JOMO KENYATTA UNIVERSITY OF AGRICULTURE AND TECHNOLOGY

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DEPARTMENT OF STATISTICS AND ACTUARIAL SCIENCE

BACHELOR OF SCIENCE IN BIOSTATISTICS

TOPIC: FACTORS ASSOCIATED WITH TIMES TO CONTRACEPTIVE DISCONTINUATION IN KENYA; A SURVIVAL ANALYSIS STUDY

DECLARATION

We declare that this proposal is our original work and has not been submitted elsewhere for examination, award of a degree or publication. Where other people's work has been used, this has properly been acknowledged and referenced.

We have not sought or used the services of any professional agencies to produce this work.

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DEDICATION

We would like to dedicate this research paper to our parents and our siblings. Their unconditional support has enabled us to reach this far. We also like to dedicate this to our close friends. Their support was immeasurable

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We acknowledge the Performance Monitoring Action project for responding to our request and providing us with the dataset we have based our proposed research on.

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Our lovely parents for their unconditional love and support.

Above all, God for sustaining us.

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Parameters

Bi	The i-th covariate
Ei	Total number of expected events in group i
I_{ij}	Cumulative probability of not discontinuing in the i-th month for reason j
L_0	Likelihood of the null model
L_1	Likelihood of the full model
Oi	Total numbers of observed events in group i
$Q_{12,j}$	Cumulative probability of discontinuing by 12 months
$S_0(t)$	Baseline survival function
S(t|X)	Survival function conditional on X
Xi	Covariate associated with the i-th person
d_{ij}	Number of episodes in the i-th month
e_i	Total number of episodes that reached the i-th duration
$h_0(t)$	Baseline hazard function
h(t)	Hazard function at time t
$q_{ij,}$	Discontinuation rate for the i-th month since start of episode and j-th reason for discontinuation

Abstract

Contraceptive discontinuation is defined as the halt of a contraceptive usage that had priorly been in application within a year from its initial adoption for reasons not associated with pregnancy. This phenomenon is particularly derogative to family planning programs and additionally among the chief causes of unwanted pregnancies and thus this report aims to further analyze the factors associated with the discontinuation of contraceptive methods. Contraceptive discontinuation for reasons other than the desire for pregnancy is associated with a high rate of unintended pregnancies leading to unsafe abortions and adverse effects on maternal, neonatal and child health outcomes. Knowledge of the factors that may lead to contraceptive discontinuation remains incomplete and a better understanding is hampered by the lack of a comprehensive framework that acknowledges the multiple and complex reasons that influence the decision to switch methods or stop using one altogether. To carry out the study, secondary data from Performance Monitoring for Action was utilized. The study participants used for this study were a sample of women who were between the ages of 15 to 49 in Kenya with calendar data and questionnaires were the main data collection tool. To accomplish our main objective, survival analysis methods were applied and a Cox proportional hazard model was fitted. There were 1054 discontinuation episodes in total. Pill users had the highest overall propensity to discontinue at all periods followed by users of injectables. Users of the Intrauterine device were least likely to discontinue use. Women in the age groups 20-24 and 25-29 had a higher discontinuation rate compared to other age groups. Women with a secondary education were observed to be more likely to discontinue across all the three periods and those in rural regions also had higher discontinuation rates. The survival analysis findings implicated that the overall discontinuation rates were 35% (12 months), 47% (24 months) and 51% at (36 months). Wanting a more effecting method accounted for about 25% of discontinuations and side effects accounted for 23% of discontinuations, whilst injection and pill recorded the highest rates. Type of method emerged as a predictor of discontinuation at 36 months with the following hazard ratio at 95% confidence interval [CI]; intrauterine device (HR = 0.168, CI = 0.074-0.382), injection (HR = 0.670, 95% CI = 0.548-0.820), implants (HR = 0.180, 95% CI = 0.139-0.234). Age (30+ years) displayed influence: 30-34 years (HR = 0.721, 95% CI = 0.568-0915), 35-39 years (HR = 0.584, 95% CI = 0.445-0.766), 40-44 years (HR = 0.601, 95% CI = 0.434-0.833) and 45-49 years (HR = 0.610, 95% CI = 0.395-0.944). Contraceptive discontinuation are associated with age categories and an individual's method of choice. The study recommends that contraceptives should be provided to women of different age groups to ensure effective use of contraception methods. In doing so, the gap created by contraceptive discontinuation will reduce. There is a need for greater education about contraceptive techniques, including their advantages and disadvantages. Therefore, the issue of contraceptive discontinuation should be addressed in family planning programs intended to prevent unintended pregnancy. This could be resolved by increasing access to a variety of contraceptive techniques and providing greater counseling regarding the side effects of those methods.

Keywords: Factors, contraceptive discontinuation, contraceptive methods, health outcomes, family planning.

CHAPTER ONE
INTRODUCTION

1.1 Background of the study

Contraceptive discontinuation is a major public health issue that leads to unwanted pregnancies and as a consequence, increased prevalence of unsafe abortions. Understanding contraceptive discontinuation is of fundamental interest because it affects women's reproductive health both positively and negatively over the course of their lives, especially younger women whose contraceptive trajectories are dynamic. Studies on discontinuation are important for family planning program managers and policymakers as they may point to several problems within the programs. Contraceptive discontinuation for reasons other than the desire for pregnancy is associated with mistimed and unwanted pregnancies, unwanted births and unsafe abortions which has increased risks of maternal morbidity and mortality (World Health Organization, 2019).

Previous research on contraceptive discontinuation has established that a major obstacle to achieving the Sustainable Development Goals (SDG) for maternal and child health is the interruption of contraceptive use for one month or longer by women who had used a method of contraception in the previous 12 months but discontinued it at least once without switching to another method. (Coulibaly *et al*., 2020)

A large number of sexually active women who want to prevent pregnancy do not use any form of contraception for a variety of reasons, some of which may include; menstrual disruption, method failure, spouse disapproval, menopause, fear of infertility, and a desire for additional children (Hussain *et al*., 2016). Existing research from the World Health Organization (WHO) indicates that globally, in 2018, 65% of sexually active women who had an unmet need for contraception discontinued using it out of fear of its side effects and health risks. (Sundaram *et al*., 2019)

A study by Sedgh *et al*., (2016) showed that about 74 million unplanned pregnancies occur annually in developing countries, mostly among women who do not

use any kind of contraception. However, consistent and efficient use of current contraception methods could reduce the number of unplanned pregnancies and the number of fatalities of pregnant women. As of 2019, around 270 million sexually active women worldwide did not use contemporary contraception in an effort to prevent pregnancies and/or delay births. (Kantorova *et al*., 2020)

It has been shown that certain socio-demographic characteristics such as younger women, higher parity, and unmarried or not with a partner are the most likely determinants of discontinuation. It has also been studied that discontinuation rates are higher among short-term method users as compared to long-acting reversible contraceptive (LARC) users, such as intrauterine devices (IUDs) and implants. (Jain *et al*., 2017).

Reports by Kenya National Bureau of Statistics(2015) stated high discontinuation at 31% within 12 months of initiating contraception, 18% unmet need for family planning and 35% unplanned births. The information from this survey shows that 32% of unintended births in Kenya were due to discontinuation (Jain *et al*., 2017). It is therefore important to identify the factors that influence discontinuation so that they can be addressed where possible and the high rates of discontinuation can be minimized.

Analysis of the Performance Monitoring for Action (PMA) calendar data derived from the women's questionnaire is the major source of information on contraceptive discontinuation; it contains robust historical data on episodes of contraceptive use, recalled by women month by month, three years preceding the survey. Even though there are some concerns about recall bias and the validity of calendar data due to its complexity and information, an analysis of studies that used calendar data and other types of questionnaires found that calendar data performs just as well or better in terms of reliability and validity when capturing information on contraceptive use.

1.2 Statement of problem

Contraceptive discontinuation for reasons other than the desire for pregnancy is associated with a high rate of unintended pregnancies leading to unsafe abortions and adverse effects on maternal, neonatal and child health outcomes. Knowledge of the factors that may lead to contraceptive discontinuation remains incomplete and a better understanding is hampered by the lack of a comprehensive framework that acknowledges the multiple and complex reasons that influence the decision to switch methods or stop using one altogether. This study therefore aims to offer more insights and better knowledge on this major public health issue.

1.3 Objectives of the study

1.3.1 Main objective

To determine the factors associated with times to contraceptive discontinuation in Kenya.

1.3.2 Specific objectives

1.To determine time to discontinuation.

2.To determine the prevalence of contraceptive discontinuation.

3.To determine whether there is significant difference between the levels of the covariates.

1.4 Significance of the study

It is important to examine contraceptive dynamics such as discontinuation so that family planning programs can provide quality services that meet client needs. Furthermore, such data would allow policymakers and program implementers to monitor progress toward achieving international development goals for family planning.

1.5 Assumptions of the Study

Women are not declared in fecund.

1.6 Strengths and limitations of the study

1.6.1 Limitations of the study

1. Recall bias- since the respondents are required to report their months of contraceptive use from memory, there may be a slight deviation in inaccuracy of data collected.
2. Some variables that are considered by past studies to affect the outcome are found to be missing from the dataset.

1.6.2 Strengths of the study

1. The data used in this study is reliable and is nationally representative for contraceptive discontinuation in Kenya.
2. The use of calendar year episodes of contraceptive history is considered robust from previous studies, and can be used as a corroboration in policy formulation and for designing family planning programs.

CHAPTER TWO
LITERATURE REVIEW

Globally, modern contraceptive usage is reported to be at 45% among women of reproductive age. Modern contraceptive use has also increased in Sub-Saharan Africa from 13% in 1990 to 29% as of 2019 (Nations, U. 2020). Kenya's adoption of long-acting reversible contraceptives (LARC) rose consistently from 4.1% in 2003 to 13.3% in 2014 (Kenya National Bureau of Statistics, 2015). In Saharan Africa, modern contraceptives have a prevalence of 22%, the three most common methods in the region being injectables (39.4%), followed by implants (26.5%) and condoms (17.5%) (Boadu, 2022). In Kenya's latest report, the prevalence of modern contraceptives is 59.2% (KNBS, 2023) which is an improvement from 53.2% in 2014 (Kenya National Bureau of Statistics, 2015). Despite the increment, from 2019, the contraceptive prevalence in Kenya has plateaued at around 58% (Statista, 2023). This relative stagnation in increment can be attributed to an increased prevalence of contraceptive discontinuation which continues to plague the nation evidenced by (KNBS, 2023), which has the prevalence at 59.2%, an increment of less than 2%.

Contraceptives have proved essential in numerous aspects of reproductive health. It is attributed to potentially preventing 25% of under-five mortalities if birth intervals were at least three years, 35% of maternal deaths and 13% of child mortality could be precluded (Eliason *et al.*, 2014). Additionally, the embrace of contraceptives has helped families in spacing their pregnancies and preventing unintended pregnancies (Kavanaugh & Anderson, 2013). However, there has been a significant decline in fertility rate from 8.0 per woman in the 1970's (Shapiro, 2015) to 3.4 per woman by 2022 (KNBS, 2023) Contraceptives and abortions are thought to account for about 70% of this plummet (Robinson & Harbison, 1995).

Despite the fore-mentioned benefits of contraception, there are still reports of discontinuation following various reasons. Contraceptive discontinuation, from previous studies, has been categorized into three: the desire to become pregnant or other reasons for ceasing usage; method failure, that is, accidental pregnancy while using a

contraceptive method; and finally, method-related reasons: which comprise of health related issues such as side effects and dissatisfaction with a method (comprising of reasons such as; the search for a more effective method, partner's dislike of the method, cost of the contraceptive of choice and the lack of availability) (M. M. Ali & Cleland, 2010).

There is low motivation to discontinue contraceptives for the reason of avoiding pregnancy, however, discontinuing because of quality-related reasons has been proven to be more common rather than by the reduced need for contraception (Curtis et al., 2011). According to Rizvi and Irfan, (2012), method use, side effects, age, parity, quality of care, fertility intentions and changes in marital status are reported to be determinants of contraceptive discontinuation. Contrarily, there is less of a consistent relationship between discontinuation and the number of methods provided, socioeconomic factors, residence, partner's disapproval, cost, and accessibility of the method (M. Ali & Cleland, 1999; Blanc *et al.*, 1999). Additionally, studies conducted have implied that women who have higher levels of education are more inclined to discontinuing their initial method, while further studies indicated that they are more likely to switch rather than cease usage post discontinuation (Alvergne et al., 2017; Ontiri et al., 2021). This may be because they are more educated on contraceptive methods and can make more informed choices.

Over the years, the 12-month contraceptive discontinuation rate has been on a decline. According to Ontiri *et al*., (2021), rates for all methods have reduced from 37.5% in 2003, to 36.7% in 2009 to 30.5% in 2014. In recent studies, overall discontinuation rates were estimated at 37% (24-months) and 74% (36 months) (Kungu et al., 2022). Intrauterine devices were reported to have the lowest 12-month discontinuation rates at 6.4% in 2014, then implants at 8.0% in 2014. This decline in discontinuation rates was attributed to an increase to those that reported side effects and those seeking a more effective method of contraception (Ontiri *et al*., 2021).

In Kenya, side effects associated with hormonal contraception have been linked as the main reason for discontinuation (Kenya National Bureau of Statistics, 2015). A study

stated that side effects accounted for 40% of discontinuations (Kungu *et al*., 2022). Additionally, studies by Castle and Askew, (2015); Blanc *et al*., (2002) have associated contraceptive discontinuation to poor quality of care, specifically the lack of proper counseling on side effects. According to the Performance Monitoring and Accountability 2020 survey, among women with unmet need, 28% of them discontinued their method of choice in the last 12 months. According to reports, about 69% of all women were informed about side effects upon seeking counseling on their contraceptive method while 9 out of 10 women were informed on what actions to take upon experiencing side effects (Performance Monitoring for Action, 2021).

Apart from women who desire to be pregnant, there are cases reported of women that discontinue despite the fact that they are still in need. Unmet need of contraceptives can be defined based on three indicators: the woman should be fecund; she should be sexually active and not using a method; or reported to want spacing of children or no children at all. Women reported to be in need of contraception by 2014 were 18% in Kenya (Kenya National Bureau of Statistics, 2015). In Kenya, 54% of pregnant women and 38% of non-users reported to discontinue despite still being in need. About 36% were reported to discontinue whilst in need (Kungu *et al*., 2022). Injectables and pills were reported to have the highest rates of discontinuation at about 30% (Kungu, 2022). Therefore, it is crucial to reduce unmet need to discourage discontinuation. Developing countries have accounted for 20% of unmet need from discontinuation due to side effects (Jain *et al*., 2013).

Contraceptive discontinuation has been affiliated to the risk of unintended pregnancies. According to Ayalew *et al*., (2022), the prevalence of unwanted pregnancies in Sub Saharan Africa was reported to be 30% and 35% in Kenya (Kenya National Bureau of Statistics, 2015). Also, previous studies are said to account 32% of recent unintended births to discontinuation in Kenya (Jain & Winfrey, 2017).

As per a study by Bellizzi *et al*., (2020), in Central Asian and in six African countries, over 80% of women with a current unintended pregnancy had not used any contraceptive

method in the previous five years. Use of long-acting modern methods remained consistently low across all countries. Among women who last used a traditional method, 83.8% discontinued due to failure, while among women who last used a long-acting modern method, 40.2% discontinued because of side effects.(Bellizzi et al., 2020). According to Dorman *et al*., (2018), the introduction of a reversible vas occlusion would reduce unintended pregnancies by 3.5% to 5.2% in the United States, by 3.2% to 5% in South Africa, and by 30.4% to 38% in Nigeria, assuming that only 10% of interested men would take up a novel male method and that users would comprise both switchers (from existing methods) and brand-new users of contraception. Unwanted pregnancies predispose women to induced abortions and other health related complications which can be curbed by improving women's knowledge on the significance of family planning services.

In an attempt to minimize the high rates of discontinuation, it is vital to identify factors that influence discontinuation of contraceptives. Therefore, understanding contraceptive discontinuation patterns, fertility related behaviors, calculating unmet need and comprehending the implications that follow discontinuation are essential in the field of reproductive health and need to be addressed where possible. The main objective of this study is to determine the prevalence of contraceptive discontinuation and the factors associated with contraceptive discontinuation.

CHAPTER THREE
METHODOLOGY

3.1 Introduction

This section identifies the techniques and procedures adopted in conducting this study. It focuses on the following sectors: study design, data collection techniques, data source, potential variables, procedures carried out and the study model.

Our study used secondary data sourced by the Performance Monitoring Action project (PMA). PMA is a study that was implemented in the country to promote the use of data for policy and program impact and enhance family planning in the country. Using their data, we focused our study on women of reproductive age (15-49) who have a history of contraceptive use, and explored the use of calendar data to determine time to event durations. The study focuses on women with varying socio-economic backgrounds, using different contraceptive methods in different geographical locations in the country, and use this data to determine factors that are associated with discontinuation and its prevalence in the country across various determining factors.

3.2 Study Design

PMA nationally representative data collected in 2021 was used in this analysis. PMA uses a multistage stratified cluster sampling design, with rural urban stratification. In the first stage, counties are selected based on household density and then enumeration areas (EAs) are selected in the second stage using probability proportional to size (PPS). In the 2021 survey, 308 enumeration areas were selected from eleven counties (West Pokot, Bungoma, Kakamega, Siaya, Nandi, Nyamira, Kericho, Kiambu, Nairobi, Kitui and Kilifi). A sample of 35 households were then randomly selected for the list of all the households in each EA. Household and female questionnaires were administered to the participants once consent was granted. More information regarding the PMA sample

design can be found on their website (PMA Kenya Phase 3 SOI Narrative | PMA Data, n.d.).

3.3 Data collection methods

PMA used questionnaires to collect data. Data based on family planning was collected using the household questionnaire (HQ) and the female questionnaire (FQ). The FQ was administered to women of reproductive age (15-49) who were registered in the household roster. The female questionnaire gathers specific information on education; fertility and fertility preferences; family planning access, choice, and use; quality of family planning services; and exposure to family planning messaging in the media, migration, empowerment, and the impact of the Covid-19 pandemic on household and family planning access. (PMA Kenya Phase 3 SOI Narrative | PMA Data, n.d.)

These questionnaires were based on model questionnaires designed by PMA staff at the Bill & Melinda Gates Institute for Population and Reproductive Health at the Johns Hopkins Bloomberg School of Public Health in Baltimore, Maryland, USA; The International Centre for Reproductive Health Kenya; and Kenya National Bureau of Statistics

3.4 Data source

Performance Monitoring for Action (PMA) is a national and county level representative data on knowledge, practice, and coverage of family planning services. (Kenya Phase 3 HQFQ Survey | PMA DataLab, 2021). The data collected for this study focuses on female participants with calendar data for their contraceptive use. Data can be sourced from: (Kenya Phase 3 HQFQ Survey | PMA DataLab, 2021) datalab.pmadata.org. https://doi.org/10.34976/ecre-cf28.

3.5 Study setting

The study was conducted in eleven counties in Kenya (West Pokot, Bungoma, Kakamega, Siaya, Nandi, Nyamira, Kericho, Kiambu, Nairobi, Kitui and Kilifi). The extracted data included all the women who reported current use of a modern method of contraception at the time of the interview during the PMA survey 2021.

3.6 Inclusion and exclusion criteria

The cases used were for participants whose data had a date of beginning and date of termination at 12 , 24 and 36 months before PMA interview date, respectively.

Those without episodes of use and those using female or male sterilization were excluded from analysis.

Only cases of discontinuation where the reason for discontinuation was not blank in the three years preceding the survey were retained.

3.7 Variables

3.7.1 Outcome variable

The event of interest was the discontinuation of a contraceptive. This study analyzes the discontinuation period which is the duration from initiation of a method of contraceptive to when one stops using. The start and end date of each episode already exists within the dataset. However, the duration of the event, a survival variable, had to be created to act as a dependent variable at 12, 24 and 36 months of contraceptive use.

3.7.2 Explanatory variables

This study examines discontinuation by utilizing the reasons for discontinuation, type of discontinuation, method of contraceptive use and socio-demographic variables (age,

place of residence, education levels, marital status, wealth status and region) to determine the levels and determinants of contraceptive discontinuation.

3.8 Data Extraction

The unit of analysis in the study was episode of use, which is defined as a period of continuous use of a particular method of contraception in months, thus an individual may contribute several episodes of contraceptive use as it is in the PMA calendar data. When extracting data from the calendar, which is represented in form of two columns: column 1: contraceptive type; column 2: reason for discontinuation, a contraceptive event-based data set was created by converting them into long, string format and converting each individual occurrence of contraceptive discontinuation into an episode of an event; where each episode of contraceptive use represents one observation or a case. This process also involved the generation of new variables, necessary for data manipulation and analysis.

3.9 Data Analysis

3.9.1 Generation of events (time to discontinuation)

PMA uses calendar data to collect information on monthly contraceptive usage, spanning three years prior to the date of data collection. Calendar data is represented by two columns; the first listing the type of family planning used and their respective code; these include: no method (0); female sterilization (1); male sterilization (2); implant (3), IUD (4); injectable (5); pill (7); emergency contraception (8); male condom (9); female condom (10); diaphragm (11); foam/jelly (12); standard days/cycle beads (13); LAM (14); rhythm method (30); withdrawal (31); other traditional methods (39), Pregnancy (P); Termination (T); and Birth (B). The second column represent the reasons for discontinuation which include: infrequent sex/ husband away (1); became pregnant while using (2); wanted to be pregnant (3); husband/partner disapproved (4); wanted more

effective method (5); side effects/health concerns (6); lack of access/too far (7); costs too much (8); inconvenience to use (9), up to God/ fatalistic (10); difficult to get pregnant/ menopausal (11); marital dissolution/ separation (12); other (39).

The calendar data, which are represented in wide format singular columns, are first split into individual columns and then restructured into having a record per month. Thereafter, the generation of century month code (CMC) is essential in calculating specific time code from when an individual started using a certain method till the date of cessation. CMC is calculated by:

$$CMC=year-1900*12+month$$

This enabled the creation of the variables indicating beginning and end of a discontinuation event. To generate the events file, creating exposure, late entries and censoring needs to be done, which will be defined by:

Exposure: The exposure period is the duration of use of a specific method within one episode of use. Exposure begins with the initial month of use and ends with discontinuation or with the month of interview if the method was still being used at the time of the interview. If the month following the last noted method indicates a pregnancy or a different method, then it is assumed that the episode ended on average in the middle of that following month. Thus, the duration of exposure is taken as the difference between the month of first use and the month of last use (i.e., equal to the number of months during that episode with a notation for the method).

Censoring: Only episodes that began within the calendar period and ended three months before the interview were included. Episodes that began before the beginning of the calendar are excluded (this does not exclude episodes that started within the calendar, but outside of the censored period of interest). Episodes that ended in the month of interview or the two months prior are censored at three months before the interview to avoid bias due to unrecognized pregnancies.

Late entries: Late entries occur when a respondent started, but did not end, an episode of contraceptive use outside of the censored period. Late entries will first enter the life table at the duration of use when they enter the period of interest.

Afterwards, it is essential to summarize each month record to episode per record for each individual. Collapsing the data in this matter enabled counting of the number of events to attain the duration of an event and also capture the prior event, the next event and their respective durations.

Since the event variable and the time duration variable was provided, we declared the data to be survival time data, using a function that runs data consistency checks to ensure that what you have declared makes sense.

3.9.2 Prevalence of contraceptive discontinuation.

Twelve-month contraceptive discontinuation rates are the cumulative proportion of episodes that are discontinued for any reason by the twelfth month of use. These discontinuation rates are categorized by reason for discontinuation. Seven categories of reason for discontinuation were constructed, of which failure is one of the reasons.

To calculate discontinuation rates, we generated a life table (multiple decrement life table). Episodes can be discontinued due to various reasons thus they can be considered competing risks. Reasons for discontinuation are mutually exclusive and the discontinuation rates by reason sum to the total discontinuation rates for any reason.

Monthly discontinuation rates q_{ij}, is calculated by dividing d_{ij} by e_i:

$$q_{ij}=d_{ij}/e_i \text{ (for any reason combined)}$$

And the cumulative probability of not discontinuing at each month i for reason j is:

$$I_{ij}=I_{i-1,j}- (I_{i-1,any} * q_{ij})$$

Where any is “any reason” combined and $I_0=1$ and $I_{any}=1$

The cumulative probability of discontinuing by 12 months duration for reason j is:

$$Q_{12,j}=1-I_{12,i}$$

Note that this is mathematically equivalent to the cumulative probability of discontinuing by 12 months duration for any reason given as:

$$Q_{12,any}=1-\cap_{i=1:12}(1- q_{j,any})$$

All these calculations were with reference to The DHS Program (The DHS Program - Calendar Tutorial). The life tables generated will show distribution of contraceptive discontinuation episodes by selected variables across periods of use; contraceptive discontinuation rates across methods; and distribution of discontinuation episodes by reasons for discontinuation.

3.9.3 Significance in levels of covariates

3.9.3.1 Log Rank Test

Comparison of two survival curves can be done using a statistical hypothesis test called the log rank test. It is used to test the null hypothesis that there is no difference between the population survival curves. It is used to test whether the difference between survival times between two groups is statistically different or not, but does not test the effect of the other independent variables.

The log-rank test is a nonparametric statistical test used in survival analysis to compare the survival distributions between two or more groups. It is commonly used to determine whether there are significant differences in survival times (time to an event of interest) between different groups with different characteristics.

The log rank statistic is approximately distributed as a chi-square test statistic and is calculated as follows:

$$2(\log \text{rank}) = (O_1\text{-}E_1)2E_2 + (O_2\text{-}E_2)2E_2$$

3.9.4 Determinants of discontinuation

3.9.4.1 Kaplan Meier

The survival function is graphically represented by the Kaplan-Meier curve. It is a survival function estimate that is non-parametric and makes no assumptions about the distribution of the data at the base of the estimate. The survival function can be calculated from data that have been censored, truncated, or have missing values using the Kaplan-Meier curve. It displays the likelihood that a subject will live until time t plotting the survival function against time results in the creation of the curve.

The Kaplan-Meier estimate is commonly used to analyze time-to-event data, where the event of interest could be death, disease recurrence, or any other event that can be measured in terms of time. This estimator can be used to study factors associated with contraceptive discontinuation.

It involves computing probabilities of occurrence of events at a certain point of time. We multiply these successive probabilities by any earlier computed probabilities to get the final estimate. It is the simplest method of calculating survival over time in spite of all of the challenges related to the subjects or circumstances.

3.9.4.2 Cox proportional hazard model

A Cox proportional hazard model will be fitted to identify the predictors of time-to-discontinuation and to calculate the hazard ratios (HR). This is a statistical technique used in survival analysis to investigate the relationship between the time to an event and one or more predictor variables. It enables us to test the effect of other independent variables on survival times of different groups.

The Cox model is expressed by the hazard function denoted by h(t).

$$h(t)=h_0(t)\, e^{\sum_{i=1}^{p} B1Xi1 + B2Xi2 + \cdots + BpXip}$$

A hazard ratio greater than 1 indicates an increased hazard, a hazard ratio less than 1 indicates a decreased hazard and a hazard ratio of 1 suggests no effect of the predictor variable on the hazard. In summary,

HR = 1: No effect

HR < 1: Reduction in the hazard

HR > 1: Increase in Hazard

3.9.4.2.1 Assumptions of the cox proportional hazard model

i. Proportional Hazards Assumption – This is the central assumption for this model. The ratio of the hazard rates for any two individuals remains constant over time. This assumption allows the Cox model to handle time-varying effects of predictors on survival.
ii. Linearity of the log hazard - The Cox proportional hazard model assumes that the relationship between the predictor variables and the log of the hazard rate is linear. It means that the effect of a predictor is constant over time when transformed into the log-hazard scale.
iii. Independence of Censoring - The Cox model assumes that censoring is independent of the survival times and the predictor variables. If censoring is dependent on the predictor variables or the survival times, the results of the Cox model may be biased.
iv. Non-informative Censoring - Censoring should not depend on unobserved data or future events. Informative censoring could bias the results of the Cox model.
v. No Perfect Multicollinearity - The predictor variables should not have perfect linear dependencies among themselves, as this would lead to issues with estimating the model.

vi. No Interaction between Covariates and Time - There should be no interaction between the predictor variables and time. The effect of the covariates should remain constant over time.

3.9.4.2.2 Proportional hazard test

The proportional hazards test is used to assess the assumption of proportional hazards. The most popular graphical techniques for evaluating this assumption involves comparing estimated –ln(–ln) survival curves over different (combinations of) categories of variables being investigated.

A log–log survival curve is simply a transformation of an estimated survival curve that results from taking the natural log of an estimated survival probability twice.

As we said, the hazard function can be rewritten as;

$$S(t|X)= [S_0(t)]^{e^{\sum_{j=1}^{p} Bj Xj}}$$

and once we applied the -ln(-ln), the expression can be rewritten as;

$$-\ln[-S(t|X)=\sum_{i=1}^{p} \beta_j X_j - In\,[-In\, S_o(t|X)]$$

Now, considering two different specifications of the covariates, corresponding to two different individuals, X_1X_1 and X_2X_2, and subtracting the second log–log curve from the first yields the expression;

$$-\ln[-\ln S(t|X1)] = -\ln[-\ln S(t|x2)] + \sum_{i=1}^{p} \mathbf{BjXj(X1i - X2j)}$$

This expression indicates that if we use a well fitted Cox model and plot the estimated log-log survival curves for individuals on the same graph, the two plots would be approximately parallel. The distance between the two curves is the linear expression involving the differences in predictor values, which does not involve time. However, if the curves cross over each other, it may indicate a violation of the assumption.

The statistical test used to formally assess the proportional hazards assumption is often based on the Schoenfeld residuals, which are residuals obtained from the Cox regression model. The Schoenfeld residuals represent the differences between the observed and expected values of the covariates for each subject at each event time. These residuals are regressed against time, and if the coefficient of the time variable is not significantly different from zero, it suggests that the proportional hazards assumption holds.

3.9.4.3 Likelihood ratio test

A statistical test frequently used in survival analysis to examine the goodness-of-fit of two nested models is the likelihood ratio test (LRT). In the context of survival analysis, a model is typically a regression model that relates survival times or hazard rates to one or more predictor variables. The likelihood ratio test is used to assess whether adding or removing predictor variables significantly improves the fit of the model.

$$LR = -2\ (L_0 - L_1\ )$$

The calculated likelihood ratio statistic is compared to the critical value from the chi-square distribution with the appropriate degrees of freedom. If the calculated value is larger than the critical value, we reject the null hypothesis, indicating that the full model fits significantly better than the reduced model.

Rejecting the null hypothesis suggests that the additional predictor variables in the full model significantly improve the fit of the model, and they are considered to have a significant association with the survival times.

3.10 Ethical approval

Written informed consent was obtained for all participants aged 18 and above. For minors, parental/guardian consent and minor assent were obtained. Ethical approval was provided by Kenyatta National Hospital/University of Nairobi ethical review committee.

3.11 Statistical analysis

Analysis was aided by the use of STATA version 17 and R.

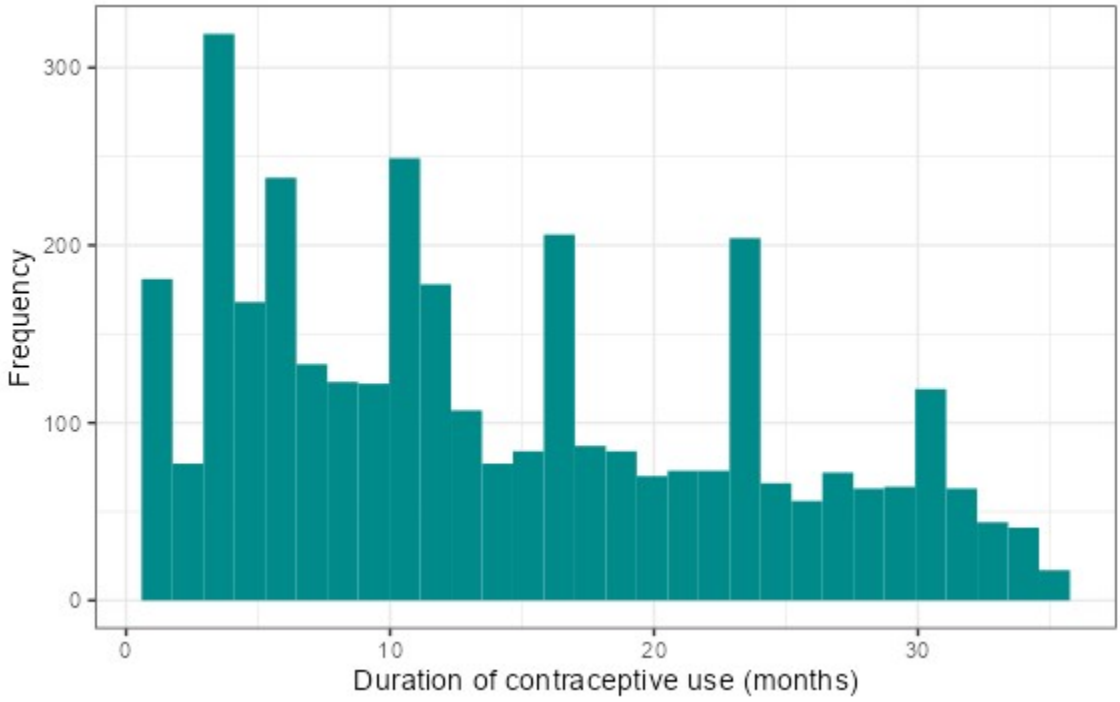
CHAPTER FOUR
RESEARCH RESULTS AND DISCUSSION

4.1 Results

4.1.1 Generation of times to event (discontinuation).

This chapter discussed the generation of times to event, whereby the event was described as discontinuation of a contraceptive method. The data collected consisted of contraceptive usage of women aged between 15 to 49 years for a period of three years (2019-2021). Each participant was followed up once a year and their calendar data was updated. At the end of three years, each participant's duration of contraceptive use preceding discontinuation was generated. This measurement was then set as the dependent variable of subsequent statistical tests. Additionally, these event times (taken across 12, 24 and 36 months) were stratified against our selected covariates in order to visualize any potential clusterization of these factors at a certain event time.

Figure 1*: Histogram of times to event.*



The times to event were summarized as shown in Figure 1. The mean time of our participants was 14 months. The median time was 12 months, and the upper and lower quantile months were at 6 and 22 months respectively. This indicates, on average, a participant is expected to exhibit consistent contraceptive use for at least 12 months. The most populated time was 6 months with 238 participants whereas the least populated time was 36 months with 17 participants.

Figure 2*: Stratification times to event by education level.*

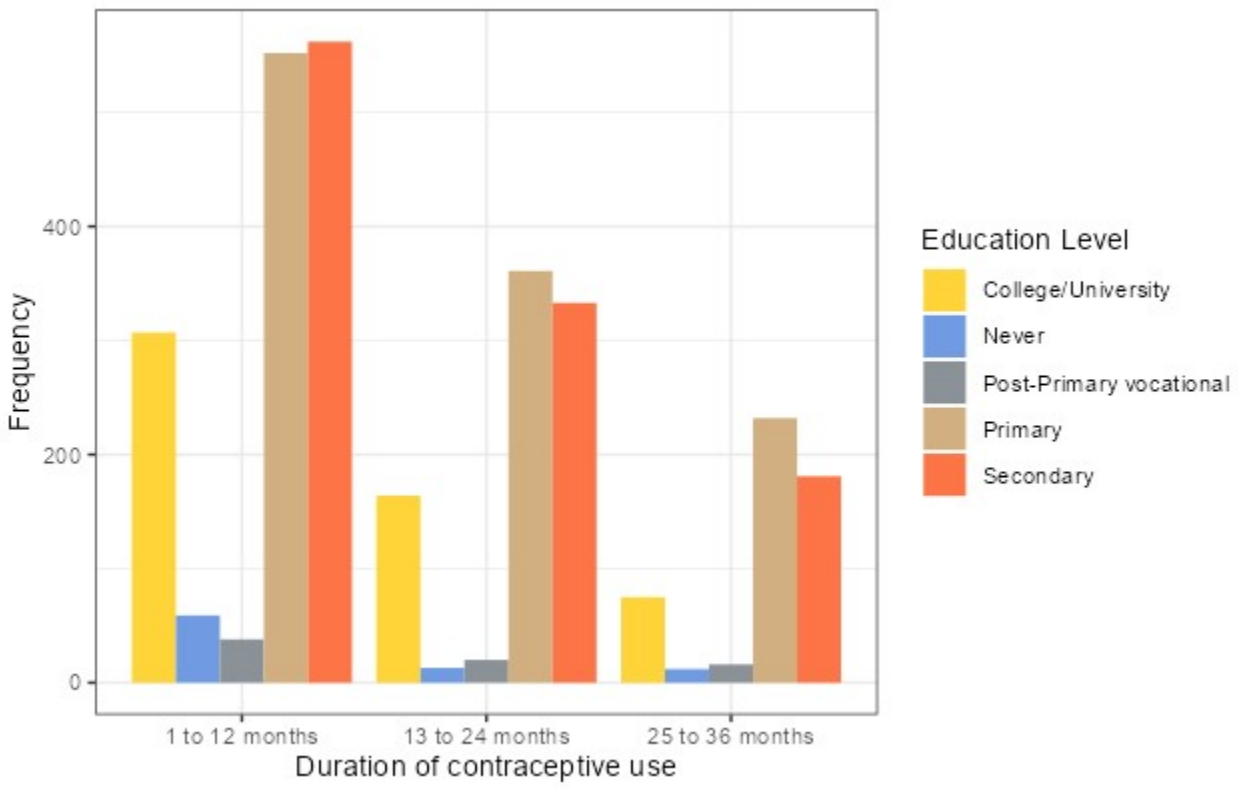
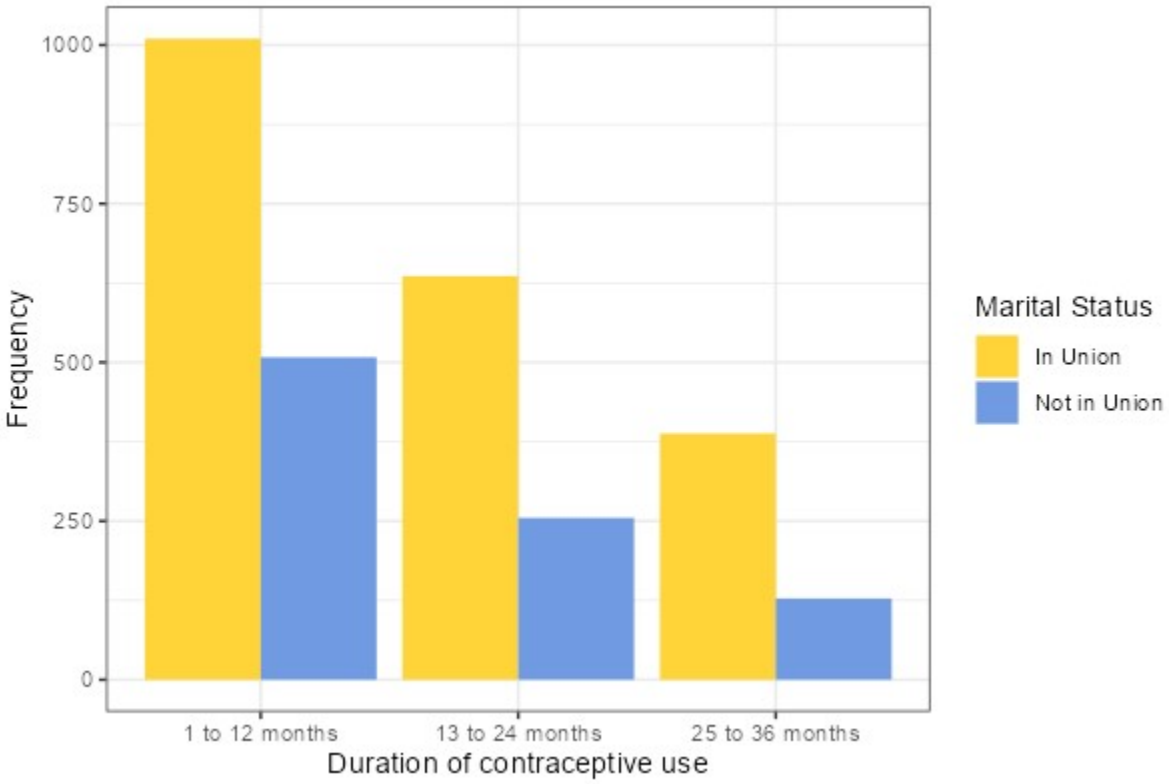


Figure 2 demonstrates the distribution of event times per four classifications of the highest education levels attained by the study participants at the beginning of the study. Women who had never got any education were the least populated (2.333%). The second least populated group were post-primary vocationally educated women (2.537%). Women who attained primary education were the most (40.4%), only surpassed slightly by women who had achieved secondary education among women who had time to event

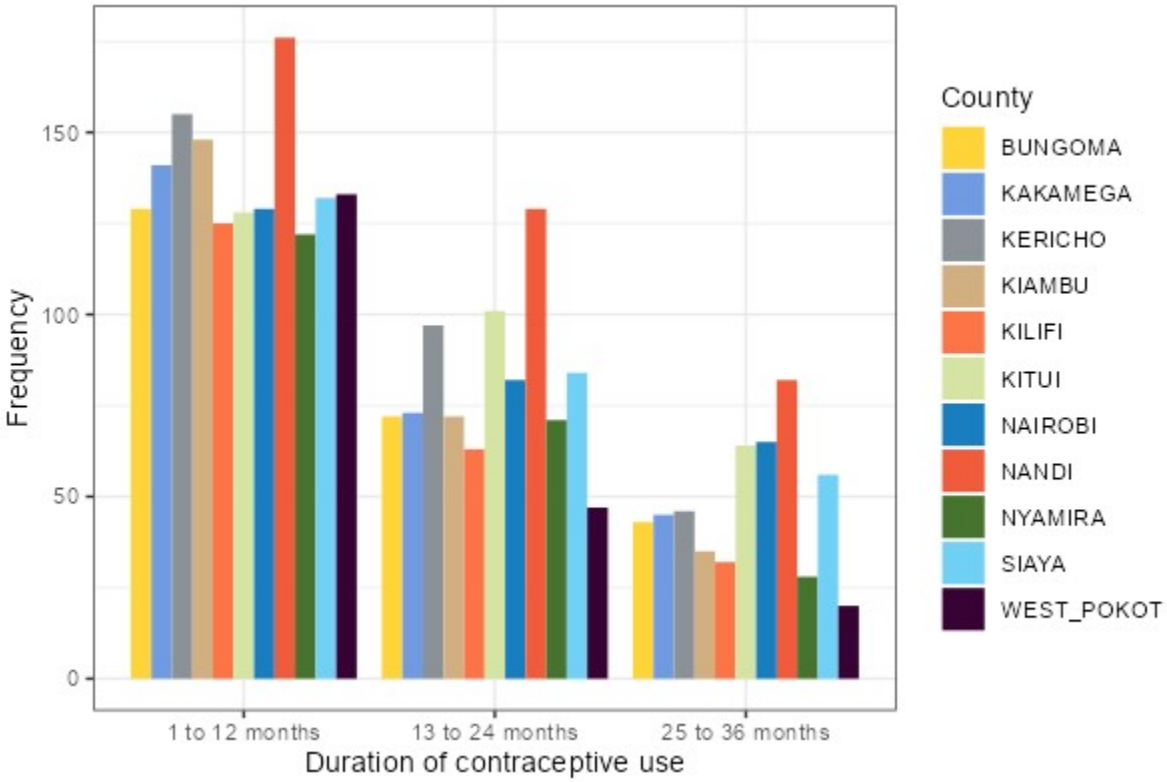
of up to a year i.e., 1-12 months. The second most populated group were the secondary educated women (36.86%) followed by college/university educated in third (17.87%).

Figure 3*: Stratification times to event by marital status.*



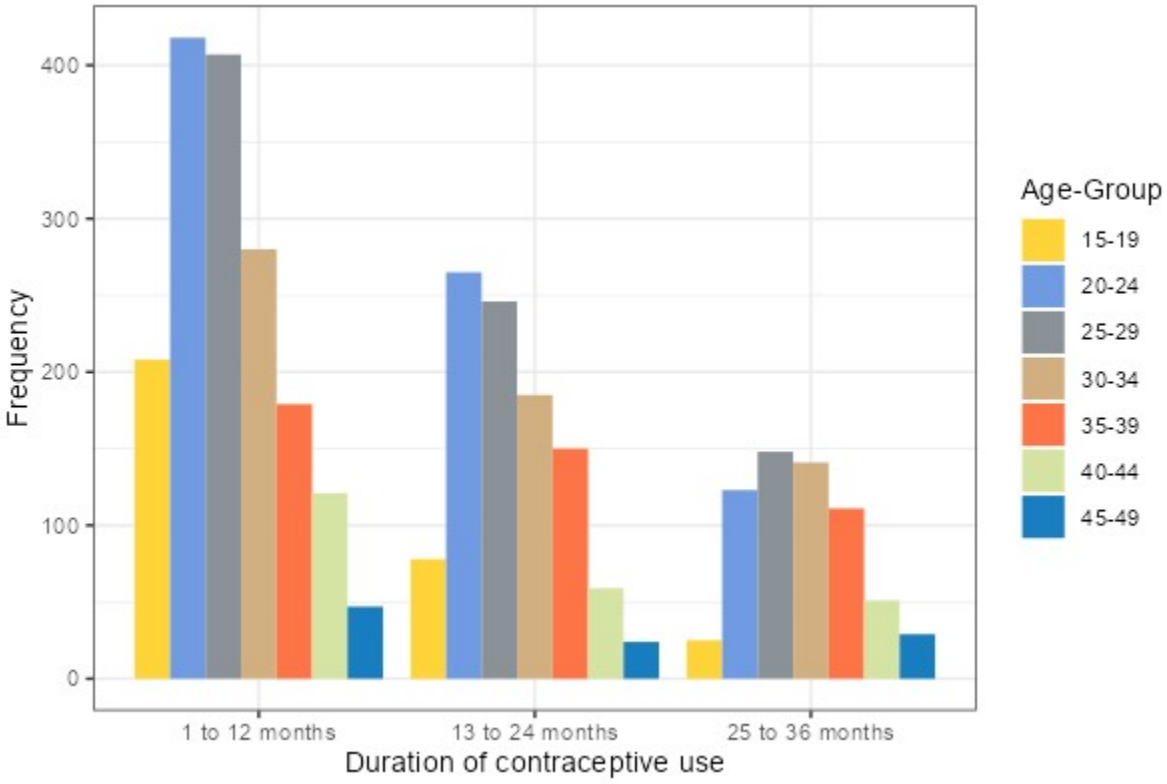
As per Figure 3, in every year of the study, women who were either married or living with a man (in union) were more than those that were single all through the event time duration classes. Women in union attributing 71.01% and women not in union 28.99% of the event times. The difference between the two groups was 51% in women who had duration of event of up to 12 months (1-12 months), to 42.857% in women who had event duration of between 13 to 24 months and 50.92% in women who had event duration of between 25 to 36 months.

Figure 4*: Stratification times to event by county.*



From Figure 4, evidently across the three classes of event duration, women from Nandi County were the most populated, attributing to 13.56%. The rest of the counties varied in frequency across the event times. Cumulatively, the following percentages for the remaining counties were observed: Nairobi (11.49%), Siaya (10.23%), Kitui (10.8%), Kericho (9.915%), Kakamega (8.696%), Bungoma (8.121%), Kiambu (7.702%), Nyamira (6.97%), Kilifi (6.612%), West-Pokot (5.983%). The marginal differences between this frequency affirms appropriate randomization of the study participants with regards to region.

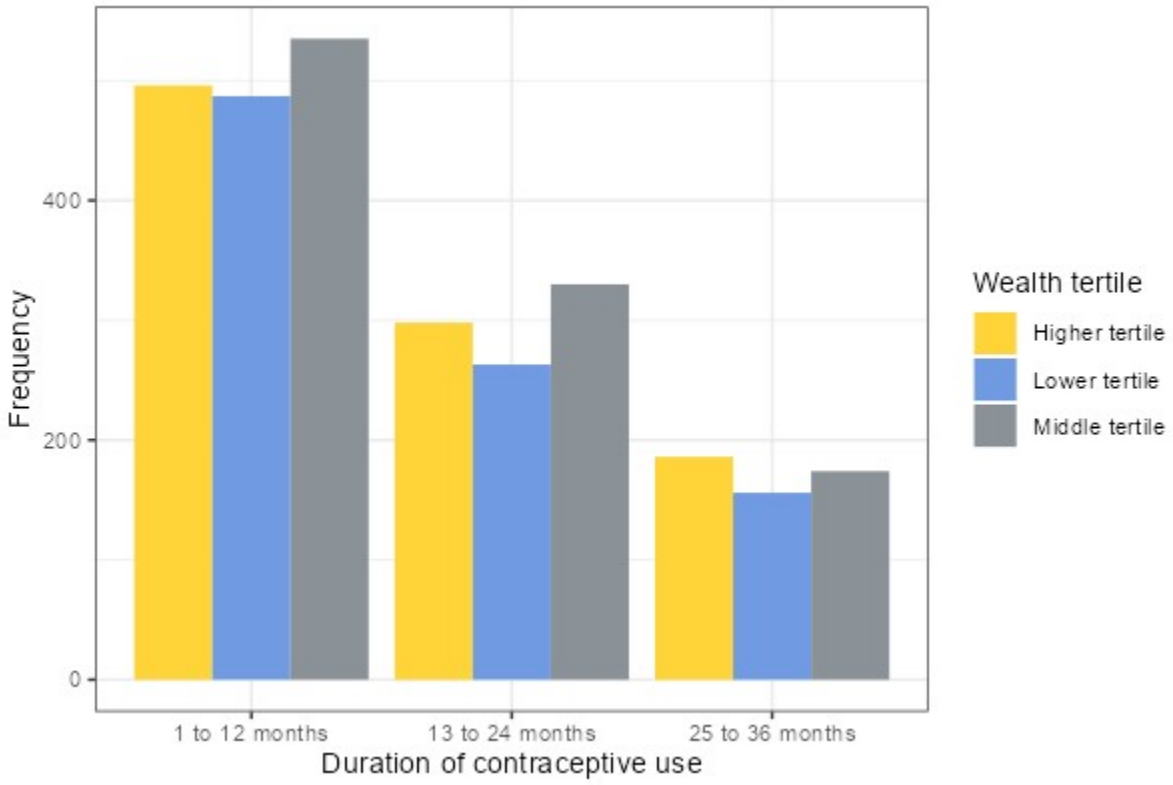
Figure 5*: Stratification times to event by Age group.*



The age bracket for our study was between ages 15 to 49. These ages were grouped into age-groups of size 5 years. Cumulatively, the age-groups attributed the following percentages to the event times: 15-19 (9.43%), 20-24 (25.80%), 25-29 (24.73%), 30-34 (18.36%), 40-44 (6.59%) ,45-49 (2.86%). As displayed in Figure 5, among both women who had event times of up to 12 months and those who had event times of between 13 to 24 months, women in the 20-24 age-group had the highest population followed by women in the 25-29 age group. However, among women who had event times of between 25 to 36 months, women in the 25-29 had the highest population, followed closely by women in the 30-34 age group and women in the 20-24 age group falling to third. Women in the 15-19 age group were the fourth most populated in the 1 to 12 months event duration class, fifth in the 13 to 24 months event duration class and sixth in the 25 to 36 months event duration class. Women in the 30-34 age group were the third most populated in the 1 to 12 months and 13 to 24 months event duration classes. Women in the 35-39 age group were the fifth most populated in the 1 to 12 months event duration

class and fourth in the other two event duration classes. Women in the 40-44 age group were the second least populated in the 1 to 12 months and 13 to 24 months event duration classes but third least populated in the 25 to 36 months event duration class. Women in the 45-49 were the least populated across all event time classes but significantly were almost similar in frequency to the women in 15-19 age group in the 25 to 36 months event duration class. These large shifts among age groups across event times point towards the potential significance of age in survival times of our participants.

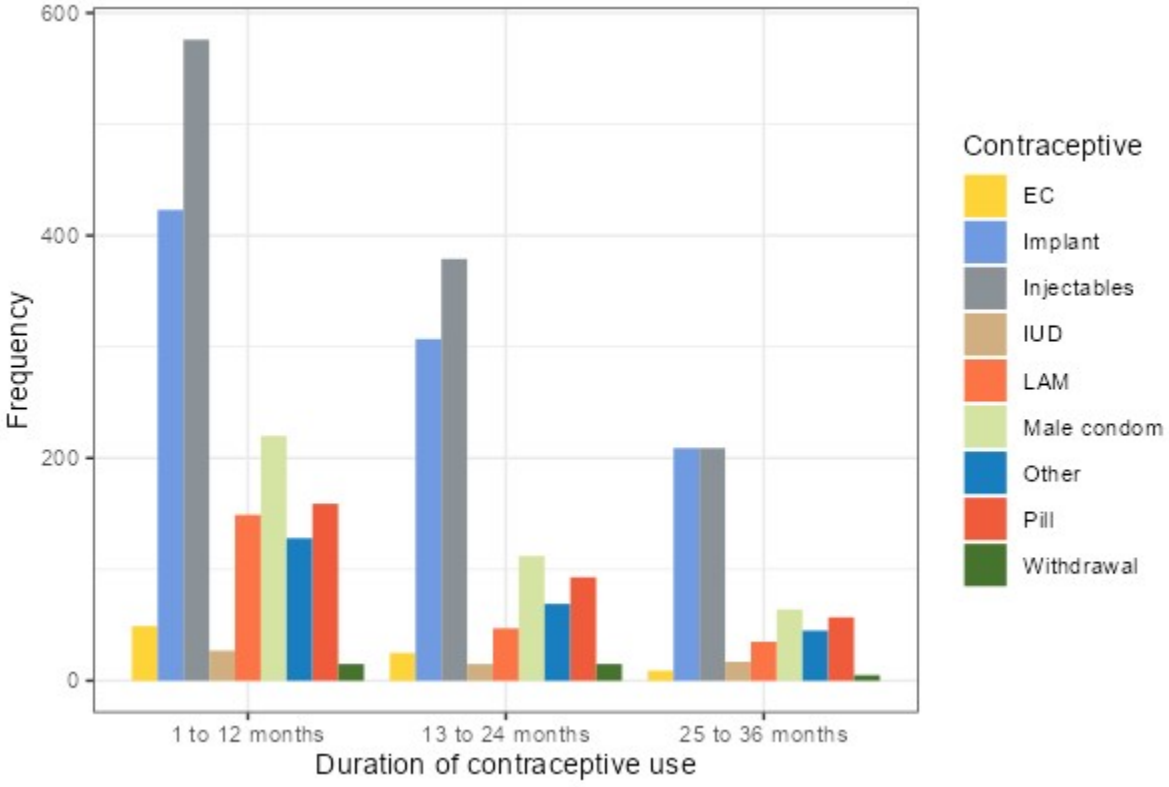
Figure 6*: Stratification times to event by Wealth.*



As shown in Figure 6, the middle wealth tertile was the most populated in the 1 to 12 months and 13 to 24 months event duration classes but dropped to second in the 25 to 36 months event duration class. The higher wealth tertile was the second most populated in the 1 to 12 months and 13 to 24 months event duration classes but was the most populated in the 25 to 35 months event duration class. The lower wealth tertile was the least populated across the event times. However, the difference in frequency among these

wealth tertile across event times is marginal. An early indicator of the potential insignificance of wealth to survival time. Cumulatively with regard to the event times, middle wealth tertile attributed 35.21%, higher wealth tertile 34.28% and lower wealth tertile 30.51% respectively.

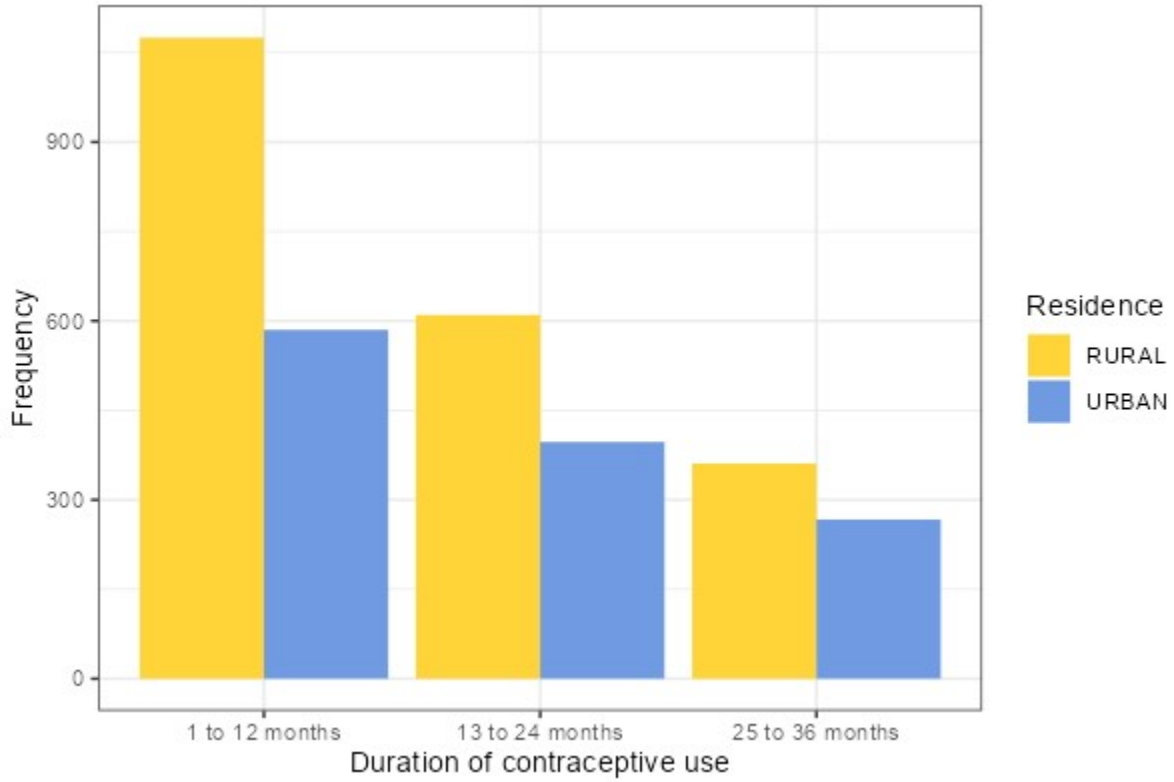
Figure 7*: Stratification times to event by Contraceptive method used.*



The contraceptive methods used by our study participated were classified into the following classes: EC (Emergency Contraceptives), implants, injectables, IUD (Intrauterine Device), LAM (Lactation Amenorrhea method), male condom, pills withdrawal and other methods which included female condom, standard days, diaphragm, foam and other traditional methods. As shown in Figure 7, in all three event duration times classes, women who used injectables had the highest population followed by women who used implants except in the 25 to 36 months event duration class where

women who used implants and those who used injectables were equally populated. Women who used implants were the second in all event duration groups bar the third where they were joint top in terms of population. Women who used male condoms were the third most populated and women who used pills fourth in all three event duration groups. In the 1 to 12 months event duration group women who used LAM were the fifth most populated, dropping to sixth in the 13 to 24 months and 25 to 36 months event duration groups. Women who used other contraceptives were the sixth most populated in the 1 to 12 months and 25 to 36 months event duration group but fifth in the 13 to 24 months event duration group. Women who used emergency contraceptives were the third least populated in the 1 to 12 months and 13 to 25 months event duration classes but were the second least populated group in the 25 to 36 months event duration group as women who use IUD were the second least populated in that event duration group. In the two prior event duration groups they were the second least populated. Women who used withdrawal method were the least populated in all three event duration groups. Cumulatively towards event times, implants attributed 35.91%, injectables 33.43%, male condom 9.358%, pill 7.694%, other methods 7.058%, LAM 2.546%, IUD 2.339%, withdrawal 0.7688% and emergency contraceptive 0.8976% respectively.

Figure 8*: Stratification times to event by residence*



Residence was dichotomized into either rural or urban residence. As displayed in Figure 8, in all event duration groups women who lived in rural residence were the most populated cumulatively attributing 61.91% to the event times and those in urban residence the remaining 38.09%.

4.1.2 Discontinuation rates

The number of discontinuation episodes at 12 months was 843, 1033 at 24 months and 1054 for 36 months. The overall discontinuation rates per method were calculated at 12-month intervals from 12 to 36 months, respectively, and the results are shown in Table 1.

Table 1*: Discontinuation rates across method types*

Method	12m %	24m %	36m %
Pills	44.4	58.3	62.9
Injectables	31.9	51.6	59.9
IUD	6.5	15.9	15.9
Implant	8.8	17.7	21.0
Male condom	38.8	44.7	44.7
All methods	35.3	46.9	50.9

4.1.2.1 Overall discontinuation rates

Table 2 *: Distribution of contraceptive discontinuation episodes across covariates at 12, 24 and 36 months*

	12		24		36	
Contraceptive method	**n**	**%**	**n**	**%**	**n**	**%**
Pill	105	12.5	125	12.1	128	12.1
IUD	4	0.5	6	0.6	6	0.6
Injectable	260	30.8	355	34.4	367	34.8
Implant	51	6.0	94	9.1	99	9.4
Male condom	124	14.7	139	13.5	139	13.2
Withdrawal	13	1.5	13	1.3	13	1.2
EC	57	6.8	58	5.6	58	5.5
Other	49	5.8	60	5.8	61	5.8
LAM	180	21.4	183	17.7	183	17.4
Age group						
15-19	92	10.9	106	10.3	106	10.1

20-24	242	28.7	285	27.6	289	27.4
25-29	215	25.5	284	27.5	289	27.4
30-34	148	17.6	181	17.5	186	17.6
35-39	82	9.7	101	9.8	104	9.9
40-44	43	5.1	51	4.9	55	5.2
45-49	21	2.5	25	2.4	25	2.4
Education level						
Never	39	4.6	41	4.0	41	3.9
Primary	279	33.1	365	35.3	374	35.5
Post-Primary vocational	22	2.6	28	2.7	30	2.8
Secondary	319	37.8	387	37.5	394	37.4
College/ University	184	21.8	212	20.5	215	20.4
Marital status						
In Union	548	65.0	706	68.3	721	68.4
Not in Union	295	35.0	327	31.7	333	31.6
Wealth						
Lowest	223	26.5	265	25.7	270	25.6
Middle	242	28.7	308	29.8	312	29.6
Highest	250	29.7	299	28.9	308	29.2
unlisted	128	15.2	161	15.6	164	15.6
Region						
Urban	257	30.5	311	30.1	318	30.2
Rural	458	54.3	561	54.3	572	54.3
unlisted	128	15.2	161	15.6	164	15.6
Total	**843**	**100.0**	**1033**	**100.0**	**1054**	**100.0**

IUD, intrauterine device; EC, Emergency contraceptive ; LAM, Lactation amenorrhea

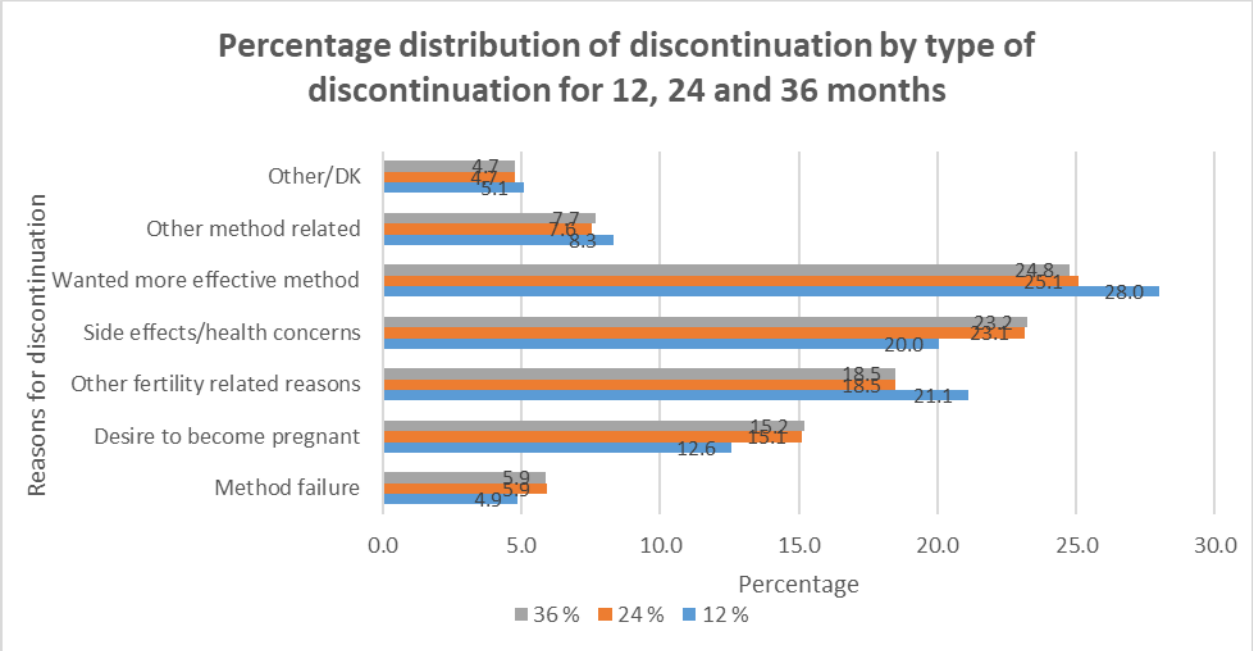
The obtained rates of discontinuation at 12, 24 and 36 months were 35%, 47% and 51% respectively. Pill users had the highest overall propensity to discontinue at all periods followed by users of injectables. Users of the IUD were least likely to discontinue use. Table 2 presents the percent distribution of discontinuation of use by contraceptive method and characteristics of the respondents for 12, 24 and 36 months. As expected, discontinuation rates varied by the contraceptive method. The distribution of discontinuation by the type of method shows users of injectables were more likely to discontinue within 24 or 36 months compared to users of other methods. Users of IUD, Withdrawal and implants had the lowest discontinuation rates.

When contraceptive discontinuation was examined across characteristics of the population, women in the age groups 20-24 and 25-29 had a higher discontinuation rate compared to the rest. Women with a secondary education were observed to be more likely to discontinue across all the three periods and those in rural regions also had higher discontinuation rates. Individuals in higher wealth tertiles also had higher discontinuation rates than other wealth classes

4.1.3 Reasons for discontinuation

This section expounds on the reasons for discontinuation.

Figure 9: *Percentage distribution of discontinuation by type of discontinuation for 12, 24 and 36 months*



Referring to Figure 9, the main reason for discontinuation was wanting a more effective method across 24.8% for 12 months, 25.1% for 24 months and 28% for 36 months. Side effects followed with 23.1% for 12 months, 23% for 24 months and 20% for 36 months.

4.1.4 Testing difference in levels of covariates to the survival time.

To test whether the levels of the covariates were significantly different from each other, a log rank test was performed for each covariate. The log rank test is a non-parametric test to test the null hypothesis of no difference in survival between independent groups. Survival curves are estimated for each group using the Kaplan-Meier method and compared statistically using the log rank test. The test compares the entire survival experience between groups and can be thought of as a test of whether the survival curves are identical (overlapping) or not. The results as displayed in Table 3.

Table 3*: Results for log rank test*

:

Variable	N	O	E	$\frac{(O-E)^2}{E}$	$\frac{(O-E)^2}{V}$
Education Level					
College/University	661	215	192.2	2.7086	3.415
Never	95	41	25.5	9.3560	9.895
Post-Primary	87	30	26.6	0.4235	0.448
Primary	1324	374	420.8	5.2069	8.932
Secondary	1291	394	388.8	0.0689	0.112
Chi square = 18.6 on 4 degrees of freedom, p-value=0.001					
Marital Status					
In union	2378	721	745	0.744	2.61
Not in union	1080	333	309	1.791	2.61
Chi square = 2.6 on 1 degrees of freedom, p-value=0.1					
County					
Bungoma	293	96	86.8	0.982	1.102
Kakamega	307	100	92.0	0.704	0.795
Kericho	346	86	105.8	3.707	4.247
Kiambu	302	126	83.4	21.755	24.363
Kilifi	242	81	70.2	1.653	1.825
Kitui	336	90	111.1	3.995	4.600
Nairobi	371	135	117.4	2.626	3.045
Nandi	436	85	140.3	21.771	25.866
Nyamira	259	83	75.2	0.820	0.910

Siaya	331	91	105.5	2.002	2.291
West_Pokot	235	81	66.4	3.215	3.544
Chi square = 65.2 on 10 degrees of freedom, p-value=0.000					
Age (years)					
15-19	326	106	83.7	5.93	6.66
20-24	892	289	260.9	3.03	4.15
25-29	855	289	261.3	2.95	4.04
30-34	635	186	203.4	1.50	1.91
35-39	423	104	140.3	9.40	11.17
40-44	228	55	72.1	4.06	4.48
45-49	99	25	32.3	1.64	1.74
Chi square = 29.5 on 6 degrees of freedom, p-value=0.000					
Wealth					
Higher	980	308	299	0.2462	0.3543
Lower	906	270	274	0.0497	0.0692
Middle	1039	312	315	0.0204	0.0300
Chi square = 0.3 on 2 degrees of freedom, p-value=0.9					
Contraceptive method					
Emergency contraceptive	83	58	11.87	179.360	188.758
Implant	939	99	348.26	178.404	278.242
Injectables	1164	367	360.54	0.116	0.181
IUD	59	6	22.53	12.124	12.745
LAM	231	183	38.70	538.036	591.376
Male condom	396	139	103.08	12.513	14.316
Other	242	61	75.06	2.634	2.922
Pill	309	128	85.22	21.477	24.114

Withdrawal	35	13	8.74	179.360	2.162
Chi square = 1011 on 8 degrees of freedom, p-value=0.000					
Residence					
Rural	1071	319	334	0.669	1.1
Urban	1854	572	557	0.401	1.1
Chi square = 1.1 on 1 degrees of freedom, p-value=0.3					

The following variables were observed to have significantly different groups with regards to survival: education level (p-value 0.001), county (p-value 0.000), age (p-value 0.000) and contraceptive method (p-value 0.000).

4.1.5 Determinants to time to discontinuation

This section presents the probability of discontinuing a contraceptive method controlling for other factors. This was done using the Cox proportional hazards regression model, which considers the duration of contraceptive use. The hazard rate represents the potential during the 36-month study period of an individual discontinuing a contraceptive method. The results are shown in Table 4.

Table 4*: Factors influencing discontinuation after 36 months duration of contraceptive use*

Variable	HR	p-value	[95% HR conf. interval]	
Method				
Pill	1	Ref	Ref	
IUD	0.168*	**0.000**	0.074	0.382
Injectables	0.670*	**0.000**	0.548	0.820
Implant	0.180*	**0.000**	0.139	0.234
Male condom	0.896	0.370	0.705	1.139
Withdrawal	1.004	0.990	0.567	1.776
EC	3.478*	**0.000**	2.547	4.749
LAM	3.557*	**0.000**	2.824	4.480
Education				

College	1	Ref	Ref	
Never	1.436*	**0.034**	1.028	2.005
Primary	0.794*	**0.007**	0.672	0.939
P-PV	1.007	0.973	0.687	1.475
Secondary	0.906	0.243	0.767	1.069
Marital status				
In union	1	Ref	Ref	
Not in union	1.111	0.111	0.976	1.265
Age group				
15-19	1	Ref	Ref	
20-24	0.874	0.236	0.700	1.092
25-29	0.872	0.230	0.698	1.090
30-34	0.721*	**0.007**	0.568	0.915
35-39	0.584*	**0.000**	0.445	0.766
40-44	0.601*	**0.002**	0.434	0.833
45-49	0.610*	**0.026**	0.395	0.944
Wealth				
Highest	1	Ref	Ref	
Lowest	0.959	0.613	0.814	1.129
Middle	0.964	0.647	0.823	1.128
Residence				
Rural	1	Ref	Ref	
Urban	0.927	0.281	0.808	1.064
County				
Bungoma	1	Ref	Ref	
Kakamega	0.983	0.904	0.743	1.301
Kericho	0.735*	**0.038**	0.549	0.983
Kiambu	1.366*	**0.021**	1.047	1.781
Kilifi	1.043	0.782	0.776	1.401
Kitui	0.732	0.033	0.549	0.976
Nairobi	1.038	0.778	0.799	1.349
Nandi	0.547*	**0.000**	0.409	0.733
Nyamira	0.998	0.991	0.744	1.339
Siaya	0.779	0.088	0.585	1.038
West_pokot	1.104	0.513	0.821	1.484

IUD, intrauterine device; EC, Emergency contraceptive ; LAM, Lactation amenorrhea; P-PV, Post-Primary vocational; Ref, reference category; CI, confidence interval; HR, hazard ratio.
* , p-value < 0.05

The cox-proportional regression analysis identified four variables as significantly influential to time to contraceptive discontinuation: age (30-34 years, 35-39 years, 40-44 years, 45-49 years); contraceptive method (implant, injectables, IUD, pill and withdrawal); education level (Primary) and county of residence (Kericho, Kiambu, Nandi).

The use of IUD and implant showed a significant association with a reduced hazard of 83.2% and 82% lower hazards respectively as compared to pill users (HR= 0.168 CI= 0.074- 0.382),(HR= 0.180 CI= 0.139 - 0.234) . Injectables had a 33% lower hazard than pills (HR= 0.67 CI= 0.57-0.82).

The study found that women who had completed primary-school education as their highest form of formal education had 20.6% lower hazard of discontinuation than women who had attained a college or university education (HR = 0.794 ,95% CI = 0.672-0.939).

Women between ages of 30-34 years were found to be 27.9% less at risk of discontinuation than women between ages of 15 - 19 years (HR =0.721 95% CI = 0.568 – 0.915). Women between ages 35-39 years were 41.6% less at risk of discontinuation (HR = 0.584, 95% CI= 0.445 – 0.766) and those aged 40-44 years were 39.9% less at risk of discontinuation than those in the 15-19 age group. Those in the age group of 45-49 years were 39% less at risk (HR = 0.610, 95% CI = 0.395 – 0.944).

Women from Kericho county were 26.5% less at risk (HR = 0.735, 95% CI = 0.549 - 0.983) of discontinuation as compared to women in Bungoma county. Similarly, women from Nandi were 45.3% less at risk of discontinuation as compared to women in Bungoma county (HR = 0.547, 95% CI = 0.409 - 0.733) whereas women from Kiambu county had a 36.6% higher hazard of discontinuation as compared to women from Bungoma county (HR = 1.366, 95% CI = 1.047-1.781).

Rural–urban differentials, wealth categories and marital status did not show any significant influence on time to discontinuation despite being reported as in previous studies such as Sseninde, J. (2019).

Table 5*: Significant variables associated with discontinuation for the nested Cox proportional model*

Variable	HR	p-value	[95% HR conf. interval]	
Method				
Pills	1.000	Ref	Ref	
IUD	0.172*	**0.000**	0.076	0.391
Injectables	0.654*	**0.000**	0.535	0.801
Implant	0.171*	**0.000**	0.131	0.222
Male condom	0.857	0.231	0.665	1.103
Withdrawal	1.032	0.913	0.583	1.829
EC	3.416*	**0.000**	2.487	4.692
LAM	3.600*	**0.000**	2.856	4.538
Age Group				
15-19	1.000	Ref	Ref	
20-24	0.995	0.963	0.790	1.251
25-29	0.995	0.967	0.783	1.264
30-34	0.800	0.085	0.620	1.032
35-39	0.698*	**0.013**	0.526	0.926
40-44	0.762	0.116	0.543	1.069
45-49	0.850	0.471	0.547	1.322

The final fitted model included the variable for Age groups and contraceptive methods, which proved to be significant and provided a good fit.

4.2 Discussion

Women from lower and middle wealth classes had higher contraceptive discontinuation rates at 28% and 30% respectively. This may be explained by their tendency to use short-term methods that are prone to higher discontinuation rates and also their lower exposure to contraceptive information and services (Magadi & Curtis, 2003) . Women who discontinue even though they don't want to become pregnant put themselves at risk for unplanned pregnancies, which can have adverse consequences such as unsafe abortions and increased rates of morbidity and mortality in mothers and children. It can also undo the positive progress made thus far in maternal and child health indicators (MOH *et al*., 2018).

Rural–urban differentials did not show any significant influence on discontinuation rates despite their significance in the choice of a method. Although prior research revealed significant differences based on residence and wealth, wealth categories did not significantly correlate with discontinuation rates (Agrahari *et al*., 2016; M. M. Ali & Cleland, 2010).

The leading cause of discontinuation was desire for a more effective method at 24.8%, 25.1% and 28.3% for 12, 24 and 36 month intervals respectively; followed by side effects at 23%, 23% and 20% across the three periods. This is in agreement with Ababa (2012) and Ali (2012). According to information from KDHS, only 60% of current modern contraceptive users had been informed about the potential side effects of their chosen method and only 52% had been told how to handle them (Kenya National Bureau of Statistics, 2015; KNBS, 2023). Several countries reported lower side effect rates of 22% (Ali, 2012). In contrast to the high satisfaction levels of 97% expressed by family planning exit customers in Kenyan health institutions, the high rates of discontinuation conceal problems with the quality of the services provided (NCPD *et al.*, 2019).

The study reveals that pill users have the highest overall propensity to discontinue at all periods followed by users of injection. Users of the IUD were least likely to discontinue

use. Long-acting reversible contraception (LARC), such as implants and IUDs, have lower discontinuation rates because they are favored by people who are restricting births or who do not aim to become pregnant for a number of years (Kungu *et al.*, 2020; Shoupe, 2016). The results of this study are in line with previous research showing that longer-acting methods that don't depend on user behavior like implants and IUDs perform better in terms of method continuation (M. Ali & Cleland, 1999). In contrast to injections or pills, removing the IUD requires purposeful action, thus women who are more likely to stop using them may also be less likely to discontinue them in the first place. In Kenya, use of short-term contraceptive methods, specifically injectables, pills, and condoms among women of reproductive age, increased from 23.0% in 2003 to 36.4% in 2014.

We hypothesize that users of injectables and pills were more likely to discontinue due to side effects, especially when combined with findings showing short-term method users are more likely to do so. This is supported by research done in sub-Saharan Africa that reported that users of pills and injectables who experienced side effects that were not tolerable, mostly due to changes in bleeding patterns, discontinued use or switched to a method perceived to be more tolerable (Chebet *et al*., 2015). Numerous studies have also shown that a woman's decision to stop using a contraceptive method or to discourage possible new users may be influenced by her fear of side effects or health issues, whether they are real or perceived (Weldemariam *et al*., 2016 ; Barden-O'Fallon *et al*., 2018)

Results of the survival analysis established that the contraceptive methods used and the age of the woman were the main determinants of time to discontinuation. The study found that women in the age groups 20-24 and 25-29 had a higher likelihood of discontinuation when compared to the rest. These results align with the Harris (2013) that claimed younger women unmarried, or not in union are the most likely to discontinue a method and conversely, older women have significantly lower hazards to contraceptive discontinuation due to the achievement of their desired family size and it is likely women in this age group are almost reaching menopause. In his article, he argues that

contraceptive discontinuation is due to increased fertility hence at 40-45, a woman is believed to be less fertile. Implants and IUDs are long-acting reversible contraception (LARC), which are preferred by those who are limiting births or are not intending to get pregnant for several years, and hence their lower risk ratios (Kungu *et.al*, 2020).

Other demographic and socio-economic factors that were found significantly associated with time to contraceptive discontinuation were education level and county of residence. Women who attained college/university having reported a higher risk of discontinuing a contraceptive than those who stopped at primary education suggests a less than adequate reproductive health awareness among campus-going and recently graduated women offered by colleges or universities. Sobol (2021) reported that "learning institutions offered limited or no comprehensive education on sexual and reproductive health, despite school-going girls preferring to receive such information from schools." (para 5). Bungoma county experiences a fertility rate of 3.6 children per woman, an increase of 0.2 from the national fertility rate of 3.4. Kericho, Nandi and Kiambu counties have fertility rates of 3.1, 3.0 and 2.9 children per woman respectively (Statista, 2023). The reduced child-bearing in Kericho, Nandi and Kiambu counties could be associated with lower desire for pregnancy as compared to women in Bungoma county and thus justifying the reduced risk as women in Bungoma are more likely to discontinue a contraceptive method in the pursuit of more children.

CHAPTER FIVE
SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

Contraceptive discontinuation is defined as the halt of a contraceptive usage that had priorly been in application within a year from its initial adoption for reasons not associated with pregnancy. This phenomenon is particularly derogative to family planning programs and additionally among the chief causes of unwanted pregnancies and thus this report aims to further analyze the factors associated with the discontinuation of contraceptive methods.

When contraceptives are stopped for non-pregnancy-related reasons, there is a higher likelihood of unplanned pregnancies, which can result in unsafe abortions and have a negative impact on the health of mothers, newborns, and children. Lack of a comprehensive framework that recognizes the various and complicated elements that impact the choice to switch or stop using a contraceptive method completely makes it difficult to gain a deeper understanding of the circumstances that may lead to cessation of the technique. Hence, the purpose of this study is to provide further understanding and information on this important public health concern.

In carrying out the study, secondary data from Performance Monitoring for Action was utilized.The study was conducted in eleven counties in Kenya: West Pokot, Bungoma, Kakamega, Siaya, Nandi, Nyamira, Kericho, Kiambu, Nairobi, Kitui and Kilifi. The study participants used for this study were a sample of women who were between the ages of 15 to 49 years. The data consisted of contraceptive usage for a period of three years (2019-2021). Each participant was followed up once a year and their calendar data were updated. At the end of three years, each participant's duration of contraceptive use preceding discontinuation was collected. Questionnaires were the main data collection tool. To accomplish our main objective, survival analysis methods were applied and a Cox proportional hazard model was fitted.

There were 1054 discontinuation episodes in total. The women's average contraceptive usage duration was about 14 months. The upper and lower quartile months were at 6 and 22 months, respectively, while the median duration was 12 months. This means that an individual should, on average, utilize contraception consistently for at least a year.

The cox-proportional regression analysis identified four variables as significantly influential to time to contraceptive discontinuation: age (30-34 years, 35-39 years, 40-44 years, 45-49 years); contraceptive method (implant, injectables, IUD, pill and withdrawal); education level (Primary) and county of residence (Kericho, Kiambu, Nandi).

Pill users had the highest overall propensity to discontinue at all periods followed by users of injectables. Users of the IUD were least likely to discontinue use. Women in the age groups 20-24 and 25-29 had a higher discontinuation rate compared to other age groups. Women with a secondary education were observed to be more likely to discontinue across all the three periods and those in rural regions also had higher discontinuation rates. Individuals in higher wealth tertiles also had higher discontinuation rates than other wealth classes.

The survival analysis findings implicated that the overall discontinuation rates were 35% (12 months), 47% (24 months) and 51% at (36 months). Wanting a more effecting method accounted for about 25% of discontinuations and side effects accounted for 23% of discontinuations, whilst injection and pill recorded the highest rates. Type of method emerged as a predictor of discontinuation at 36 months with the following hazard ratio (HR) at 95% confidence interval [CI]; intrauterine device (IUD) (HR = 0.168, CI = 0.074-0.382), injection (HR = 0.670, 95% CI = 0.548-0.820), implants (HR = 0.180, 95% CI = 0.139-0.234). Age (30+ years) displayed influence: 30-34 years (HR = 0.721, 95% CI = 0.568-0915), 35-39 years (HR = 0.584, 95% CI = 0.445-0.766), 40-44 years (HR = 0.601, 95% CI = 0.434-0.833) and 45-49 years (HR = 0.610, 95% CI = 0.395-0.944). Contraceptive discontinuation had an association with age categories and an individual's method of choice.

5.2 Conclusion

Discontinuation has been given the analogy of a leaking bucket where some current contraceptive users slowly drop into another bucket of past and never users meaning the bucket of current users can never get full or even rise sustainably.

This research delved into the critical issue of contraceptive discontinuation and aims to identify its various associated factors.

From the study, the factors that lead to contraceptive discontinuation include age, method of contraception, education level and county of residence while most noted causes of discontinuation were the need for a more effective method and the presence of side effects. Individuals with relatively lower education levels had higher rates of contraceptive discontinuation.

5.3 Recommendations

The study recommends that contraceptives, in whichever form preferable, should be provided to women of different age groups to ensure effective use of contraception methods. In doing so, the gap created by contraceptive discontinuation will reduce.

There is also a need for greater education about contraceptive techniques, including their advantages and disadvantages. Therefore, the issue of contraceptive discontinuation should be addressed in family planning programs intended to prevent unintended pregnancy. This could be resolved by increasing access to a variety of contraceptive techniques and providing greater counseling regarding the side effects of those methods.

National family planning programs should intentionally put in place strategies to address contraceptive discontinuation. Side effects are a major concern among current and potential contraceptive users. As part of provision of quality family planning services, during the initiation of contraceptive use, women ought to be provided with information on potential side effects and options to consider, including method switching, when they experience intolerable side effects. Health education should be provided to women to allay potential fear of side effects. Several studies have also indicated that the fear of side effects/health concerns whether perceived or real can influence a woman's decision to discontinue use of a contraceptive method, or deter potential new users (Weldemariam *et al*., 2016 ; Barden-O'Fallon *et al*., 2018). These concerns need to be taken seriously and addressed.

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Appendix

Sustainable Development Goals (SDG)

World Health Organization WHO

Long-Acting Reversible Contraceptive (LARC)

Intrauterine Devices (IUDs)

Performance Monitoring for Action (PMA)

Kenya National Bureau of Statistics (KNBS)

Enumeration Areas (EAs)

Probability Proportional to Size (PPS)

Household Questionnaire (HQ)

Female Questionnaire (FQ)

Lactation Amenorrhea Method (LAM)

Century Month Code (CMC)

Demographic Health Survey (DHS)

Hazard Ratios (HR)

Likelihood Ratio Test (LRT)

Confidence Interval (CI)

Analytic Code

STATA code

```
clear all

*set directorate

cd "D:\Bridget\Disk d\STATA\School project\take 2"

**************************************************************************

*importing the data

use "D:\Bridget\Disk d\STATA\School project\take 2\KEP3_WealthWeightAll_8Mar2022.dta",clear

**************************************************************************


*Data cleaning

keep if HHQ_result_cc==1 & FRS_result_cc==1

keep if last_night==1

keep if calendar_events_exist=="1"

*****************************************************************

*Generating age groups


egen Age_Group=cut(FQ_age), at(15(5)50)

label define Age_Group 15 "15-19" 20 "20-24" 25 "25-29" 30 "30-34" 35 "35-39" 40 "40-44" 45 "45-49"

label val Age_Group Age_Group


*Generating parity

egen parity=cut(birth_events), at(0, 1,2,4, 40)

label define parity_list 0 "No child" 1 "1 child" 2 "2-3 children" 4 ">4 children", modify

label values parity parity_list


*Marital status

recode FQmarital_status (1 2= 1 "In Union") (3 4 5=2 "Not in Union"), gen (Marital_status)
```

```
*Frequency of intercourse per week

replace n_sex_permonth=. if n_sex_permonth==-99| n_sex_permonth==-88

gen n_sex_perweek= n_sex_permonth/4

gen sexperweek=.

replace sexperweek=1 if n_sex_perweek<2

replace sexperweek=2 if n_sex_perweek>=2 & n_sex_perweek<=35

label define n_sex_perweek 1 "<2/week" 2 ">2/week"

label val sexperweek n_sex_perweek

*Education level

label define education 0 "Never" 1 "Primary" 2 "Post-Primary vocational" 3 "Secondary" 4
"College/ University"

recode school (4 5 =4 "College/ University"),gen (education_level)

label val education_level education

*Unmet need for both spacing and limiting

cap gen unmet_need=0 if unmet !=.

replace unmet_need=1 if unmet_need==0 & unmet ==1 | unmet==2

label define need 1 "unmet need" 0 "met / other"

label val unmet_need need

tab unmet_need,m

**********************************************************************

*Keeping necessary varialbles

keep member_number FQmetainstanceID current_methodnumEC  Marital_status Age_Group
wealthtertile_Kenya FQmarital_status cc_col1_full cc_col2_full ur pill implant IUD injectables
education_level doi doi_corrected FQdoi FQdoi_corrected FQdoi_correctedSIF doimonth
```

```
doiyear doicmc current_user_first current_user recent_user current_userEC recent_userEC
totaldemand FQweight* sexperweek parity level1 unmet_need

**********************************************************

*Saving dataset

save "D:\Bridget\Disk d\STATA\School project\take 2\KEP3.dta",replace


use "D:\Bridget\Disk d\STATA\School project\take 2\KEP3.dta",clear


*************************************************************************

*Checking for duplicates

duplicates tag FQmetainstanceID, gen(d)

keep if d== 0

drop d

*************************************************************************

*Splitting the columns


split cc_col1_full, p(,) generate(method_month_)


foreach i of varlist method_month_1-method_month_48{

        replace `i'="81" if `i'=="B"

        replace `i'="82" if `i'=="P"

        replace `i'="83" if `i'=="T"

                }


label define event -99 "No response" 0 "No Method Used" 1 "Female sterilization" 2 "Male
sterilization" 3 "Implants" 4 "IUD" 5 "Injectable" 7 "Pill" 8 "Emergency Contraceptives" 9 "Male
Condom" 10 "Female Condom" 11 "Diaphragm" 12 "Foam/Jelly" 13 "Standard days/cycle beads"
14 "LAM" 30 "Rhythm" 31 "Withdrawal" 39 "Other Traditional methods" 81 "Birth" 82
"Pregnancy" 83 "Termination",modify


foreach var of varlist method_month_1-method_month_48 {

        destring `var', replace
```

```
        lab val `var' event
}

*label val method_month event

*Column 2 reason for discontinued
*splitting, labelling and destringing

split cc_col2_full, parse(,) generate (reason_month_)

label define reason 1 "Infrequent_sex/husband_away" 2 "Became pregnant while using" 3
"Wanted_to_be_pregnant" 4 "Husband/Partner_disapproved" 5 "Want_more_effective" 6
"Side_effects_health_concerns" 7 "Lack_access/too_far" 8 "Cost_too_much" 9
"Inconvinience_to_use" 10 "Up_to_god" 11 "Difficult_to_get_pregnant/menopausal" 12
"Marrital_dissolution/Separation" 96 "Other", modify

foreach var of varlist reason_month_1-reason_month_48{
   destring `var', replace
        label val `var' reason
}

**********************************************************************
*Renaming variables following the calendar with m_m_1 being the cc_col1 value of interview
data

*Macro for full calendar
global cal_len=36

forvalues i = 1/48 {
  local j = 49 - `i'
   rename method_month_`i' m_m_`j'
}
```

```
forvalues i = 1/48 {
  local j = 49 - `i'
   rename reason_month_`i' r_m_`j'
}

*Dropping empty calendar columns

drop m_m_48-m_m_37
drop r_m_48-r_m_37
*****************************************************************
local cal_len=36
local cal_len = $cal_len

* Set episode number - initialized to 0
gen episodes_tot = 0
* Set previous calendar column 1 variable to anything that won't be in the calendar
gen prev_cal_col = -1

set trace on
* Create variable to identify unique episodes of use
forvalues j = `cal_len'(-1)1 {
 local i = `cal_len' - `j' + 1
 * Increase the episode number if there is a change in cc_col1_
 replace episodes_tot = episodes_tot+1 if m_m_`i' != prev_cal_col
 * Set the episode number
 gen int event_number`i' = episodes_tot
 * Save the cc_col1_* value for the next time through the loop
 replace prev_cal_col = m_m_`i'
}
```

```
*Reshape to data into Long Format and drop unnnecessary variables
* Drop the calendar variables now we have the separate month by month variables
drop *_full episodes_tot prev_cal_col
* Reshape the new month by month variables into a long format
reshape long event_number m_m_ r_m_ , i(FQmetainstanceID) j(i)

* label the event number variable
label variable event_number "Event number"

*Generate Century Month Code for start of calendar and date of interview

*Generating cmc for each calendar month
global firstyear 2019
global lastyear 2021
local firstyear $firstyear
local lastyear $lastyear

* Drop blank episodes occurring after the date of interview
gen start_cmc = ((`firstyear'-1900)*12)+1
gen cmc=start_cmc+i-1

* CMC Dates for today
replace FQdoi_correctedSIF=dofc(FQdoi_correctedSIF)
format FQdoi_correctedSIF %td
gen today_cmc = ((year(FQdoi_correctedSIF)-1900)*12)+month(FQdoi_correctedSIF)

* Drop blank episodes occurring after the date of interview
drop if cmc > today_cmc

**********************************************************************
**
```

```
save "D:\Bridget\Disk d\STATA\School project\take 2\KEP3_reshaped.dta", replace

use "D:\Bridget\Disk d\STATA\School project\take 2\KEP3_reshaped.dta", clear

* Collapse the episodes within each case, keeping start and end, the event code

collapse FQweight* today_cmc start_cmc (first) event_start=cmc (last) event_end=cmc (count)
event_duration=cmc ///

 (last) event_code_numeric=m_m_ discontinuation_code_numeric=r_m_, by(FQmetainstanceID
event_number)

* label the variables created in the collapse statement

label variable event_start  "CMC event begins"

label variable event_end  "CMC event ends"

label variable event_duration "Duration of event"

label variable event_code_numeric "Event code"

label variable discontinuation_code_numeric "Discontinuation Code"

format event_number %2.0f

format event_start event_end %4.0f

*Generate Variables that document current, previous and next Event status

* capture the previous event and its duration for each respondent

by FQmetainstanceID:gen previous_event = event_code_numeric[_n-1] if _n > 1

by FQmetainstanceID:gen previous_event_dur = event_duration[_n-1] if _n > 1

* capture the following event and its duration for this respondent

by FQmetainstanceID:gen next_event = event_code_numeric[_n+1]  if _n < _N

by FQmetainstanceID:gen next_event_dur = event_duration[_n+1]  if _n < _N

* label the event file variables and values

label variable event_code_numeric  "Current Event code"

label variable discontinuation_code_numeric   "Discontinuation code"
```

```
label variable previous_event  "Prior event code"
label variable previous_event_dur "Duration of prior event"
label variable next_event  "Next event code"
label variable next_event_dur "Duration of next event"
label values previous_event cc_option1_list
label values next_event cc_option1_list
label values event_code_numeric cc_option1_list
label values discontinuation_code_numeric cc_option2_list

format event_duration event_code_numeric discontinuation_code_numeric      ///
          previous_event previous_event_dur next_event next_event_dur %2.0f


* save the events file
save "D:\Bridget\Disk d\STATA\School project\take 2\_eventsfile.dta", replace
* save the events file
save "D:\Bridget\Disk d\STATA\School project\take 2\_eventsfile.dta", replace

* Drop ongoing events as the calendar began
drop if start_cmc == event_start


* drop births, terminations, pregnancies, and episodes of non-use
* keep missing methods. to exclude missing change 99 below to 100.
drop if (event_code_numeric > 39| event_code_numeric ==0 ) & event_code_numeric!=.

* time from beginning of event to interview
gen tbeg_int = today_cmc - event_start
label var tbeg_int "time from beginning of event to interview"

* time from end of event to interview
gen tend_int = today_cmc - event_end
```

```
label var tend_int "time from end of event to interview"

* Generate Discontinuation Variable
gen discont = 0
replace discont = 1 if discontinuation_code_numeric != .
* censoring those who discontinue in last three months
replace discont = 0 if tend_int < 3
label var discont "discontinuation indicator"
tab discont
tab discontinuation_code_numeric discont, m

//////////////////
*Generate late entry variable
gen entry = 0
replace entry = tbeg_int - 23 if tbeg_int >= 24
tab tbeg_int entry

* taking away exposure time outside of the 3 to 23 month window
gen exposure = event_duration
replace exposure = event_duration - (3 - tend_int) if tend_int < 3
recode exposure -3/0=0

* drop those events that started in the month of the interview and two months prior
drop if tbeg_int < 3

* drop events that started and ended before 23 months prior to survey
drop if tbeg_int > 23 & tend_int > 23

* censor any discontinuations that are associated with use > 20 months
replace discont = 0 if (exposure - entry) > 20
```

```
* to remove sterilized women or women whose partners use male sterilisation
replace exposure = . if (event_code_numeric == 1| event_code_numeric == 2)

/////
* Keeping only first occurence of discontinuation and censoringthe rest

bysort FQmetainstanceID: generate event_count=_n

order event_count event_duration, a(event_number)

keep if event_count==1

*checking for duplicate ids
duplicates tag FQmetainstanceID, gen (dup)
keep if dup==0
drop dup

//////////////////
save "D:\Bridget\Disk d\STATA\School project\take 2\_discont_file.dta",replace

* Step 6
* recode methods, discontinuation reason

* recode contraceptive method
recode event_code_numeric  ///
        (7 = 1) ///*pills
        (4 = 2) ///*IUD
        (5 = 3) ///*Injectbales
        (3 = 4) ///*implants
        (9 = 5) ///*MC
        (31 = 7) ///*Withdrawal
```

```
        (8 = 8) /// *EC
        (14 = 14) ///*LAM
        (nonmissing = 9) ///* other
        (missing = .), gen(method)

label define method_list 1 "Pill" 2 "IUD" 3 "Injectables" 4 "Implant" 5 "Male condom" 7
"Withdrawal" 8 "EC" 9 "Other" 14 "LAM"
label values method method_list
tab event_code_numeric method, m

* LAM and Emergency contraception are grouped here
* Other category is Female Sterilization, Male sterilization, Other Traditional, Female Condom,
Other Modern, Standard Days Method

* recode reasons for discontinuation - ignoring switching
recode discontinuation_code_numeric
        ///
        (0 .    = .)                                                    ///
        (2      = 1 "Method failure")                           ///
        (3      = 2 "Desire to become pregnant")        ///
        (1 11 12 = 3 "Other fertility related reasons")     ///
        (6    = 4 "Side effects/health concerns")  ///
        (5      = 5 "Wanted more effective method")     ///
        (7 8 9 = 6 "Other method related")                  ///
        (nonmissing = 7 "Other/DK") if discont==1, gen(reason)
label var reason "Reason for discontinuation"
tab discontinuation_code_numeric reason if discont==1, m

* Calculate the competing risks cumulative incidence for each method and for all methods

* create global lists of the method variables included
```

```
levelsof method
global meth_codes `r(levels)'
*modify meth_list and methods_list according to the methods included
global meth_list pill iud inj impl mcondom withdr ec other lam
global methods_list `" "Pill" "IUD" "Injectables" "Implant" "Male condom" "Withdrawal" "EC" "Other" "LAM" "All methods" "'
global drate_list
global drate_list_sw
foreach m in $meth_list {
        global drate_list $drate_list drate_`m'
        global drate_list_sw $drate_list_sw drate_`m'_sw
}

* competing risks estimates - first all methods and then by method
tokenize allmeth $meth_list
foreach x in 0 $meth_codes {

        * by reason
        * declare time series data for st commands
        stset exposure if `x' == 0 | method == `x' [iw=FQweight], failure(reason==1) enter(entry)
        stcompet discont_`1' = ci, compet1(2) compet2(3) compet3(4) compet4(5) compet5(6) compet6(7)
        * convert rate to percentage
        gen drate_`1' = discont_`1' * 100

        * Get the label for the method and label the variables appropriately
        local lab1 All methods
        if `x' > 0 {
                local lab1 : label method `x'
        }
```

```
        label var drate_`1' "Rate for `lab1'"

        * shift to next method name in token list
        macro shift
}

* Keep the variables we need for output
keep FQmetainstanceID method drate* exposure reason discont_sw FQweight entry discont

* save data file with cumulative incidence variables added to each case
save "D:\Bridget\Disk d\STATA\School project\take 2\_drates.dta", replace

*For each time 6, 12, 24, 36
local x 12
* Now tabulate (using table instead of tab to avoid extra Totals)
table method reason [iw=drate_]

table method [iw=drate_]

*****************************************************************
use "D:\Bridget\Disk d\STATA\School project\survival\episode_file.dta",clear

////Merging file with attributes and rates and event file

merge 1:1 FQmetainstanceID using "D:\Bridget\Disk d\STATA\School project\take 2\KEP3.dta"

drop if _merge==2
drop _merge

*cleaning
drop member_number doi doi_corrected FQdoi  FQdoi_corrected FQdoi_correctedSIF implant
IUD pill injectable
```

```
order level1 ur wealthtertile_Kenya  Age_Group parity FQmarital_status Marital_status
education_level sexperweek current_methodnumEC ,a(FQmetainstanceID )

************************************************************

*Saving dataset

save "D:\Bridget\Disk d\STATA\School project\survival\svl_dataset.dta",replace


use "D:\Bridget\Disk d\STATA\School project\survival\svl_dataset.dta",clear

************************************************************

*Discontinuation episodes across

*******Across reasons**************************

*12m

collapse (count) exposure (percent) per_epi=exposure if exposure<=12 & discont==1, by
(reason)


*24m

collapse (count) exposure (percent) per_epi=exposure if exposure<=24 & discont==1, by
(reason)


*36m

collapse (count) exposure (percent) per_epi=exposure if exposure<=36 & discont==1, by
(reason)


******Across methods**************************

*12m

collapse (count) exposure (percent) per_epi=exposure if exposure<=12 & discont==1, by
(method)


*24m

collapse (count) exposure (percent) per_epi=exposure if exposure<=24 & discont==1, by
(method)
```

*36m

collapse (count) exposure (percent) per_epi=exposure if exposure<=36 & discont==1, by (method)

********Across age groups************************

*12m

collapse (count) exposure (percent) per_epi=exposure if exposure<=12 & discont==1, by (Age_Group)

*24m

collapse (count) exposure (percent) per_epi=exposure if exposure<=24 & discont==1, by (Age_Group)

*36m

collapse (count) exposure (percent) per_epi=exposure if exposure<=36 & discont==1, by (Age_Group)

**************Across UR**********************

*12m

collapse (count) exposure (percent) per_epi=exposure if exposure<=12 & discont==1, by (ur)

*24m

collapse (count) exposure (percent) per_epi=exposure if exposure<=24 & discont==1, by (ur)

*36m

collapse (count) exposure (percent) per_epi=exposure if exposure<=36 & discont==1, by (ur)

*****************Across education level*****************

*12m

collapse (count) exposure (percent) per_epi=exposure if exposure<=12 & discont==1, by (education_level)

*24m

collapse (count) exposure (percent) per_epi=exposure if exposure<=24 & discont==1, by (education_level)

*36m

collapse (count) exposure (percent) per_epi=exposure if exposure<=36 & discont==1, by (education_level)

**********Across marital status**********

*12m

collapse (count) exposure (percent) per_epi=exposure if exposure<=12 & discont==1, by (Marital_status)

*24m

collapse (count) exposure (percent) per_epi=exposure if exposure<=24 & discont==1, by (Marital_status)

*36m

collapse (count) exposure (percent) per_epi=exposure if exposure<=36 & discont==1, by (Marital_status)

**********Across wealth tertiles**********

*12m

collapse (count) exposure (percent) per_epi=exposure if exposure<=12 & discont==1, by (wealthtertile_Kenya)

*24m

collapse (count) exposure (percent) per_epi=exposure if exposure<=24 & discont==1, by (wealthtertile_Kenya)

*36m

collapse (count) exposure (percent) per_epi=exposure if exposure<=36 & discont==1, by (wealthtertile_Kenya)

**********Across urbanisation**********

*12m

collapse (count) exposure (percent) per_epi=exposure if exposure<=12 & discont==1, by (ur)

*24m

```
collapse (count) exposure (percent) per_epi=exposure if exposure<=24 & discont==1, by (ur)
*36m
collapse (count) exposure (percent) per_epi=exposure if exposure<=36 & discont==1, by (ur)

************************************************************

****SURVIVAL ANALYSIS
*Model
use "D:\Bridget\Disk d\STATA\School project\survival\svl_dataset.dta",clear

stset exposure, failure(discont==1)

*univariate models
stcox i.method
stcox b4.education_level
stcox i.Age_Group
stcox b3.wealthtertile_Kenya
stcox b2.ur
stcox i.Marital_status
stcox i.county

*Multivariate (backward)
stcox i.method i.Age_Group i.ur i.Marital_status i.education_level i.wealthtertile_Kenya i.county

stcox method Age_Group ur Marital_status education_level wealthtertile_Kenya county

*Testing
test  2.wealthtertile_Kenya 3.wealthtertile_Kenya ///insignificant

test 1.education_level 2.education_level 3.education_level 4.education_level ///insignificant
```

test 20.Age_Group 25.Age_Group 30.Age_Group 35.Age_Group 40.Age_Group 45.Age_Group //significant

test 2.method 3.method 4.method 5.method 7.method 8.method 9.method 14.method //significant

stcox i.method i.Age_Group i.ur i.Marital_status i.education_level i.wealthtertile_Kenya i.county

estat ic // 12654.41

stcox i.method i.Age_Group i.ur i.education_level i.wealthtertile_Kenya i.county

*wealth insignificant

estat ic //12657.88

stcox i.method i.Age_Group i.ur i.education_level i.county

*education insignificant

stcox i.method i.Age_Group i.ur i.county

test 2.ur //significant

test 2.county 3.county 4.county 5.county 6.county 7.county 8.county 9.county 10.county 11.county

stcox i.method i.Age_Group i.ur i.county

estat ic // 15402.35

stcox i.method i.Age_Group

estat ic // 15399.66

stcox method Age_Group

***Interarctions

stcox i.method i.Age_Group c.method#i.Age_Group //sig

stcox i.method i.Age_Group c.method#c.Age_Group

*p-value 0.678 : insignificant

stcox i.method i.Age_Group i.ur i.county c.method#i.ur //insignificant

stcox i.method i.Age_Group i.ur i.county c.Age_Group#i.ur //insignificant

stcox i.method i.Age_Group i.ur i.county c.method#c.county //isignificant

stcox i.method i.Age_Group i.ur i.county c.Age_Group#c.county //insignificant

stcox i.method i.Age_Group i.ur i.county c.ur#c.county //insignificant

stcox i.method i.Age_Group c.method#c.Age_Group //no interactions

//All tested Interactions are insignificant

stcox i.method i.Age_Group

estat ic // 15399.66

stcox i.method i.Age_Group i.ur i.county

estat ic // 12651.21

**Goodness of fit

stcox i.method i.Age_Group

estimate store model1

stcox i.method i.Age_Group i.ur i.county

estimates store model2

lrtest model1 model2

*Model 1 has a better fit

R code

Generation of event times histogram

```
library(ggplot2)

ggplot(data=svl_dataset,aes(event_duration))+ geom_histogram(fill="cyan4")+  labs(x
="Duration of contraceptive use (months)", y="Frequency")+ theme_bw()

hist(svl_dataset$event_duration)
```

Event times stratification

```
#Education level

ggplot(data=svl_dataset,aes(cattimes_string,fill=education_level_string))+  geom_bar(position =
"dodge")+  labs(x='Duration of contraceptive use',y="Frequency",fill="Education
Level")+theme_bw() +

  scale_fill_simpsons()

#Marital status

ggplot(data=svl_dataset,aes(cattimes_string,fill=marital_status))+ geom_bar(position =
"dodge")+

  labs(x='Duration of contraceptive use',y="Frequency",fill="Marital Status")+theme_bw()+

  scale_fill_simpsons()

#County

ggplot(data=svl_dataset,aes(cattimes_string,fill=level1))+ geom_bar(position = "dodge")+

  labs(x='Duration of contraceptive use',y="Frequency",fill="County")+theme_bw()+

  scale_fill_simpsons()

#Age

ggplot
(data=glen_contraceptive1_new_svl_dataset,aes(cattimes_string,fill=Age_Group_string))+

  geom_bar(position = "dodge")+  labs(x='Duration of contraceptive
use',y="Frequency",fill="Age-Group")+theme_bw()+  scale_fill_simpsons()

#Wealth

ggplot(data=svl_dataset,aes(cattimes_string,fill=wealth_string))+  geom_bar(position =
"dodge")+

  labs(x='Duration of contraceptive use',y="Frequency",fill="Wealth tertile")+theme_bw()+
```

```
 scale_fill_simpsons()
#Contraceptive
ggplot(data=svl_dataset,aes(cattimes_string,fill=method_string))+
 geom_bar(position = "dodge")+
 labs(x='Duration of contraceptive use',y="Frequency",fill="Contraceptive")+theme_bw()+
 scale_fill_simpsons()
#urbanization/residence
ggplot(data=svl _dataset,aes(cattimes_string,
 fill=ur_string))+ geom_bar(position = "dodge")+  labs (x='Duration of contraceptive
use',y="Frequency",fill="Residence")+theme_bw()+  scale_fill_simpsons()
```

Survival curves

```
library (survival)
library (survminer)
library (ggplot2)

#1. plotting survival curve associated with education level
kp.meier.est<-survfit(surv_data~education_level)
ggsurvplot(kp.meier.est,data = svl_dataset,xlim=c(0,36),xlab="Survival time(0-36 months)",
legend.labs=c("Never","Primary","Post-primary","Secondary","College/University"),
 pval = T, ggtheme=theme_linedraw())
#testing Log rank of the groups
surv_diff <- survdiff(Surv(event_duration,discont) ~education_level_string , data = svl_dataset)
surv_diff

#cox-ph model
res.cox <- coxph(Surv(event_duration,discont) ~education_level, data = svl_dataset)
res.cox
tab_model (res.cox)
tabcoxph (res.cox)
```

```
summary(res.cox) #checks model validity


#2. plotting survival curve associated with marital status

kp.meier.est<-survfit(surv_data~Marital_status)

ggsurvplot(kp.meier.est,data = svl_dataset,xlim=c(0,36),xlab="Survival time(0-36 months)",pval
= T,

legend.labs=c("Married","Unmarried"),ggtheme=theme_linedraw())

#testing Log rank of the groups

surv_diff <- survdiff(Surv(event_duration,discont) ~Marital_status_string , data = svl_dataset)

surv_diff


#coxph model

res.cox <- coxph(Surv(event_duration,discont) ~marital_status , data = svl_dataset)

res.cox

tabcoxph(res.cox)

summary(res.cox)#checks model validity


#3. County

surv_data<-Surv(svl_dataset$event_duration,svl_dataset$discont)

attach(svl_dataset)

kp.meier.est<-survfit(surv_data~ svl_dataset$County)

ggsurvplot(kp.meier.est,data = svl_dataset,xlim=c(0,36),

legend.labs=c("Bungoma","Kakamega","Kericho","Kiambu","Kilifi","Kitui","Nairobi","Nandi","Ny
amira","Siaya","West-Pokot"),xlab="Survival time(0-36 months)",pval = T,
ggtheme=theme_linedraw())

#testing Log rank of the groups

surv_diff <- survdiff(Surv(event_duration,discont) ~level1 , data = svl_dataset)

surv_diff


#coxph model
```

```
res.cox <- coxph(Surv(event_duration,discont) ~level1 , data = svl_dataset)

res.cox

tabcoxph(res.cox)

summary(res.cox)#checks model validity


#4. Age

surv_data<-Surv(event_duration,discont)

kp.meier.est<-survfit(surv_data~Age_Group)

ggsurvplot(kp.meier.est,data = new_svl_dataset,xlim=c(0,36),legend.labs=c("Age-Group 15-
19","Age-Group 20-24","Age-Group 25-29","Age-Group 30-34","Age-Group 35-39","Age_Group
40-44","Age 45-49"),xlab="Survival time(0-36 months)",pval = T,ggtheme=theme_linedraw())

#testing Log rank of the groups

surv_diff <- survdiff(Surv(event_duration,discont) ~Age_Group_string , data = svl_dataset)

surv_diff


#coxph model

res.cox <- coxph(Surv(event_duration,discont) ~Age_Group_string , data = svl_dataset)

res.cox

tabcoxph(res.cox)

summary(res.cox)#checks model validity


#5. Wealth

kp.meier.est<-survfit(surv_data~wealthtertile_Kenya)

ggsurvplot(kp.meier.est,data = svl_dataset,xlim=c(0,36),legend.labs=c("Lower tertile","Medium
tertile","Higher tertile"),xlab="Survival time(0-36 months)",pval = T,ggtheme=theme_linedraw())

#testing Log rank of the groups

surv_diff <- survdiff(Surv(event_duration,discont) ~wealth_string , data = svl_dataset)

surv_diff


#coxph model

res.cox <- coxph(Surv(event_duration,discont) ~wealth_string , data = svl_dataset)
```

```
res.cox

tabcoxph(res.cox)

summary(res.cox)#checks model validity


#5. Contraceptive

surv_data1<-Surv(svl_dataset$event_duration,

svl_dataset$discont)

kp.meier.est<-survfit(surv_data1~ svl_dataset$method_string)

ggsurvplot(kp.meier.est,data =
svl_dataset,xlim=c(0,36),legend.labs=c("EC","Injectables","LAM","Other
methods","Withdrawal","Implant","IUD","Male Condom","Pill"),xlab="Survival time(0-36
months)",

pval = T,ggtheme=theme_linedraw())

#testing Log rank of the groups

surv_diff <- survdiff(Surv(event_duration,discont) ~method_string , data = svl_dataset)

surv_diff


#coxph model

res.cox <- coxph(Surv(svl_dataset$event_duration,svl_dataset$discont) ~method_string ,data =
svl_dataset)

res.cox

tabcoxph(res.cox)

summary(res.cox)#checks model validity

#8.ur

surv_data<-Surv(svl_dataset$event_duration,svl_dataset$discont)

kp.meier.est<-survfit(surv_data~ svl_dataset$ur)

ggsurvplot(kp.meier.est,data = new_svl_dataset,xlim=c(0,36),legend.labs=c("Urban","Rural"),

pval = T,ggtheme=theme_linedraw())

#testing Log rank of the groups

surv_diff <- survdiff(Surv(svl_dataset$event_duration,svl_dataset$discont) ~ ur , data
=svl_dataset)
```