

# Risk of Discontinuance in Contraceptive Uptake Among Kenya Women: A Survival Analysis Using the Cox Proportional Hazard Model

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## ABSTRACT

A problem of equal importance is the substantial challenge posed by the discontinuance of contraceptive use in family planning programs, particularly for developing countries such as Kenya. Investigating the determinants of contraceptive discontinuation using demographic factors can provide insights to enhance the efficacy of family planning. Using data from the Performance Monitoring for Action (PMA) survey, this study examined the demographic and contraceptive method-related covariates associated with the risk of discontinuation of contraception among Kenyan women. The study employed Cox proportional hazards models to analyze sampled data of Kenyan women from the PMA survey. Two separate models were used: a standard model which included demographic characteristics with a baseline contraceptive variable (Ever use contraceptive) and an extended model showing how specific contraceptive methods impact the likelihood of the risk of discontinuing contraception. Older age (Coefficient of -0.268 with a hazard ratio of 0.765) was associated with a decreased risk of contraceptive discontinuation. At the same time, women with higher educational levels (Coefficient of 0.015, with a hazard ratio of 1.015) were related to an elevated hazard and were more likely to discontinue their current method of contraception. The extended model showed that subcutaneous injectable contraceptives (Coefficient of -2.040 with a hazard ratio of 0.130) and male condoms (Coefficient of -1.137 with a hazard ratio of 0.321) were conditionally related to a significantly decreased hazard of discontinuation. The results highlight the importance of contraception choice and the significance of age and education in maintaining continuous contraception. To support Kenyan women in maintaining continuous contraception in achieving their reproductive health goals comprehensive education on emergency contraception and the provision of long-acting reversible contraceptives should be provided by health and family planning organizations. There is a call for a longitudinal study to offer an understanding of the dynamic behavior of contraception over time and the need for time-varying analyses to capture the evolving nature of contraception and its discontinuation.

**Keywords:** Cox proportional hazards models, contraceptive discontinuation, family planning, Performance Monitoring for Action (PMA)

## Introduction

Contraceptive use is an important aspect of family planning initiatives, empowering women to manage

their reproductive health (Shiferaw & Musa, 2017). Kenya has one of the highest levels of unmet need for contraception in the world, with nearly one in five married women with an interest in avoiding pregnancy but not using any form of contraception (Ontiri et al. 2021). This is a problem as the funding for family planning is lagging, and the population keeps proliferating (Kantorova et al. 2020). The discontinuation of contraception presents a significant problem in countries with higher fertility rates and untapped demand for contraception as it is in Kenya (kamuyango et al., 2020). Examining the factors of stopping contraception is important for effective and efficient planning that fosters continuous contraception (Kungu et al., 2022).

The findings of previous research done in Kenya show that demographic, socio-economic, and type of methods of contraception are related to contraception and its changes. Young Maasai ladies are most affected by misconceptions and negative perceptions towards family planning which may limit the consistent use of contraceptives (Stats et al., 2020) (Belete et al., 2018) This study aimed to determine the data on the demographic and method-related factors for contraceptive disposal among Kenyan women using Performance Monitoring for Action (PMA) survey data. Using the Cox Proportional hazards model, the study establishes a relationship between demographic factors and types of contraception and the likelihood of contraception discontinuation.

### **Contraceptive Use and Discontinuation Globally**

Discontinuation of contraception is reportedly high in developing countries for reasons attributed to few choices and limited access to family planning services (Polis et al., 2016). Available studies show that the Discontinuation of contraception leads to the experience of unwanted pregnancies increasing fertility rates and imparting additional health risks to expectant moms and their infants (Staveteig et al., 2015).

### **Contraceptive Use and Discontinuation in Kenya**

In Kenya, the percentage of women who discontinue contraception often is a little higher at around 30% (Kungu et al., 2022). Despite witnessing the early establishment of family planning programmes in the early 1980s, this remains a problem. Factors such as demographic information, socioeconomic level, and other contraceptive methods-related issues contribute to this problem.

In Kenya, there has been an increase in the use of contraceptives, but the rate of stopping is of concern. KDHS 2014 report gives the prevalence of dropping the method chosen within the first year at 31%. This is due to side effects of the contraceptive method, ineffectiveness, or desire to conceive. This concurs with the fact that user satisfaction and method choice impact the stopping rates of contraception in Kenya ( Adanikin et al., 2019) ( Machiyama et al 2017). The majority of women in Kenya drop out of contraception due to fertility issues and the kind of contraception they use (Belete et al. 2018).

### **Factors Influencing Contraceptive Discontinuation**

Several studies have shown that there are factors that determine why women decide to cease using contraceptives some of which are- The methods chosen as well as other factors like level of education and age. Younger women are more likely to discontinue the use of contraception because of the side effects of the method, health concerns, or the desire to have a child among others. On the other hand, most women, who are older, and have achieved their reproductive goals are less inclined to halt the usage of contraceptives (Berglas et al., 2021).

Another demographic characteristic that can affect contraception in most of the studies is the level of educ-

ation. It is claimed in some literature that women with higher education are more resistant to the discontinuation of contraception because they know more about it and its advantages (Hirth et al., 2021). On the contrary, some other studies posit that educated women switch methods, and therefore contraction discontinuation rate is higher (Casterline et al., 2007).

The method of contraception that is preferred however is more significant, it is safe to say long-acting reversible contraceptives (LARCs), for instance, injectable and intrauterine devices have lower rates of discontinuation than the short-term methods most use overwhelmingly such as the pill and condom (bande et al., 2024). The fact that the methods are easy to obtain and administer also contributes to the sustained use of the contraceptive methods (Sitruk-Ware et al., 2021).

## Methodology

### Study Design and Data Source

This research utilizes Performance Monitoring for Action (PMA) survey data that collects a representative sample of Kenyan women of reproductive age. The data collection in PMA entailed collecting information on various demographic characteristics, contraceptive use history, and the methods used. Some of the important variables of interest in the analysis were age, education level, marital status, history, and types of birth control methods used at present or in the past.

### Statistical analysis

Survival analysis was performed by utilizing the Cox proportional hazard model to determine the hazard ratios (HRs) specifically for the risk of ceasing contraception. Semi-parametric regression method assumes a parametric form for the influence of prognostic factors on the hazard rather than a baseline hazard function. The survival time is assumed to have a parametric structure, but its time dependence is not described. Cox (1972) put out the Cox model as:

$$h(t|X) = h_0(t) \exp(\beta_1 x_1 + \beta_2 x_2 + \dots + \beta_p x_p) = h_0(t) \exp(\beta' x) \quad (1)$$

Where:  $h_0(t)$  is the baseline hazard function,  $x = (x_1, x_2, \dots, x_p)$  represent the values of the vector of explanatory variables for a particular individual and  $\beta' = (\beta_1, \beta_2, \dots, \beta_p)$  represent the vector of regression coefficients. The Cox proportional hazards model assumes independent survival times and represents survival time, relative risk, and constant hazard ratio. It calculates the coefficient of regression, the hazard ratio, and provides adjusted curves. The hazard ratio assesses predictors' significance for survival times:

$$HR = \frac{\hat{h}_0(t) \exp(\sum_{i=1}^k \beta_i x_i^*)}{\hat{h}_0(t) \exp(\sum_{i=1}^k \beta_i x_i)} = \exp \left[ \sum_{i=1}^k \beta_i (X_i^* - X_i) \right] \quad (2)$$

In terms of mathematics survival analysis, firstly we state that if  $HR > 1$  than the first cohort ( $X^*$ ) is to be understood as belonging to a stratum characterized by the high risk of occurrence of the event in question. On the other hand if  $HR < 1$ , this would mean that the second cohort ( $x$ ) is encased in a stratum that is rather high risk. An HR of 1 communicates that the two cohorts have similar chances of incurring the event in question. The Cox model uses the partial likelihood function that accounts for censored data to estimate the parameters in equation 1.1. the partial likelihood function is provided by:

$$L(\beta) = \prod_{i=1}^n \left( \frac{\exp(X_i \beta)}{\sum_{j \in R(t_i)} \exp(X_j \beta)} \right) \quad (3)$$

Where  $R(t_i)$  denotes the risk set at a time  $t_i$ , which consists of individuals who are still at risk,  $\exp(X_i\beta)$  represents the hazard function for individual  $i$  at time  $t_i$ , which is defined as  $\lambda(t_i|X_i) = \lambda_0(t_i) \exp(X_i\beta)$ , where  $\lambda_0(t_i)$  is the baseline hazard function. The denominator represents the sum of the hazard functions for all individuals in the risk set at a time  $t_i$ . The numerator only includes event times  $t_i$ , while the denominator includes censored and uncensored observations, the log of the partial likelihood gives the sum over the risk set, we obtain:

$$l(\beta) = \ln(L(\beta)) = \sum_{j=1}^r \left\{ X_j\beta - \ln \left( \sum_{k \in R(t_j)} \exp(X_k\beta) \right) \right\} \quad (4)$$

If there are tied events in the data sets, the partial likelihood method cannot be used. This is because no pair of subjects can experience an event at the same time. If ties exist in the survival outcome of any event of interest, an approximation to the partial likelihood derived by Breslow (1974) and Efron (1977) must be employed.

Two models were specified:

**Standard Model:** This model included demographic variables such as age, level of education, and marital status, along with general contraceptive use variables such as ever-used contraceptives, and currently using contraceptives).

$$h(t|X) = h_0(t) \exp(\beta_1 \text{Age} + \beta_2 \text{Level of Education} + \beta_3 \text{Marital Status} + \beta_4 \text{Ever Use Contraceptive} + \beta_5 \text{Currently Using Contraceptive}) \quad (5)$$

**Extended Model:** This model incorporated specific contraceptive methods to assess their impact on the hazard of discontinuation.

$$h(t|X) = h_0(t) \exp(\beta_1 \text{Emergency Contraceptive} + \beta_2 \text{Female Condom} + \beta_3 \text{Female Sterilization} + \dots + \beta_n \text{Age}) \quad (6)$$

Both models were fitted using standard techniques, and the results were presented as hazard ratios with 95% confidence intervals. Statistical significance was determined at the  $p < 0.05$  level.

## Results

### Demographic Characteristics

The study sample is made up of 8, 223 Kenyan women from all walks of life with an average age of 27.7 years within the range of 15 to 45 years old with a standard deviation of 8. 6 years. The majority of respondents had completed primary education (44.18%), followed by 36.51% with secondary education, 10.13% with a college education, and 2.65% with a university education. 4.34% had no educational background and 2.17% had undergone primary vocational training. Regarding marital status, the majority of the women were married (53.31%), 33.11% were never married, 5.69% were living with their partner, 5.64% were divorced or separated, and 2.22% were widowed. On contraception, more than half (53%) were currently not using any form of contraceptive (Table 1).

**Table1: Demographic Characteristics**

Variable	Categories	Frequency	Percentage (%)
<b>Age (Years)</b>	Mean ± SD (Range)	27.7 ± 8.6 (15-45)	
<b>Level of Education</b>	College	833	10.13%
	Never	357	4.34%
	Post-primary vocational	179	2.17%
	Primary	3633	44.18%
	Secondary (A Level)	3003	36.51%
	University	218	2.65%
<b>Marital Status</b>	Divorced/Separated	464	5.64%
	Living with a Partner	468	5.69%
	Married	4384	53.31%
	Never Married	2723	33.11%
	No Response	1	0.02%
	Widow/Widower	183	2.22%
<b>FP Start Method</b>	Diaphragm	3	0.04%
	Emergency Contraception	63	0.94%
	Female Condom	17	0.25%
	Female Sterilization	156	2.32%
	Foam/Jelly	3	0.04%
	Implant	2350	34.98%
	Injectables	2355	35.05%
	Injectables SC	144	2.14%
	IUD	239	3.55%
	LAM	27	0.40%
	Male Condom	398	5.92%
	Male Sterilization	1	0.14%
	No Response	36	0.53%
	Other Traditional Method	79	1.17%
	Pill	592	8.81%
	Rhythm Method	154	2.29%
	Standard Days/Cycle Beads	52	0.77%
Withdrawal	49	0.72%	
<b>Current Using FP</b>	Yes (1)	3889	47%
	No (0)	4334	53%
<b>Current Method</b>	Diaphragm	1	0.03

	Emergency Contraception	87	2.24
	Female Sterilization	115	2.96
	Implant	1413	36.32
	Injectables	1198	30.80
	Injectables SC	144	3.70
	IUD	129	3.32
	LAM	21	0.54
	Male Condom	264	6.79
	Male Sterilization	1	0.03
	No Response	1	0.03
	Other Traditional Method	59	1.52
	Pill	277	7.12
	Rhythm Method	113	2.90
	Standard Days/Cycle Beads	36	0.93
	Withdrawal	31	0.80

Source: PMA, Kenya

### Survival Analysis

#### Standard Cox PH model

The standard Cox model (Table 2) provided insights into the role of demographic factors in contraceptive discontinuation:

**Age:** Women approaching older age are less likely to discontinue contraception, with age acting as a protective (HR = 0.765,  $p < 0.001$ ).

**Level of Education:** Education level marginally raised the hazard of discontinuation of contraceptives (HR = 1.015,  $p < 0.05$ ). This indicates that women with higher education are more knowledgeable about their contraceptive options, leading to higher rates of method switching and temporary discontinuation

**Ever Used Contraceptives:** Contraceptive history was a significant predictor of discontinuation due to dissatisfaction or side effects (HR = 1.353,  $p < 0.001$ ).

**Table 2: Cox Proportional-hazards Results (Standard Model)**

Variable	Coefficient	exp(coef)	Pr(> z )	exp(-coef)	lower .95	upper .95	Significance
Age	-0.268	0.765	<2e-16	1.307	0.718	0.814	***
Level of education	0.015	1.015	0.0151	0.985	1.003	1.028	*
marital Status	-0.017	0.983	0.0925	1.018	0.963	1.003	
Ever use Contraceptive	0.303	1.353	<2e-16	0.739	1.308	1.4	***

Currently Using Contraceptive	-20.480	1.27e-09	0.8743	7.85e+08	8.06e-120	2.01e+101	
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significance levels are denoted as follows: \*p<0.05, \*\*p<0.01, \*\*\*p<0.001.

Measure	Value	Standard Error	df	p-value
Concordance	0.848	0.002		
Likelihood ratio test	24041		5	<2e - 16
Wald test	446.4		5	<2e - 16
Score (log-rank) test	17961		5	<2e - 16

### Extended Cox PH Model

The extended model (Table 3) concentrates on the effect of individual contraceptive methods on discontinuation rates:

**Emergency Contraception:** Women who used emergency contraception had a lower hazard of discontinuation (HR = 0.299, p < 0.01), this may be due to its immediate effect in terms of preventing unintended pregnancy.

**Injectables SC:** Subcutaneous injectables had the strongest protective effect against discontinuation with an 87% reduction of hazard (HR 0.130, p < 0.001). This an indication of the continued use of long-acting contraceptives.

**Male Condom:** Male condoms significantly reduced the odds of discontinuation of contraceptives by 7.9 percent (HR = 0.321, p < 0.01) because it is convenient, no side effects, and easy to access.

**Pill and Other Methods:** The other means of contraception including; Pills, IUDs, and female sterilization had varying effects on discontinuation. However, many of these effects were non-significant implying that the causes for termination might be diverse and therefore not easily explainable.

**Table 3: Cox Proportional-hazards Results (Extended Model)**

Variable	Coefficient	exp(coef)	Pr(> z )	exp(-coef)	lower .95	upper .95	Significance
Emergency Contraception	-1.208	0.299	0.00315	3.347	0.134	0.667	***
Female condom	0.522	1.686	0.22487	0.594	0.727	3.912	
Female sterilization	-0.532	0.587	0.17818	1.702	0.271	1.272	
Foam/jely	1.136	3.116	0.15655	0.321	0.647	15.015	
Implant	-0.299	0.741	0.43063	1.348	0.353	1.559	
Injectables	-0.128	0.88	0.73536	1.137	0.419	1.848	
Injectables SC	-2.04	0.13	3.54e-05	7.691	0.049	0.342	***
IUD	0.102	1.107	0.79129	0.903	0.521	2.353	
LAM	-0.802	0.448	0.07684	2.231	0.184	1.09	.

Male condom	-1.137	0.321	0.00297	3.116	0.152	0.679	**
Male sterilization	-0.862	0.422	0.28228	2.368	0.088	2.033	
No response	1.172	3.228	0.00434	0.31	1.443	7.223	**
Other traditional method	-0.827	0.437	0.04442	2.288	0.195	0.98	*
Pill	-0.174	0.84	0.64658	1.19	0.399	1.77	
Rhythm method	-1.145	0.318	0.00374	3.141	0.147	0.69	**
Standard Days/Cycle beads	-0.435	0.647	0.29072	1.545	0.289	1.45	
Withdrawal	-0.766	0.465	0.06815	2.152	0.204	1.059	.
Never	0.531	1.7	3.00e-11	0.588	1.454	1.988	***
Post-primary /Vocational	-0.24	0.786	0.01393	1.271	0.65	0.952	*
Primary	-0.139	0.871	0.00221	1.149	0.797	0.951	**
Secondary/A-level	-0.146	0.865	0.0012	1.157	0.792	0.944	**
University	0.005	1.005	0.95400	0.995	0.849	1.19	
Living with a partner	-0.465	0.627	2.30e-08	1.593	0.533	0.739	***
Married	-0.487	0.614	2.51e-15	1.628	0.544	0.693	***
Never married	0.115	1.122	0.07632	0.892	0.988	1.275	.
No response	-10.79	2.060e-05	0.95049	48530	0.000	173.5	
Widow/widower	0.278	1.320	0.01727	0.757	1.050	1.660	*
Age	-0.066	0.936	< 2e-16	1.069	0.931	0.940	***

significance levels are denoted as follows: \* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$ .

### Discussion

The findings of this study supplement the existing literature on contraceptive use and also contribute to the understanding of the patterns of contraceptive discontinuation amongst women in Kenya. The survival analysis approach using the Cox PH model provided an understanding of the contributing effect of demographic characteristics and contraceptive methods leading to discontinuation of contraception.

Several factors were associated with the discontinuation of contraception among the Kenyan women. Age was indicated as a protective factor, women approaching older age are less likely to discontinue contraception. Some specific methods such as subcutaneous injectables and male condoms were associated with a lower hazard of discontinuation of contraception significantly, which shows that these methods were effective for continued usage. Emergency contraception had a lower discontinuation, this may be due to its immediate effect in terms of preventing unintended pregnancy. Such findings align with other research studies conducted in Kenya and other countries on contraceptive method choice, user



satisfaction, and duration of contraceptive usage (Polis et al., 2016), (Adanikin et al., 2018), (Machiyama et al., 2017), (Casterline et al., 2003), (Bande et al., 2024) and (Sitruk-Ware et al.,

Based on the study findings several recommendations can be made for the Kenyan family planning programs as well as other similar programs. It is suggested that strategies should be put in place and designed in such a manner as to avoid user dropout by the use of effective contraceptive methods like long-acting, reversible contraceptive subcutaneous injectables. There should be rigorous creation of awareness among women about emergency contraceptives to help prevent unwanted pregnancies.

## Conclusion

The study adopted survival analysis to examine factors that predispose women to stop contraceptive use in Kenya. Choosing a method of contraception and meeting the satisfaction of the user is key to encouraging the ongoing use of contraceptives. To ensure Kenyan women effectively employ contraceptives in fulfilling health developmental goals, the policymakers and program deliverers must enhance the capacity of permanent reversible contraceptives, extend counseling of emergency contraceptives, and explore sociocultural and provider barriers to contraceptive discontinuation. A cross-sectional study is recommended to provide knowledge of some time-dependent behavior concerning contraception and the need for time-varying analysis to quantify changes in contraception and its discontinuation.

## REFERENCE:

1. Adanikin, A. I., McGrath, N., & Padmadas, S. S. (2019). Power relations and negotiations in contraceptive decision-making when husbands oppose family planning: analysis of ethnographic vignette couple data in Southwest Nigeria. *Culture, health & sexuality*, 21(12), 1439-1451.
2. Bande, A. D., Handiso, T. B., Hanjelo, H. W., & Jena, B. H. (2024). Early discontinuation of long-acting reversible contraceptives methods and its associated factors in Hosanna town, central Ethiopia: a cross-sectional study. *Scientific Reports*, 14(1), 11841.
3. Belete, N., Zemene, A., Hagos, H., & Yekoye, A. (2018). Prevalence and factors associated with modern contraceptive discontinuation among reproductive age group women, a community based cross-sectional study in Humera town, northern Ethiopia. *BMC women's health*, 18, 1-8.
4. Berglas, N. F., Kimport, K., Mays, A., Kaller, S., & Biggs, M. A. (2021). "It's Worked Well for Me": Young Women's Reasons for Choosing Lower-Efficacy Contraceptive Methods. *Journal of pediatric and adolescent gynecology*, 34(3), 341-347.
5. Casterline, J. B., & El-Zeini, L. O. (2007). The estimation of unwanted fertility. *Demography*, 44, 729-745.
6. Hirth, J. M., Dinehart, E. E., Lin, Y. L., Kuo, Y. F., & Patel, P. R. (2021). Reasons why young women in the United States choose their contraceptive method. *Journal of Women's Health*, 30(1), 64-72.
7. Kamuyango, A., Hou, W. H., & Li, C. Y. (2020). Trends and contributing factors to contraceptive use in Kenya: a large population-based survey 1989 to 2014. *International journal of environmental research and public health*, 17(19), 7065.
8. Kantorová, V., Wheldon, M. C., Ueffing, P., & Dasgupta, A. N. (2020). Estimating progress towards meeting women's contraceptive needs in 185 countries: A Bayesian hierarchical modelling study. *PLoS medicine*, 17(2), e1003026.

9. Kungu, W., Agwanda, A., & Khasakhala, A. (2022). Prevalence of and factors associated with contraceptive discontinuation in Kenya. *African journal of primary health care & family medicine*, 14(1), 2992.
10. Machiyama, K., Casterline, J. B., Mumah, J. N., Huda, F. A., Obare, F., Odwe, G., ... & Cleland, J. (2017). Reasons for unmet need for family planning, with attention to the measurement of fertility preferences: protocol for a multi-site cohort study. *Reproductive health*, 14, 1-11.
11. Ontiri, S., Mutea, L., Naanyu, V., Kabue, M., Biesma, R., & Stekelenburg, J. (2021). A qualitative exploration of contraceptive use and discontinuation among women with an unmet need for modern contraception in Kenya. *Reproductive health*, 18, 1-10.
12. Polis, C. B., Curtis, K. M., Hannaford, P. C., Phillips, S. J., Chipato, T., Kiarie, J. N., ... & Steyn, P. S. (2016). An updated systematic review of epidemiological evidence on hormonal contraceptive methods and HIV acquisition in women. *Aids*, 30(17), 2665-2683.
13. Shiferaw, K., & Musa, A. (2017). Assessment of utilization of long-acting reversible contraceptive and associated factors among women of reproductive age in Harar City, Ethiopia. *Pan African Medical Journal*, 28(1).
14. Sitruk-Ware, R., Nath, A., & Mishell Jr, D. R. (2013). Contraception technology: past, present and future. *Contraception*, 87(3), 319-330.
15. Stats, N. Z. (2020). Families and households in the 2018 Census: Data sources, family coding, and data quality. *Stats NZ*.
16. Staveteig, S., Mallick, L., & Winter, R. (2015). Uptake and discontinuation of long-acting reversible contraceptives (LARCs) in low-income countries.