis – PMA2020 (Age: 15 years or older but less or equal to 49 years; n = 2450)

Variables	Frequency (n)	Percentage (%)
Currently using Injectable Contraceptive		
Yes	1041	42
No	1409	58
Education Level		
Never attended	51	2
Primary	1211	49
Post-primary/vocational	45	2
Secondary/A-level	745	30
College (Middle Level)	330	13
University	68	3
Marital Status		
Married	1790	73
Living with a partner	102	4
Divorced / separated	113	5
Widow / widower	46	2
Never married	398	16
Wealth quintile		
Lowest quintile	329	13
Lower quintile	534	22
Middle quintile	495	20
Higher quintile	550	22
Highest quintile	542	22
Religion		
Catholic	448	18
Protestant / other	1765	72
Christian		
Muslim	87	4
No religion	89	4
Other	59	2
Place or Residence		
Urban	917	37
Rural	1533	63

A total of 2450 women were included in the study all comprising of modern contraceptive users out of which 1041 (42%) were injectable contraceptive users. The median age of those interviewed was 30 years and the median number of birth events was 2. Most study subjects had completed the primary and secondary level of education (49% and 30% respectively). Among all the modern contraceptive users interviewed, the majority (73%) were married while 16% had never been in any marriage. Cumulatively, close to two-thirds (64%) of the participants had attained at least the middle quintile wealth status. The most dominant religion of those interviewed was Christian Protestants represented by 72% and the majority (63%) resided in rural areas, while 37% resided in rural areas at the time of the survey.

Univariable Logistic Regression Analysis: In the univariable analysis, most of the socioeconomic and sociodemographic characteristics were significantly associated with the injectable contraceptive uptake. From the results in Table 2, the education level, marital status, wealth quintile, number of births and place of residence were found to be significant predictors of injectable contraceptive. Age and religion were found to be statistically insignificant predictors of injectable contraceptive uptake. From the analysis, modern contraceptive users with a primary level of education were 54% less likely used injectable contraceptive compared to those who had no education at all (crude POR = 0.46, 95% C.I. (0.26, 0.77)) while those with post-primary education were 58% less likely to use injectable contraceptive compared to those who never attended school (crude POR = 0.42, 95% C.I. (0.24, 0.72)). Women users of modern contraceptives who were divorced or separated were 33% less likely to use injectable contraceptive compared to those who are married (crude POR = 0.67, 95% C.I. (0.45, 0.99)) while those who have never married were 55% less likely to use injectable contraceptive compared to those who are married (crude POR = 0.45, 95% C.I. (0.35, 0.57)).

Further, respondents belonging to the lower wealth quintile were 47% less likely to use injectable contraceptive injectable respectively compared to those of the lowest quintile (crude POR = 0.53, 95% C.I. (0.44, 0.65)). Those of the middle wealth quintile were 21% less likely to use the injectable contraceptive compared to those of the lowest quintile (crude POR = 0.79, 95% C.I. (0.65, 0.96)).

Table 2: Univariable logistic regression analysis for determinants of injectable contraceptive uptake among women of reproductive age in Kenya

Variables	Crude Prevalence Odds Ratio	95% C.I.	Overall p-value
Age	0.998	0.988-1.009	0.7680
Education level			<0.0001
Never attended	Ref.		
Primary	0.458*	0.265-0.774	
Post-primary/vocational	0.421*	0.240-0.718	
Secondary/A level	0.947	0.634-1.401	
College/Middle Level	0.776	0.562-1.065	
University	1.202	0.810-1.808	
Marital status			<0.0001
Married	Ref.		
Living with a partner	1.230	0.825-1.837	
Divorced/separated	0.674*	0.451-0.994	
Widow(er)	0.693	0.371-1.257	
Never married	0.452*	0.355-0.572	
Wealth quintile			<0.0001
Lowest quintile	Ref.		
Lower quintile	0.535*	0.440-0.649	
Middle quintile	0.791*	0.654-0.957	
Higher quintile	0.900	0.755-1.074	
Highest quintile	0.895	0.751-1.065	
No. of births	1.070*	1.027-1.114	0.0011
Religion			0.1076
Catholic	Ref.		
Protestant/Christian	1.128	0.915-1.394	
Muslim	0.769	0.471-1.235	
No religion	1.248	0.788-1.971	
Other	0.642	0.350-1.135	
Place of residence			<0.0001
Urban	Ref.		
Rural	1.494*	1.264-1.768	

Ref. Reference Category; * Significant ($P < 0.05$), Non-significant ($P > 0.05$)

Women were 7% more likely to use injectable contraceptive for every additional birth event (crude POR = 1.07, 95% C.I. (1.03, 1.11)) and those residing in the rural areas were 49% more likely to use injectable contraceptive compared to those in urban areas (crude POR = 1.49, 95% C.I. (1.26, 1.77)).

Multivariable Logistic Regression Analysis:

Multivariable analysis was conducted on the predictors that became statistically significant in the univariable model. At this stage, the multivariable logistic regression model was built to explore the relationship between the injectable contraceptive use and various covariates while adjusting for other variables. The model is shown in Table 3 below.

In this model, holding all other variables constant among modern contraceptive users, women with post-primary/vocational level of education were 54%

less likely to use an injectable contraceptive compared to those with no education at all (Adjusted POR = 0.46, p-value = 0.0059, 95% C.I. (0.26, 0.79)). On marital status, divorced/separated women were found to have 38% (Adjusted POR = 0.62, p-value = 0.02, 95% C.I. (0.41, 0.93)) lesser odds of using injectable contraceptive than those married after adjusting for the other variables. Similarly, women who have never been in any marriage were 53% less likely to be injectable contraceptive users compared to those married (Adjusted POR = 0.47, p-value = <0.0001, 95% C.I. (0.35, 0.61)). Adjusting for education level, marital status, number of births and place of residence, women in the lower quintile were 37% less likely to use the injectable contraceptive compared to those in the lowest quintile (Adjusted POR = 0.63, p-value = 0.000191, 95% C.I. (0.49, 0.80)).

Table 3: Multivariable logistic regression analysis for determinants of injectable contraceptive uptake among women of reproductive age in Kenya

Variables	Crude Prevalence Odds Ratio	95% C.I.	p-value
Intercept	0.689		
Education level			
Never attended	Ref.		
Primary	0.701	0.392-1.234	0.2230
Post-primary/vocational	0.457	0.258-0.790	0.0059 **
Secondary/A level	0.943	0.628-1.403	0.7758
College/Middle Level	0.773	0.556-1.067	0.1207
University	1.140	0.762-1.729	0.5274
Marital status			
Married	Ref.		
Living with a partner	1.168	0.777-1.757	0.4545
Divorced/separated	0.623	0.413-0.927	0.0212*
Widow(er)	0.641	0.340-1.174	0.1564
Never married	0.465	0.355-0.608	<0.0001 ***
Wealth quintile			
Lowest quintile	Ref.		
Lower quintile	0.626	0.489-0.800	0.00019 ***
Middle quintile	0.879	0.722-1.071	0.1998
Higher quintile	0.916	0.766-1.095	0.3354
Highest quintile	0.887	0.743-1.059	0.1849
No. of births	0.960	0.913-1.010	0.1155
Place of residence			
Urban	Ref.		0.3507
Rural	1.101	0.899-1.349	

Ref Reference Category, CI Confidence Interval

Significant Codes at 5% level of significance: * 0.01, ** 0.001, *** 0.0001

However, all other categories in the explanatory variables assessed were found to be statistically insignificant compared to the reference categories after adjusting for all other covariates. Further, the analysis revealed that the number of births and place of residence were not statistically significant in determining injectable contraceptive usage given that other variables are held constant. After stepwise model selection, number of births was retained as a significant variable though the level of association was very weak. This means that women are 4% less likely to use injectable contraceptive for every additional birth event (Adjusted POR=0.96).

Fitting the Injectable Contraceptive Use Model:

The 5 regression coefficients that were significant in the multivariable analysis were used to construct the multiple logic model of using the injectable contraceptive method. Before evaluating the model fit, the best model was selected using a stepwise selection method and place of residence was found to be insignificant. As such, a model was refitted using the level of education, marital status, wealth quintile

and number of births as predictor variables. The multiple logistic regression model fitted to predict the injectable contraceptive usage among modern contraceptive users were:

$$\ln\left(\frac{\text{injectable}}{\text{non-injectable}}\right) = -0.318(\text{Intercept})$$

- 0.784 Highest Education Level: Post-primary/vocational
- 0.487 Marital status: Divorced/Separated
- 0.764 Marital Status: Never married
- 0.518 Wealth Quintile: Lower quintile
- 0.038 Birth Events

Evaluating Goodness of Fit: The adequacy of the model fitted was evaluated using Hosmer-Lemeshow (HL) goodness of fit test statistic; which is based on predicted probabilities, or risks of the outcome in the model being evaluated. The test statistic helps to determine whether the model adequately describes the data. A value of significance less than 0.05 indicates a poor fit. The fitted multiple logit model was assessed for adequacy and results showed that there was no sufficient evidence to suggest that the

fitted model is a poor fit ($\chi^2(8) = 11.731$, $p\text{-value} = 0.1636$). Therefore, the fitted model is good and can be used for prediction.

Discussion

Determinants of Injectable Contraceptives: From the findings, we found out that most of the socioeconomic and sociodemographic characteristics were significantly associated with the injectable contraceptive uptake at a univariable analysis. We observed that education level, marital status, wealth quintile, number of births and place of residence were significant predictors of injectable contraceptive use at the univariable level. While number of births and place of residence were significant at univariable analysis level, the covariates, however, became statistically insignificant in the multivariable analysis after adjusting for all the other variables included in the model. This, however, contrasts with another study in which revealed that the number of living children was statistically significant and the more the number of children a woman had, the higher the chances of using the injectable contraceptive (12).

Women who have higher education level up to post-primary level were 58% less likely to use the injectable contraceptive compared to those with no education at all. This result concurs with a study by Morroni et. al. in South Africa, which reported that less-educated women especially those that are married utilize the DMPA as opposed to other contraceptive methods available (13). This may also be partly based on the assumption that less-educated women would go for the injectable for fear that their partners may not allow them to access contraceptives; leaving them with the injectable as the option. This inference is further supported by Bouthina K. et. al., who indicated that 2.3% of women of reproductive age experience covert use of the injectable contraceptive due to their husbands' refusal use a contraceptive method (14).

Concerning the effect of marital status, this study has revealed that only two categories are significantly associated with the injectable contraceptive uptake compared to the reference category (married). Women who are married are more likely to use the injectable contraceptive compared to whom that are divorced/separated or those who have never married. It has been postulated that opposition from partner to use other contraceptive methods facilitates women's choice of the injectable as it is not easily detectable by the partner. In their study on covert contraceptive

use among women in Ghana, Baiden et. al., found out that women's inability to exercise autonomy in their reproductive choices largely contributes to covert contraceptive use (15). A review of data from Sub-Saharan Africa, South East Asia and South Central Asia among women with unmet need for a modern contraceptive method, also revealed that women partner's approval is a precondition to the uptake of contraceptive method (16). Further, secondary analysis of the 2010 Rwanda Demographic Health Survey (RDHS) datasets indicated that partner's approval has a significant effect on the choice of another contraceptive method over injectables (8). This points to the fact that interventions to enhance contraceptive uptake should target both partners so that the challenge occurring due to unmet need for available family planning methods is adequately addressed.

In this study, wealth quintile was also found to be a significant factor in the injectable contraceptive uptake. We discovered that women of higher wealth quintile are less likely to use the injectable contraceptive compared to those of the lowest quintile. Studies have associated the use of the injectable to those living in the poorest regions of the globe. In a report by the United Nations, the injectable contraceptive method is widely used in some of the poorest countries and is common in Eastern & Southern Africa, South-Eastern Asia as well as in developing sub-regions of Oceania (17). Another study by Ross and Agwanda aimed at exploring factors related to increased use of injectable contraception in SSA concluded that injectable contraception usage was significantly associated with wealth quintile (7).

At both levels of analysis, age, religion, place of residence and number of births did not have a statistically significant association with the injectable contraceptive uptake among women of reproductive age in Kenya. However, the stepwise selection retained the number of births as a significant variable at the multivariable level. The insignificance especially associated with religion may be attributed to the fact that the majority of the regions sampled for the survey are majorly inhabited by Christians. This, however, contrasts findings from studies done in other countries especially within the SSA and other developing world which pointed out to the fact that these factors were strongly associated with injectable uptake (6, 10, 13).

Multiple logit model fit and adequacy: Before the

model was built, variable selection was done by first conducting a univariable analysis of each variable with the outcome variable. Any variable that was found to be statistically significant at 5% level of significance based on overall p-values was then considered for multivariable analysis. This approach is useful when the interest is not only on prediction but also when modelling the risk factors (18).

The model building for this study was done using a generalized linear model in R and the regression coefficients found significant after the stepwise selection were used to refit the multiple logit model. Comparing the AIC values, the model with the smallest AIC was subjected to the Goodness of Fit test using Hosmer and Lemeshow test which is the most widely used test statistic for logistic regression model (19). Overall, the fitted model was found to be adequate for predicting the odds of injectable contraceptive uptake among Kenyan women of reproductive age using any of the modern contraceptive methods.

Our study was however faced with a few limitations. Since the study was based on secondary data, the analysis was limited to a number of predictor variables whose data was available though there may be other important factors associated with the use and non-use of injectable contraceptive. Another limitation was an issue of three subjects with missing data (two on religion and one on marital status); they were however excluded from the analysis and only completed interviews were used. Further, this being a purely quantitative study, no relevant qualitative data was collected thereby missing out triangulation to explore reasons behind the choice of the injectable contraceptive among other modern methods.

Recommendations: The policy implementers should consider intensifying campaigns targeted at women who are divorced/separated, never married, those with post-primary education, those in the lower quintile and the ones with more birth events as they are key populations identified by the study as having lesser odds of using the injectable contraceptive. The findings should inform which subgroups of the population to target for provision of the injectable contraceptives due to the rising demand and should also inform the design of targeted interventions aimed at addressing the increasing demand of the injectable among women of reproductive age in Kenya.

Efforts should be put in place to ensure that women have equal access to family planning

information material so that they are knowledgeable and able to make informed decision on the choice of the contraceptive method. We further recommend that the ministry of health takes up this findings and utilize in coming up with comprehensive sexual education programmes with facts on contraceptive injectable. Finally, since the injectable contraceptive is available in different types, future studies should consider exploring on the determinants of women's preference for one type of the injectable over the other as it fell out of the scope of this study.

Conclusion

The findings of this study underscore the influence of education, marital status, wealth quintile, place of residence and number of births as key predictors of the injectable contraceptive uptake by women of reproductive age in Kenya. Multiple logistic regression model fitted was found to be adequate for use in predicting injectable contraceptive uptake among Kenyan women in reproductive age using any modern contraceptive method.

Conflict of Interests

Authors have no conflict of interests.

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