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FERTILITY DIFFERENTIALS BETWEEN MOMBASA AND NAIROBI COUNTIES BASED ON KDHS 2014

Research Report in Mathematics, Number , 2016

LILIAN OWINO

August 2017

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

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

Prepared for The Director
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Abstract

Estimation of fertility has been done in Kenya since 1980s by various researchers using census and surveys datasets. The continuous update of data has made it possible to estimates current fertility rate in Kenya.

The aim of this study is to estimate the current fertility rate in Nairobi and Mombasa counties and by socioeconomic factor level, using the results obtained this study also predict the fertility levels in Kenya for the year 2019. The socioeconomic factors explored in this study are Education level, marital status level and the use of contraceptives. Relational Gompertz method is used to estimate the total fertility rate at the county and national level, the dataset used in this study is KDHS 2014.

Nairobi and Mombasa counties are majorly urban centers with Nairobi being the most Population County and Mombasa being the second most populated county in Kenya. Results obtained show that women with higher level of education have low TFR in both Counties: 3.03 in Mombasa and 2.25 in Nairobi while those with no education have high fertility level: 6.8 in Mombasa and 5.11 in Nairobi. Married women in Nairobi County fertility rate is at 3.67 which is lower than those who have never been in a union (4.58) while in Mombasa married women have a fertility rate of 4.2 higher fertility rate compared to those who have never been in a union (3.52). TFR among those using contraceptives is low (2.9 in Nairobi and 3.4 in Mombasa) compared to those who are not using (3.9 in Nairobi and 4.1 in Mombasa). Teenagers with no primary education shy away from using contraceptive (1 percent) while 69 percent of those with primary education being major users of contraceptives.

The total fertility rate in Nairobi is 2.85 while the total fertility rate in Mombasa is 3.2. Fertility rate in Kenya is 3.18 in 2014 and it is predicted to be 3.00 in the year 2019.

Policies should focus on encouraging female education beyond primary level and creating awareness on the various available contraceptives methods in both Counties and urban areas in general. The result obtained in this study can be used as a baseline for future studies.

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Declaration and Approval

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

Signature Date

LILIAN OWINO
Reg No. I56/74302/2014

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

Signature Date

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Dedication

This project is dedicated to all those who have helped me get this far in life and progress academically.

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Acknowledgments

I am grateful to all those who have helped me get this far in my academic life. Special thanks to my supervisor PROF. J.A.M. Ottieno, his guidance and pointers on direction with regards to this thesis was of great encouragement.

I thank God almighty for the strength He gave me to enable me accomplish this task. Lastly I will like to thank my parents and siblings for being supportive and encouraging me on.
Thank you all. ....

LILIAN OWINO

Nairobi, 2017.

1 Introduction

1.0.1 GENERAL INTRODUCTION

1.0.2 Background Information

Population growth of a country is of vital importance in planning, monitoring and evaluating events and trends by government and businesses (Siegel, 2002). As seen in the theme adopted by Kenyan census in 1999 "Counting Our People for Development" estimating the growth rate of Kenya population is essential for development purpose.

The three principal components of population growth are:

- **Fertility**- the number of live birth in a population over a given period of time or place.
- **Mortality**-the number of death in a population over a given period of time.
- **Migration**- movement of people from one location to another.

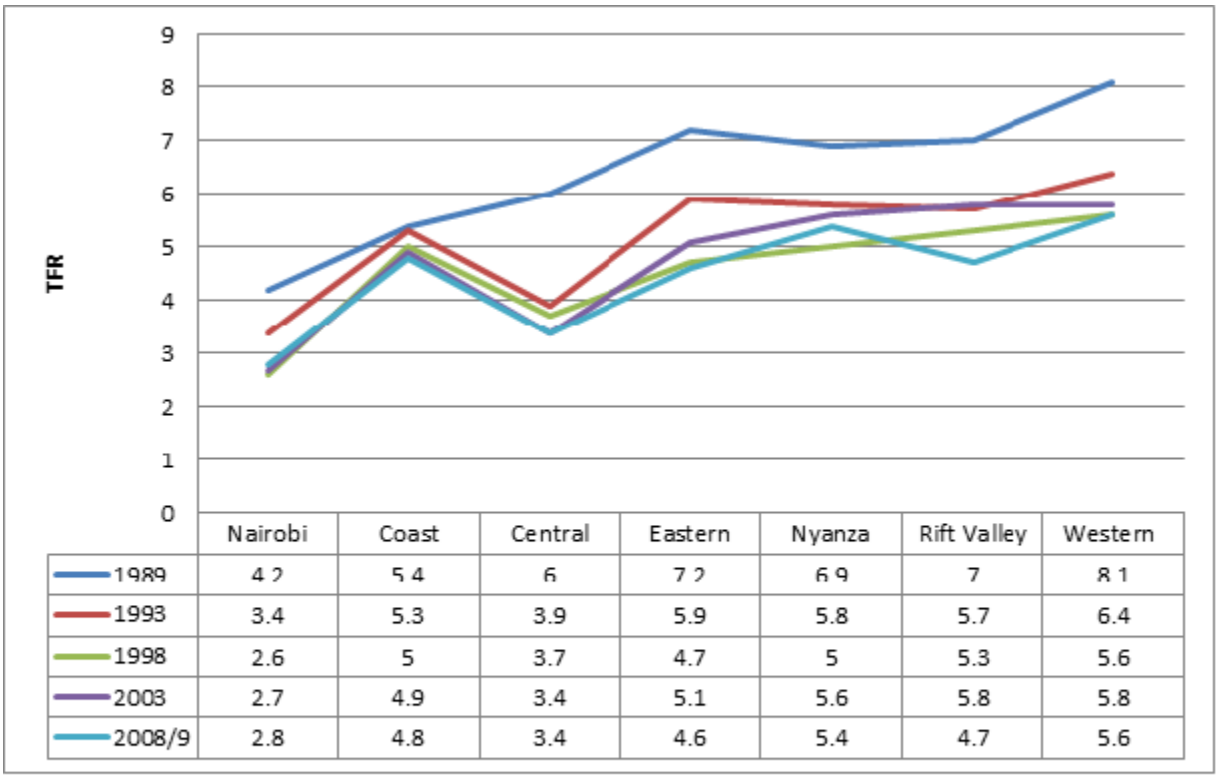
In this study the focus is on fertility, fertility between Nairobi and Mombasa counties. Fertility in Kenya has been among the highest in the world with an average of 8 children per woman (1977).Table 1.1 shows the trend of fertility in Kenya between 1989 and 2009.

Rapid decline in fertility was observed in 1980s and 1990s a change estimated to be of 29.9 percent, an overall average of 6.7 children per woman in 1989 reduced to 4.7 children per woman in 1998(KDHS). At the same time an increase in mortality rate mainly attributed to spread of HIV/AIDS epidemic was observed, some other factors that were attributed to decrease in fertility were postponement of childbearing and marriage by women in pursuit of education and usage of contraceptive.

Year	Total Fertility
1989	6.7
1993	5.4
1998	4.7
2003	4.9
2008/9	4.6

Table 1.1: Total Fertility Rate in Kenya, 1989-2008/9

The counties under study were once part of the provinces with Nairobi County being in Nairobi Province and Mombasa County being in Coast province.



	Nairobi	Coast	Central	Eastern	Nyanza	Rift Valley	Western
1989	4.2	5.4	6	7.2	6.9	7	8.1
1993	3.4	5.3	3.9	5.9	5.8	5.7	6.4
1998	2.6	5	3.7	4.7	5	5.3	5.6
2003	2.7	4.9	3.4	5.1	5.6	5.8	5.8
2008/9	2.8	4.8	3.4	4.6	5.4	4.7	5.6

Figure 1.1: Trend of Total Fertility in Kenya Regions, (Source: KDHS Surveys)

Nairobi and Coast provinces have always had low total fertility rate compared to the other provinces in Kenya (Figure 1.1).Between the year 1989 and 2008/9 Coast Province had a fertility decline of 11.11 percent, a total change of 60 percent and Nairobi province had a fertility decline of 33.3 percent from the year 1989 to 2008/9, a total change of 1.4 (140 percent). Both the provinces have experienced a huge decline in fertility.

Population in these two counties is high, mainly because they are urban centers with diverse economic and social activity. Nairobi County has a high population of 3,138,369 people in an area of $694.9km^2$ while Mombasa County considered being the smallest county with an area totaling $294.7km^2$ has a total population of 939000 people (2009 Census). The economic activity in the community influences choices such as family sizes desired.

Factors that can be attributed to decrease or increase in fertility are broadly classified in theory as biological, economical or cultural factors: these are women's education level, household income, contraceptive use, marital status, age at first birth, desired family size, place of residence, religion affiliation et al.

1.0.3 Definition of Notations and terminologies

General fertility rate (GFR) :
The total number of live births per 1000 women between ages 15-49 years(reproductive years) in a given year(Hussain, 2000).
Formula for GFR is: GFR=

$$\frac{Number\,of\,live\,births}{Female\,population\,aged\,15-49} * 1000$$

Age specific fertility rate (ASFR) :
The Total Number of births occurring to women in a given age group per 1000 women in that same age group in a given year. In calculating ASFR numerator is restricted to number of births occurring to women of a specific age interval and the denominator is restricted to being the number of person-years lived by women in the age interval (Preston, Hueveline and Guillot 2001).number of births per 1000 women of a particular age group per year.
Formula for ASFR is given by: ASFR =

$$\frac{Number\,of\,live\,births\,of\,women\,per\,each\,age\,group}{Female\,population\,in\,that\,age\,group} * 1000$$

Total fertility rate(TFR) :
The average number children a woman is likely to bear between the ages of 15-49 given the current age schedule of fertility rates. This is the frequently used fertility indicator. It is considered a summary measure of fertility as it is easy to interpret and understand. Formula for TFR is given by:

TFR =

$$5 \sum_{n=15}^{49} ASFR(x)$$

Demographic Health Survey (DHS) :
are a household surveys that are national representative providing collected data for monitoring and evaluating indicators in areas of population, health and nutrition.(USAID)

World Fertility Survey (WFS) :
Is a collection of international surveys of human fertility conducted in the late seventies and early eighties (USAID)

Fertility Differentials : differences in fertility level as they are affected by various factors e.g. social, cultural, economic.

1.0.4 Problem Statement

There has been a major change in leadership structure in Kenya with the implementation of 2010 constitution. The previous 8 provinces have been subdivided into 47 units of administration known as counties. Very few demographic research and analysis has been focused on counties hence there is need to study fertility at different county level. Therefore this study using KDHS 2014 dataset, the first national survey on health and demography to be conducted at county level in Kenya, will estimate fertility level in Mombasa county and Nairobi county,these are the two major urban centers in Kenya.

Estimation of fertility rates aids in assessing impact of population intervention program while adding and updating information on population growth. For adjustment of retrospective birth reports relational Gompertz model is used to estimate fertility rate, this method remedies errors common in fertility data: that is few birth reported among younger women and too many births reported among older women. This model will be suitable in

estimating fertility rate as it controls variability and ensures reliability of estimates.

1.0.5 Objectives

The objective of this study is:

- To estimate the current fertility rate in Mombasa and Nairobi counties
- To estimate fertility rate by Socio-economic factors specifically by female education level, marital status and contraceptive usage
- To forecast fertility rate of Kenya in the near future(2019)

2 LITERATURE REVIEW

2.0.1 Introduction

This chapter reviews the different research done on fertility. The various factors affecting fertility contributing to increase or decrease of fertility rate.

2.0.2 Studies on Fertility

Worldwide surveys that collect information pertaining to fertility are Census: usually conducted after every ten years, DHS: conducted every 5 years and WFS which was carried out in the early 70's and 80's. WFS and DHS have a consistent datasets for women (Arnold and Blanc, 1990). Using these data, yearly fertility rates of regions and key groups are estimated, shedding light on the onset of fertility transition (Opiyo and Levin, 2013). Fertility transition varies from place to place, in Nigeria fertility transition has been limited to the south west part mainly (Cohen,1993) while in Kenya fertility has stalled between the years 2001-2008(Bongaarts, 2005).

Socio-economic and biological factors impact fertility and majorly contribute to increase and decrease of fertility rate. One of the major contributors to the rapid decline of fertility rate in Kenya and Zimbabwe is contraceptive usage (Kirk and Pillet, 1998). In examining fertility preference among 23 countries in Africa it is observed that contraceptive use has been accepted among the younger cohorts, education in women is found to reduces child mortality and this in turn lowers the fertility rate. Examining only the proportion of married women using contraceptives, Bongaarts proximate determinants finds one percent reduction of births per woman.

The increased usage of contraceptive can be attributed to: availability and accessibility of various contraceptive methods to the public through health sector. In adopting contraceptives usage fertility rises before it decline (Frank and Bongaarts, 1991) this was observed in Kenya, Botswana, Ghana and Zimbabwe. The positive attitude about contraceptive use adopted by women across all ages and a large number of the population desire to monitor their family size has also encouraged use of contraceptive either to space births or to have a small family size.

There exist direct and indirect relationship between fertility and women involvement in labor force and years it takes to attain education (McClamroth, 1996), areas with women with higher education level experience large reduction in fertility level (Kirk and Pillet, 1998). Increase of women in labour force tends to decrease fertility rate as working women tend to have fewer children or postpone child bearing to later years when already stable in employment and secure in their careers. Alicia,A. in 2001 and 2003 observed a decrease of fertility with change in labor market due to unemployment and unstable work contract among women. In developing countries fertility decline has been linked to exposure of women to paid work opportunities (Lloyd 1991).

Considering that fertility in women is time bound, women who start having children early usually have large number of children (Kohler and Ortega,2002) while older women usually have a few, though advance in technology enables women of all ages to have their desired number of children.

Women with 12 years of education and more are the major contributors to low fertility rate. Higher education level mostly leads to higher income which enables one to purchase better birth control, seek better medical facilities leading to few or more children as desired depending on the attitude, values and beliefs about family size. Education changes idea and attitude towards early child bearing especially in rural areas.

AIDS epidemic: women who are HIV positive tend to have lower fertility rate compared to HIV negative women, alteration in fertility is attributed to biological: social and economic factors and behavioral reasons, (Zaba and Gregson,1998) findings indicate that national level of fertility reduces by 4 percent if 10 percent of the population is HIV+.

Factors having effect on fertility have quantified the effects of variables and modeled the direct influence to fertility (Bongaarts, 1978). Collection of data mainly on fertility increases its availability and improves on its quality to guide in policy making. Kenya ‘s ministry of health adopted policy establishing maternal child health and family planning program (MCH/FP) in 1967 and in 2012 the government passed a policy that will enable it manage the population growth reducing the number of children to 3 per women by 2030.

2.0.3 Fertility Estimation Models

Indirect models are used to estimate fertility rate as they address errors of omission and commission that might have occurred while collecting data e.g. Relational Gompertz Model.

Relational Gompertz model was first proposed by Brass (Brass,1968), he stated that this model worked best with dataset from a high fertility population, where the quality of data collected seemed to be compromised by several errors of under reporting of births and misdating of events, (Brass,1968).Accuracy of estimating ASFR in developing countries is high with application of Relational Gompertz model.

Fertility has been on the decline though the total fertility rate has remained relatively high in African countries. Recent application of Relational Gompertz model to estimate fertility in South Africa, Botswana and Lesotho dataset (Moultrie and Dorrington, 2004),(Hlabana, 2006) show the limitations of understating fertility in old age as the parameters in use are unadjusted parameters. A proposition by Booth is to use standard fertility schedule for datasets with unadjusted parameters.

The current fertility model is best achieved using Relational Gompertz Model(United Nations,1983) considering its been refined and can be fitted without direct estimation since the assumption which required fertility to be constant and total fertility to be the input when estimating were addressed (Zaba, 1981).

The other indirect methods used for estimating fertility are **1**.Reverse survival method, it provides independent estimates from Census survey and estimate fertility using function (lx/lo) at age x. **2**.Own Child method, this method is deemed superior to direct estimates from birth history (Avery,St.Clair,Levin et al 2013) and **3**.Parity Progressive Ratios model which like Relational Gompertz model smoothens and reduce irregularities. Relational Gompertz model when compared to these other model of estimating fertility is a better fit for African datasets . Osiemo (Osiemo,1986) applied relational Gompertz model to estimate fertility level of Kenya using data drawn from census 1969 and 1979 and was able to estimated fertility levels and differentials at national, provincial and district levels.

3 DATA SOURCE AND ANALYSIS METHOD

3.0.1 Introduction

In this chapter variables that help achieve the objective of the study which is to estimate fertility levels in Nairobi and Mombasa Counties and at different socio-economic levels as well as to predict the fertility level of Kenya are selected from KDHS survey of 20964 respondents and the method used for analysis explained in details.

3.0.2 Data Source

The source of data for this study is secondary data KDHS 2014. The survey covered the whole country with each county being chosen as strata. Each county was stratified into urban and rural strata except Nairobi and Mombasa counties which were stratified as urban areas only. One of the objectives of KDHS was to measure changes in fertility hence detailed information pertaining to the number of births in the previous year are recorded, this helps in estimating fertility levels.

The 5360 clusters were split into 4 equal subsamples and samples drawn proportional to strata size and without replacement. The choice of clusters had been updated between the year 2013-2014. Samples in each sampling stratum were selected by simple random sampling. Data is weighted to represent the whole Country.

Data variables used in this study are:

- Five year age group of women (15-19,20-24,25-29,30-34,35-39,40-44,45-49)
- Number of children born in the past one year by five-year age group of women
- Marital status by five-year age group of women
- Education level by five-year age group of women
- Contraceptive use by five-year age group of women

Data is analyzed using SPSS 20 and Microsoft Excel.

3.0.3 Analysis Method

Various methods have been used to estimate fertility rate. Direct methods that are mostly used are General fertility rate, Age-specific fertility rate, Total fertility rate and Crude fertility rate. In this study we use an indirect method to estimate fertility, the method used is:

- Relational Gompertz Model

Relational Gompertz Model

Relational Gompertz Model is a modification of Coale and Trussell model by Brass, (1978).It seeks to estimate age specific fertility and total fertility using recent data on births reported in censuses or surveys by determining shape of fertility schedule. Retrospective data on children ever born suffer from reporting errors, Gompertz model according to Zaba,(Zaba,1981) provides adjustment tool that corrects fertility distribution reports of children born.

The Gompertz function is of the form

$$F(x)/F = A^{B^x}. \quad \text{.....(3.1)}$$

where $F(x)$ is the cumulated age specific Fertility rates up to age x,F is Total Fertility,A and B are constants between 0 and 1.
A and B describe the pattern of fertility, A being the proportion of total fertility obtained by age x and B determining the growth rate of the curve measure of spread of age specific fertility.

It is convenient to work with the Gompertz function in a linear form hence Gompertz function is transformed into a linear form by taking natural logarithms twice on both side of the equation:

$$-ln[F(x)/F] = -B^x lnA$$
suppose we let $(lnA) = A$‘
then $-ln[F(x)/F] = -A‘B^x$.....$let(-lnA) = A$“
$$ln(-ln[F(x)/F]) = ln(A“B^x) = lnA“ + xlnB$$
$$-ln(-ln[F(x)/F]) = -ln(A“) - xlnB$$

$$-ln(-ln(F(x)/F) = a + bx$$
Where $a = -ln(-lnA)$ and $b = -lnB$
$-ln[-ln(F(x)/F)] = a + bx$.....(3.2)
$Y(x) = a + bx$.....(3.3)

where $Y(x) = -ln[-ln(F(x)/F)$ This function (3.3)is still a broad representation of the pattern of fertility age and the shape is quite not right yet:poor fit for younger and older women parities.Therefore we transform equation(3.3) to improve on the efficiency of the model using standard value $Y_s(x)$

$Y(x) = a + bY_s(x)$ .....(3.4)

a and b are constants that reflects the fertility pattern of the population.
Transformed fertility is assumed now to be linearly related to transformed standard fertility implying similarity of deviation from observed and standard fertility from Gompertz function

a and b constants are estimated by plotting Z(x)-e(x) against g(x) for current data.
e(x) and g(x) are standard values obtained from a standard distribution table.

Replacing $F(x)$ with P_i in Equation (3.2) we have Gompertz model for parity data.P_i is the mean parity of an age group of women with i=1,2,3,4,5,6,7.... where :

$-ln[-ln[P_i/F] = c + dY_s(i)]$
letting this be equal to $Y(i)$ where $Y(i) = c + dY_s(i)]$.....(3.5)

c and d are constants:similar to a and b and estimated similarly,reflecting the fertility pattern of the population.

Two estimation procedures are suggested by Brass to fit equation (3.4) and (3.5), using parity data or current fertility data. The estimation equations are $Z(i) = -ln[-ln(P_i/P_{i+1})]$and $Z(x) = -ln[-ln(F(x)/F(x+1))]$
where i=1,2,3,4,5,6,7 and x=19.5,24.5,.....,.49.5

At the origin of the standard $Ys(x) = 0$ and $F(x) = 1/e$ where e=2.17.... so that comparison between P and 1/e indicate relative proportion of observed and standard fertility by age x_0, the resulting curvature is right skewed that captures fertility pattern fairly well for both young and old women.

substituting a and b into equation (3.4) and c and d into equation (3.5), Y(x) and Y(i) are obtained. The values are used to calculate
$F(x)/F = exp[-exp(-Y(x))]$
and $P(i)/P = exp(-exp(-Y(i)))$

TFR=P(i)/P or TFR =F(x)/F

NOTE: $F(x) = Fexp(-exp(-(a+bYs(x))))$ for current data and $P(i) = Fexp(-exp(-(a+bYs(i))))$ is estimate for parity,$F(x)$ is the cumulated fertility up to age x, $P(i)$ is the average parity for the i^{th} age group, F is the total fertility rate,a,b,c and d are constants and values $Ys(x)$ and $Ys(i)$ are both obtained from standard tables

Steps in computation

- Classify fertility data by five year age group of the women
- Calculate $F(x)/F(x+5)$ and $P(i)/P(i+1)$,
- Compute Z(x) and Z(i): $Z(x) = -ln[-lnF(x)/F(x+5)]$ and $Z(i) = -ln[-ln[Pi/Pi+1]]$
- Least square method is used to obtain constants a and b that is $Z(x) - e(i)$ is plotted against $g(x)$, $e(x)$ and $g(x)$ values are in obtained from standard table, similarly $Z(i) - e(i)$ is plotted against $g(i)$ to obtain parities constants.
- $TFR = Pi/P^I$ or $TFR = F(x)/F^x$

Data requirements from survey or census

- Female population classified by five year aged group.
- Number of children born within 12 or 24 or 36 months before the survey, classify by five year age group.

4 DATA ANALYSIS

4.0.1 Introduction

This chapter presents statistical findings of KDHS 2014 on fertility at the national and county level. Data is analysed using SPSS 20 and Microsoft Excel.Results are presented in figures and tables for ease of interpretation.

4.0.2 Description of the Population

A total of 19564 females aged 15-49 years participated in the 2014 DHS national survey. A large number of the respondents were aged between 20 years and 34 years (75 percent) as shown in Figure 4.1. Records of population distribution in developing countries are of similar nature that is a large number of the populations are at the peak of their reproductive ages.

Respondents in age group 15-19 years and 40-44 years had similar percentage of participants in the survey hence we can conclude that teenagers and 40-44 age group number of population are identical.

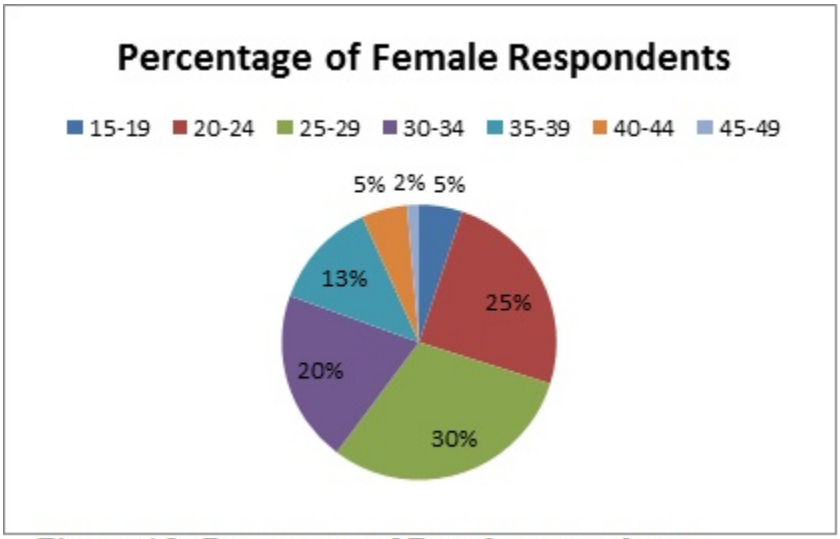


Figure 4.1: Percentage of Female respondents

The number of female who participated in the survey by 5 year age group follows a normal distribution curve (Figure 4.2 below) with an elongated right hand side. The highest peak being age 25-29 years.

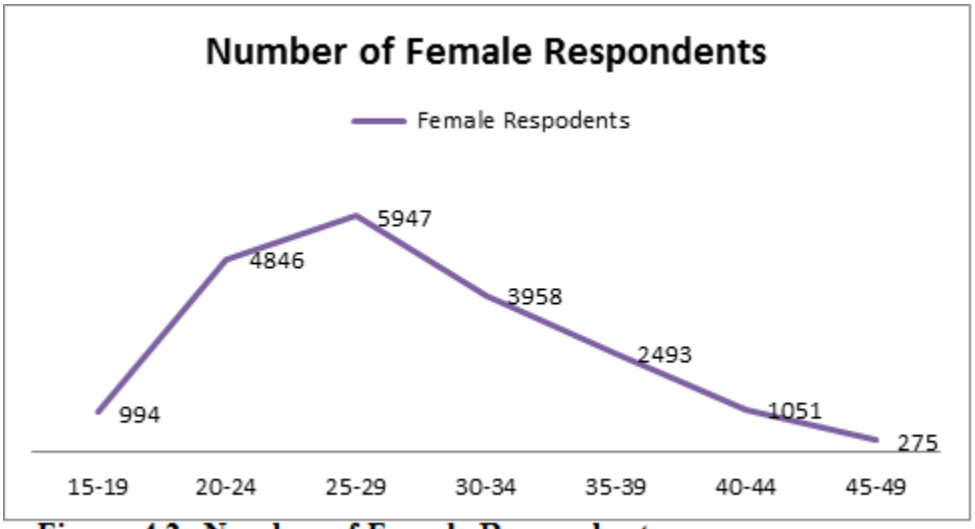


Figure 4.2: Number of Female Respondents

Stem and Leaf Plot of Respondents

Figure 4.3 below presents summary statistics of the survey data collected. The average age for fertility for most females is 28.56 years with a deviation of 6.5 years. This finding suggests that fertility is highly concentrated at age 22-34 years.KDHS 2003 findings generalize fertility peak to be between ages 24-34 in urban areas.
The youngest female who participated in this survey was aged 15 years a 0.1% of the participants, which is the same percentage for the oldest participants who were aged 49 years.

Respondent's current age Stem-and-Leaf Plot

Frequency	Stem &	Leaf
20.44	15 .	00
74.50	16 .	000000
122.43	17 .	000000000
296.72	18 .	00000000000000000000000
479.97	19 .	000000000000000000000000000000000000
712.82	20 .	000000000000000000000000000000000000000000000000000000
860.72	21 .	00000000000000000000000000000000000000000000000000000000000000000
1158.37	22 .	000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
899.04	23 .	00000000000000000000000000000000000000000000000000000000000000000000
1214.70	24 .	0000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
1274.17	25 .	000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
1226.11	26 .	00000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
1181.49	27 .	00000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
1263.84	28 .	00000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
1001.43	29 .	000000000000000000000000000000000000000000000000000000000000000000000000000
1151.04	30 .	000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
799.60	31 .	000000000000000000000000000000000000000000000000000000000000
813.42	32 .	0000000000000000000000000000000000000000000000000000000000000
542.11	33 .	00000000000000000000000000000000000000000
652.17	34 .	0000000000000000000000000000000000000000000000000
658.81	35 .	00000000000000000000000000000000000000000000000000
567.81	36 .	0000000000000000000000000000000000000000000
497.12	37 .	0000000000000000000000000000000000000
432.77	38 .	000000000000000000000000000000000
336.13	39 .	0000000000000000000000000
402.52	40 .	000000000000000000000000000000
263.05	41 .	00000000000000000000
194.92	42 .	000000000000000
101.38	43 .	00000000
89.33	44 .	0000000
104.38	45 .	00000000
75.54	46 .	000000
94.75 Extremes		(>=47)

Figure 4.3: Stem and Leaf Plot of Respondents

Number of Children Born

The total number of children born was a sixty seven percent of the whole population (13059). Table 4.1 indicates the largest percentage of births to be 31 percent in age group 25 -29 years and low births was reported in age group 45-49 years (2 percent) this can be attributed to majority of women in their late forties have already achieved their desired family size while women above twenty four years are just starting to form their families.

Women of 20-24 years and 30-34 years rate of giving birth are similar (22 percent). The low birth percentage (3 percent) in age group 15-19 years can be attributed to the fact that most females are still unmarried and the strong policies in the country are to do away with teenage pregnancy.

Age group	Female Population	Births
15-19	994	412
20-24	4846	2929
25-29	5947	4037
30-34	3958	2859
35-39	2493	1746
40-44	1051	829
45-49	275	247
Total	19564	13059

Table 4.1: Births in the Past Year in Each Age Group

General Fertility Rate

Results from Table 4.1 are used to calculate the number of live births per 1000 women in the reproductive age 15-49 years: General Fertility Rate (GFR) in Kenya.

Formula:

$$\frac{Total number of live births in the past year}{Total number of female sged 15-49 years} * 1000$$

$$= (13059/19564) * 1000$$
$$= 667.5$$

A total of 667.5 live births are occurring per 1000 women in Kenya aged between 15-49 years.

4.0.3 Estimation of Fertility in Kenya

This sub chapter contains findings of fertility estimation at national level in Kenya.

Age specific fertility rate, Kenya

Births across all the specific age group are above 500 children per 1000 women. As shown in Figure 4.4 below, the age group with the largest number of female: 25-29 years, has a total of 679 children born per 1000 women. Generally births from younger age to older age have an upward trend.

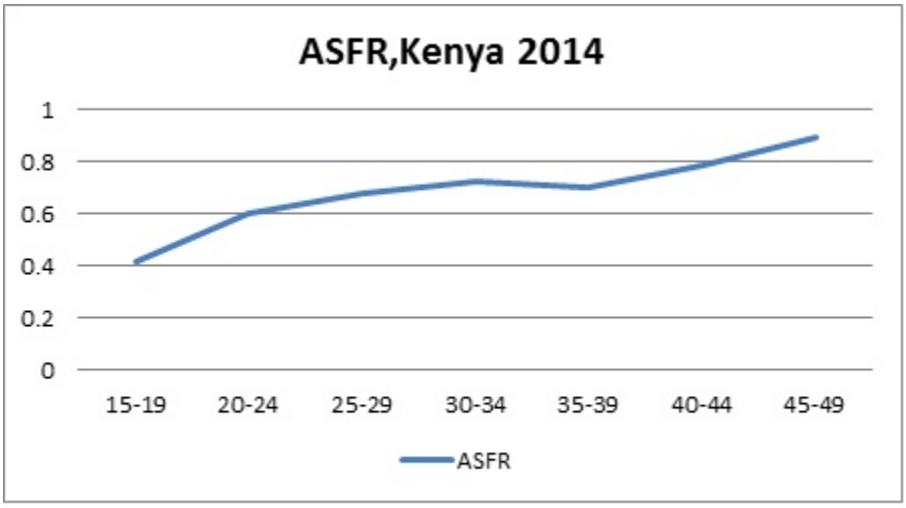


Figure 4.4: Age Specific Fertility Rate at National Level, Kenya

Fertility Estimation Using Gompertz Model, Kenya

Step by step values for the computation of fertility estimate at national level in Kenya are shown in Table 4.2 below. The Total Fertility rate for the whole country is 3.18 meaning on average 3.18 births will occur to women in Kenya between ages 15 to 49 by the end of their fertility period, given the current fertility age schedule.

Age Group	F(x)	F(x)/F(x+5)	Z(x)	Z(x)-e(x)	Fitted	Exp	TFR
15-19	0.414	0.686	0.97	-0.36	0.53	0.55	3.738
20-24	0.604	0.890	2.15	0.74	0.76	0.63	4.826
25-29	0.697	0.940	2.78	1.48	0.97	0.68	4.958
30-34	0.722	1.031	NUM!	NUM!	1.21	0.74	-
35-39	0.700	0.888	2.13	1.69	1.55	0.81	4.326
40-44	0.789	0.878	2.04	2.04	2.20	0.90	4.406
45-49	0.898	-	-	-	5.12	0.99	-
Total							3.18
a=0.772, b=0.315							

Table 4.2: Estimation of Total Fertility by Fitting Gompertz Relational Model, Kenya

Computation of total fertility rate:

- F(x): this is the cumulated fertility obtained by dividing births in the past years by female population
- x: x=1,2 ,3,4,5,6,7 each associated with age groups 1 for 15-19, 2 for group 20-24 and so on.
- F(x)/F(x+5): obtained by dividing F(1) to F(2)
- Z(1) =-ln(-ln(F(1)/F(1+5))
- Z(1)-e(1), e(x) is obtaining form standard table
- To estimate a and b constant, Z(1)-e(1) is plotted against g(1)
- Fitted a+bYs(1)
- F= exp(-exp(-fitted))
- Averaged sum of F(x)/F is multiplied by 5 to obtain estimated total fertility rate.
- • Ys(x), e(x) and g(x) values are in the appendix

4.0.4 Fertility Estimation at County Level: Mombasa County

A total of 2,254 female in Mombasa aged 15-49 years participated in the survey. The distribution of respondents in a five year age group is shown in Figure 4.5 below.

The population has a high concentration at age 20-34 years (73 percent).

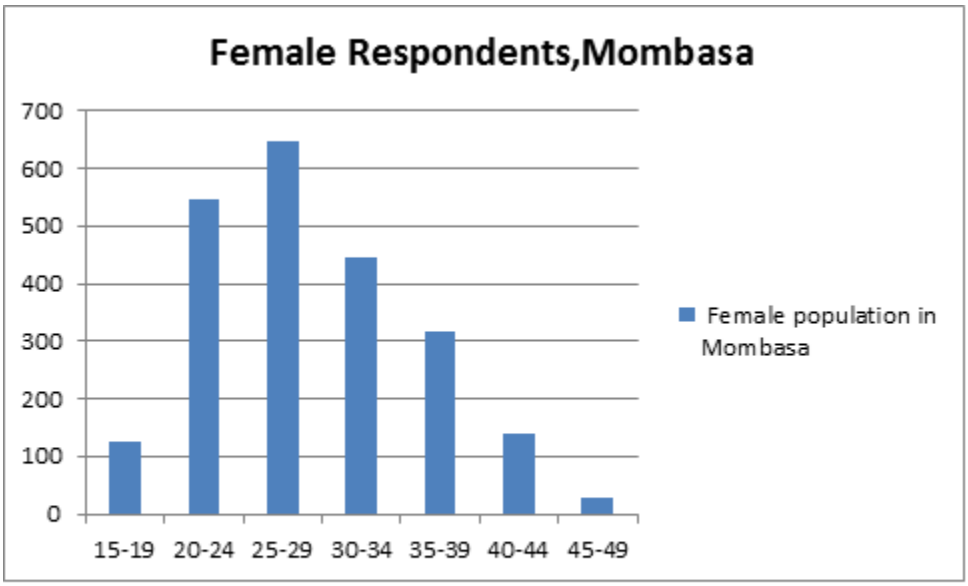


Figure 4.5: Frequency of Female respondents in Mombasa County

Births in Mombasa County

65 percent of the population in Mombasa had live births by 2014 this is a total of 1472 children.
For the ten year age difference 20-24 years and 30-34 years the difference in births between them is 2 percent as shown in Figure 4.6. Most females (29 percent) gave birth between ages 25-29 years. Teenage pregnancy (15-19 years) is at 3 percent while older females birth percentage is 2 percent compared to all the other age group.

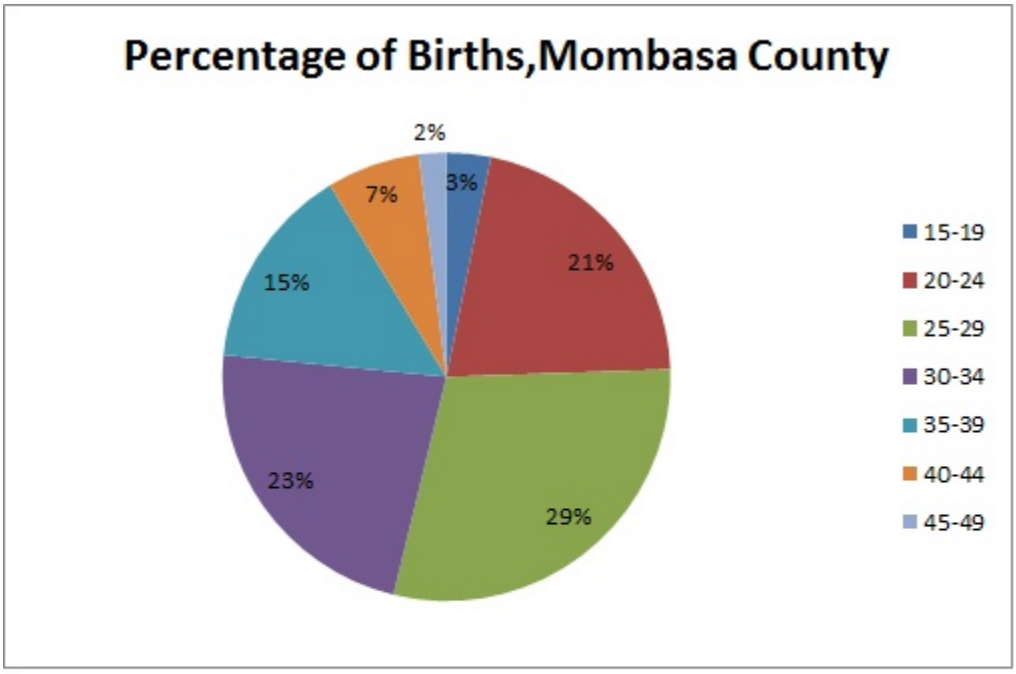


Figure 4.6: Percentage of Births in Mombasa County

Age Specific Fertility Rate, Mombasa County

Age Specific Fertility on all ages is above 350 births per 1000 women in that age group. Figure 4.7 below shows a slight constancy of births in age group 35-39 and 40-44. Births rate rises per age group except for a slight drop in age group 35-39.

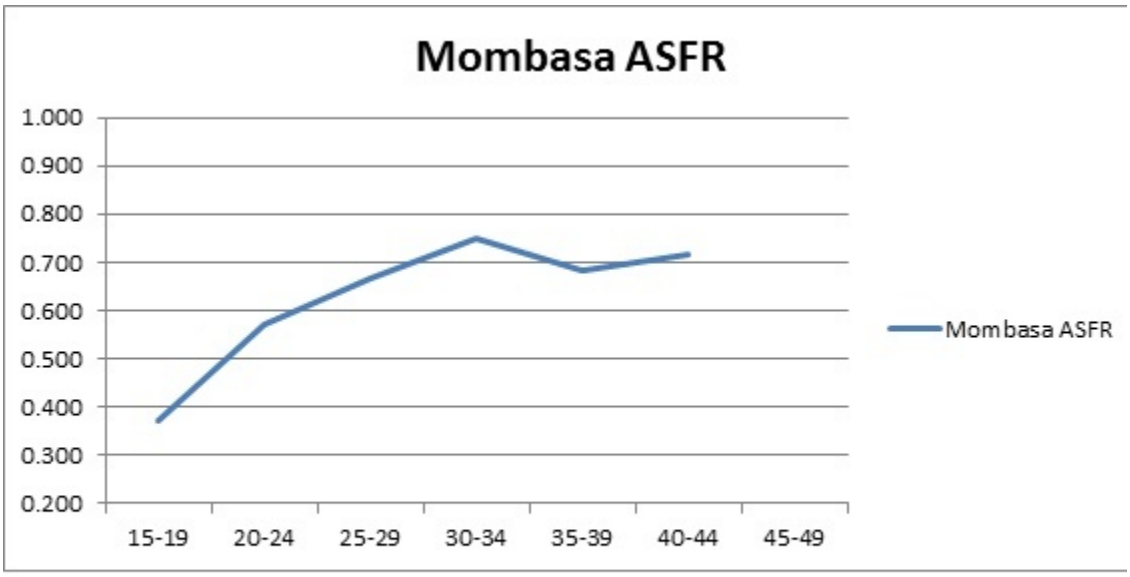


Figure 4.7: Age Specific Fertility Rate, Mombasa County

Total Fertility Estimation Using Gompertz Relational Model, Mombasa County

Using Gompertz relational Model as shown in Table 4.3 below the Total Fertility Rate in Mombasa is 3.2: meaning on average women in Mombasa will have 3.2 children within their reproductive ages given the current age specific fertility schedule.

Age Group	F(x)	F(x)/F(x+5)	Z(x)	Z(x)-e(x)	Fitted	Exp	TFR
15-19	0.37	0.648	0.835	-0.496	0.411	0.515	3.592
20-24	0.571	0.858	1.877	0.460	0.626	0.586	4.875
25-29	0.666	0.886	2.113	0.818	0.823	0.645	5.164
30-34	0.751	1.097	NUM!	NUM!	1.046	0.704	-
35-39	0.685	0.954	3.060	2.619	1.366	0.775	4.418
40-44	0.717	0.717	1.102	1.101	1.966	0.869	4.126
45-49	1.00	-	-	-	4.687	0.991	
Total							3.2
a=0.6379, b=0.2931							

Table 4.3: Estimation of Total Fertility by Fitting Gompertz Relational Model, Mombasa County

Total Fertility Computation for women at age 20-24

- Cumulated fertility F(x) at age 20-24
  F(x) =313/548=0.571
- F(x)/F(x+) =0.571/0.666 = 0.858
- We chose Z(x) equation for estimating current data where Z(x) = −ln(-ln(F(x)/F(x+1))) substituting with values we have Z(x) =-ln(-ln 0.858) =1.877
- We obtain the value e(x) from constant tables so to calculate Z(x)-e(x) = 1.877- 1.4167 =0.460
- To estimate constants a and b we plot values of Z(x)-e(x) against g(x), for Mombasa county a = 0.6379 and b= 0.2931
- Fitting values using equation 0.6379 + 0.2931*(exp) which is also denoted as Y(x)
- F = exp (-exp (-Y(x)))
  = exp (-exp (-0.586)) = 0.975*5=4.875
- F(x)/F = 0.571/0.586 =0.975, (0.975*5) =4.875
- Sum (F(x)/F) /7= (3.592+4.875+5.164+4.418+4.126)/7 =3.2

4.0.5 Fertility Estimation at County Level, Nairobi County

A total of 2024 females in Nairobi participated in the survey.Figure 4.8 below shows the distribution of the population in five year age group. Age group 30-34 constitutes of 18 percent of the whole population and 35-39 constitute of 16 percent of the population. A large percent of the population is aged between 20-39 years (86 percent). 6 percent of the population are teenagers the remaining are 45-49 years.

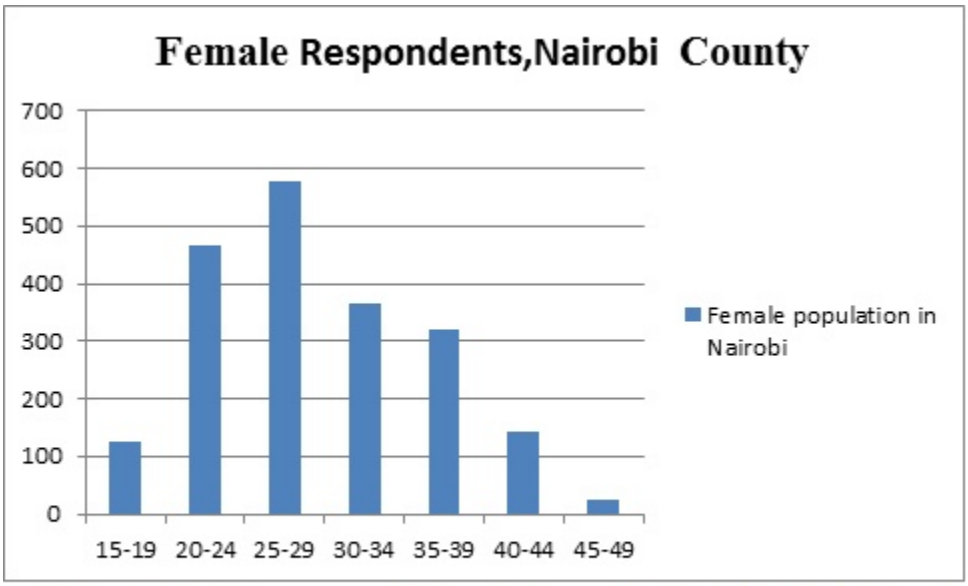


Figure 4.8: Frequency of Female Respondents in Nairobi County

Births in Nairobi County

In Nairobi County, 64 percent of the population gave birth the previous year, a total of 1295 births the percentage distribution is shown in Figure 4.9 below. Birth occurred in high percentage at 25-29(31 percent). A 2 percent difference in births is observed at age 30-34 (18 percent) and 35-39 (16 percent), meaning that women from age 30 years to 39 years on average have almost the same number of children. Teenager pregnancy is at 4 percent slightly higher than births occurring in older women (45-49, 2 percent).

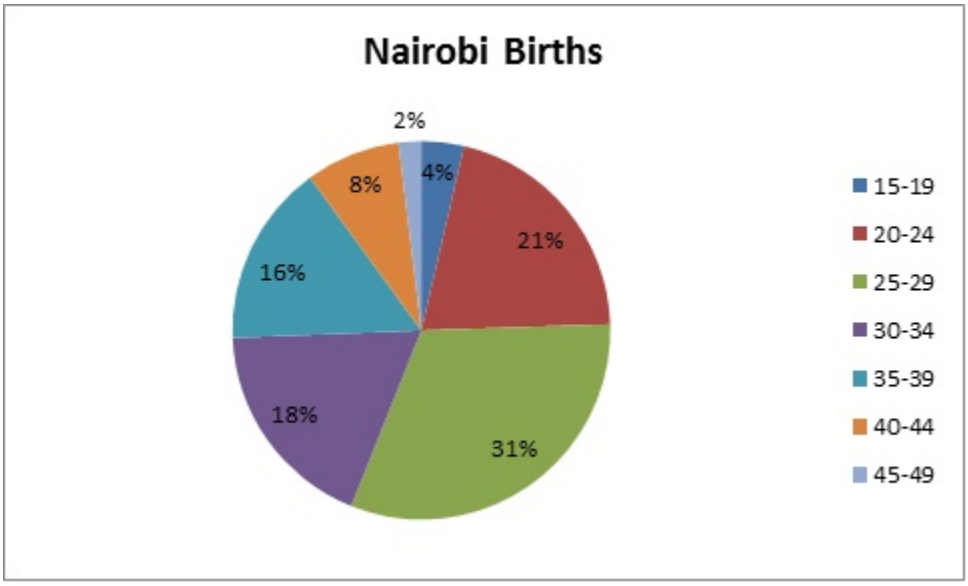


Figure 4.9: Percentage of Births per each Age Group, Nairobi County

Age Specific Fertility Rate, Nairobi County

Age specific fertility schedule for Nairobi ranges between 379 and 961 birth occurring per 1000 women as shown in Figure 4.10 below. There is a slight birth constancy at age 30-34 years.

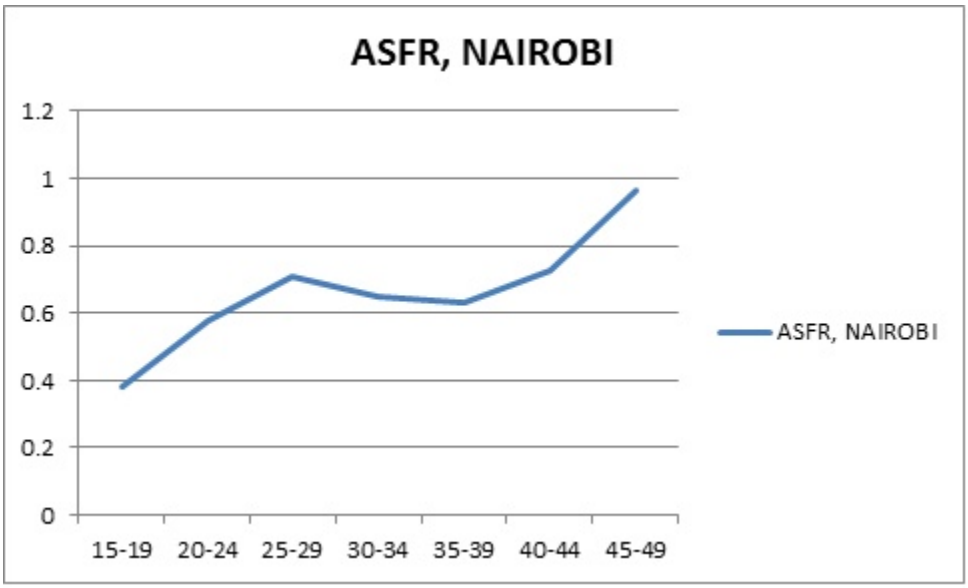


Figure 4.10: Age Specific Fertility Rate, Nairobi County

Total Fertility Rate Using Gompertz Relational Model, Nairobi County

Table 4.4 below contains values obtained when estimating total fertility rate for Nairobi County using Gompertz model. The total fertility rate for Nairobi is 2.85: in Nairobi 2.85 births are occurring for women between the ages 15-49 years given the current schedule for age fertility.

Age Group	F(x)	F(x)/F(x+5)	Z(x)	Z(x)-e(x)	Fitted	Exp	TFR
15-19	0.379	0.656	0.862	-0.469	0.059	0.390	4.86
20-24	0.578	0.818	1.608	0.191	0.278	0.469	6.617
25-29	0.706	1.085	NUM!	NUM!	0.477	0.538	-
30-34	0.651	1.031	NUM!	NUM!	0.704	0.610	-
35-39	0.631	0.866	1.937	1.496	1.028	0.699	4.514
40-44	0.729	0.758	1.285	1.284	1.637	0.823	4.429
45-49	0.962	-	-	-	4.397	0.988	-
Total							2.85
a=0.2898, b=0.2973							

Table 4.4: Estimation of Total Fertility by Fitting Gompertz Relational Model, Nairobi County

Comparison of Nairobi and Mombasa Counties

Teenage pregnancy is one percent higher in Nairobi County (4 percent) than in Mombasa County (3 percent). Births in both counties is high between the ages 20-29 years old, in Mombasa County the difference in birth occurring between age group 30-34 and 35-39 year is 8 percent and in Nairobi County the difference is 2 percent.
Births in age group 45-49 is the lowest in both counties this can be attributed to the fact that most females in these age group have already achieved their desired family size.

4.0.6 Socio Economic Factors

In this study socioeconomic factor that are associated with fertility are shown in Figure 4.11 below, they are Educational factor with 4 levels, contraceptive use with 2 levels and marital status with 5 levels. These factors have been observed to impact fertility rate.

Figure 4.11: Socioeconomic factors influencing Fertility

Marital status defined as the description of a person's relationship with a significant other.

Marital status has 4 different levels. these levels are:

- Single: those who have never been in a union before, legally or otherwise.
- Married: those currently in a legal union marriage
- Widowed: female whose spouse has died
- Divorced: female who are legally separated from their spouse.
- Living with partner: those living together with their partner yet the union not formalized

Contraceptive has two levels, these levels are classified with one being person using contraceptives whether modern or traditional method and the other one being persons not using contraceptives. Contraceptive is used to either space births or control for fertility.

Educational level constitutes 4 different levels. These levels are:

- No education: a person who has never been to school for education purpose
- Primary level: a person whose highest education is at primary level.
- Secondary level: a person whose highest education is at secondary school
- Higher level: a person who has either tertiary or university education

Frequency and percentages of each factor at various levels are shown in Table 4.5 below. Majority of the women are married (77 percent), they do have basic primary education (56 percent) and are using contraceptives (55 percent).

Socioeconomic Factor levels						
Marital status	**Age groups**	**Single**	**Living with partner**	**Married**	**Widowed**	**Divorced**
	15-19	333	46	544	4	21
	20-24	584	408	3431	40	57
	25-29	262	392	4793	88	97
	30-34	112	256	3239	96	58
	35-39	61	169	1978	116	62
	40-44	16	66	832	61	23
	45-49	10	21	220	15	3
	percentage	7%	7%	77%	2%	2%
Education levels	**Age groups**	**No education**	**Primary**	**Secondary**	**Higher education**	
	15-19	47	696	246	5	
	20-24	418	2727	1477	223	
	25-29	717	3151	1398	681	
	30-34	489	2208	807	454	
	35-39	380	1390	504	219	
	40-44	185	654	162	50	
	45-49	72	153	38	13	
	percentage	12%	56%	24%	8%	
Contraceptive use	**Age groups**	**Using**	**Not using**			
	15-19	452	542			
	20-24	2642	2204			
	25-29	3493	2454			
	30-34	2231	1727			
	35-39	1311	1182			
	40-44	474	577			
	45-49	114	161			
	percentage	55%	45%			

Table 4.5: Distribution of Socio-economic factor at various level by five year age

group

The Different Types of Contraceptive

The various types of contraceptive that are used in Kenya are shown in Figure 4.12 below. Females prefer injections (50 percent) form of contraceptive compared to condom (3 percent). The percentage of females who use pills is twice as those who periodically abstain. This can be attributed to availability and perception towards use of each method.

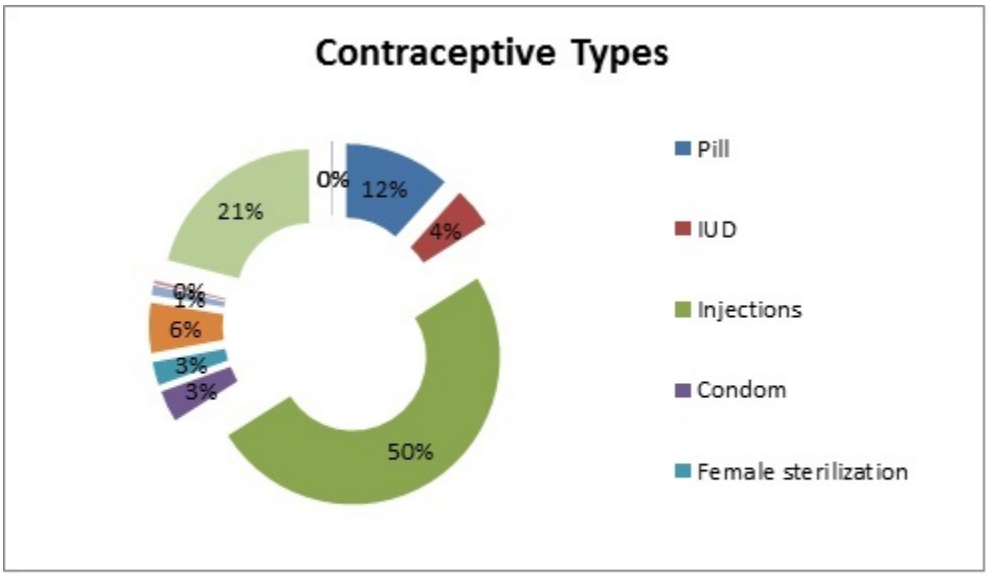


Figure 4.12: Contraceptive Types

Comparison of Contraceptive Use and Marital Status

From Table 4.6 below, the group that has high exposure to pregnancy (married women) are the major uses of contraceptives (81 percent) while only one percent of women who are either divorced or widowed use contraceptive, the necessity of it seem to be low among them.

Contraceptive use among single teenagers (15-19years) is the highest compared to single females in other age groups.

Contraceptive Use verses Marital Status						
contraceptive use Age Group	Never in union	Married	Living with Partner	Widowed	Divorced	Total percentag
15-19	24%	64%	6%	0%	3%	4%
20-24	9%	74%	9%	1%	1%	25%
25-29	3%	84%	7%	1%	1%	33%
30-34	2%	85%	8%	2%	1%	21%
35-39	2%	85%	6%	3%	2%	12%
40-44	1%	84%	5%	4%	2%	4%
45-49	1%	79%	11%	4%	0%	1%
Total percentage	5%	81%	8%	1%	1%	

Table 4.6: Relationship of contraceptive use and marital status

Comparison of Contraceptive level and Education level

Findings from Table 4.7 show contraceptive use among those with primary education to be the highest (58 percent),those in the older age group with no education have embraced contraceptive use (13 percent). Teenagers with no education are at high risk of pregnancy as only 1 percent use contraceptives.

Contraceptive use verses Education level					
Contraceptive use Age group	No education	Primary	Secondary	Higher	Total
15-19	1%	69%	28%	1%	4%
20-24	2%	57%	36%	4%	25%
25-29	4%	57%	27%	13%	33%
30-34	4%	59%	24%	14%	21%
35-39	5%	58%	26%	11%	12%
40-44	5%	66%	23%	6%	4%
45-49	13%	62%	18%	7%	1%
Total	3%	58%	28%	10%	

Table 4.7:Relationship between Contraceptive use and Education Level

Comparison of Education level and Marital status

Marriage is high among women with no education 85 percent as shown in Table 4.8. Singlehood in women increases with increase in education level, the highest being higher education with 12 percent. Women with higher education are less prone to living with partner (5 percent).

Marital status verses education levels						
	Never in union	married	living with partner	widowed	divorced	Total
No education	1%	85%	6%	4%	2%	12%
Primary	6%	76%	7%	3%	2%	56%
Secondary	10%	74%	7%	1%	1%	24%
Higher	12%	76%	5%	1%	2%	8%
Total	7%	77%	7%	2%	2%	

Table 4.8:Relationship between Education Level and Marital Status.

Total Fertility by Differentials by Socio-economic factor levels in Counties

Fertility rate of the different socio-economic level in Nairobi and Mombasa Counties using Relational Gompertz model is as shown in Table 4.9 below.

	Total Fertility Differentials By Education			
	none	primary	secondary	Higher
Kenya	5.4	4.74	4.69	3.5
Mombasa	6.8	4.61	3.59	3.03
Nairobi	5.11	4.83	3.11	2.25
	Total Fertility Differentials By Marital Status			
	Never in a Union	Married	Widowed	Divorced
Kenya	3.35	5.52	3.57	4.69
Mombasa	3.52	4.20	3.23	3.9
Nairobi	4.58	3.67	2.4	3.851
	Total Fertility Differentials By Contraceptive Use			
	using	not using		
Kenya	3.515			
Mombasa	3.456	4.127		
Nairobi	2.956	3.942		

Table 4.9: Fertility by County level

Females living with their partners the data was too limited hence no computation for total fertility rate for females living with partner.

4.0.7 Projected Fertility Rate

Using the past KDHS estimates on total fertility, this study estimates the fertility rate expected in 2019. The fertility rate in 2019 estimated using Figure 4.13 below is expected to be 3.00 children born per women during her reproductive ages(15-49). This is a reduction in fertility rate in the country and consistence with the almost persistence decline in fertility levels in Kenya.

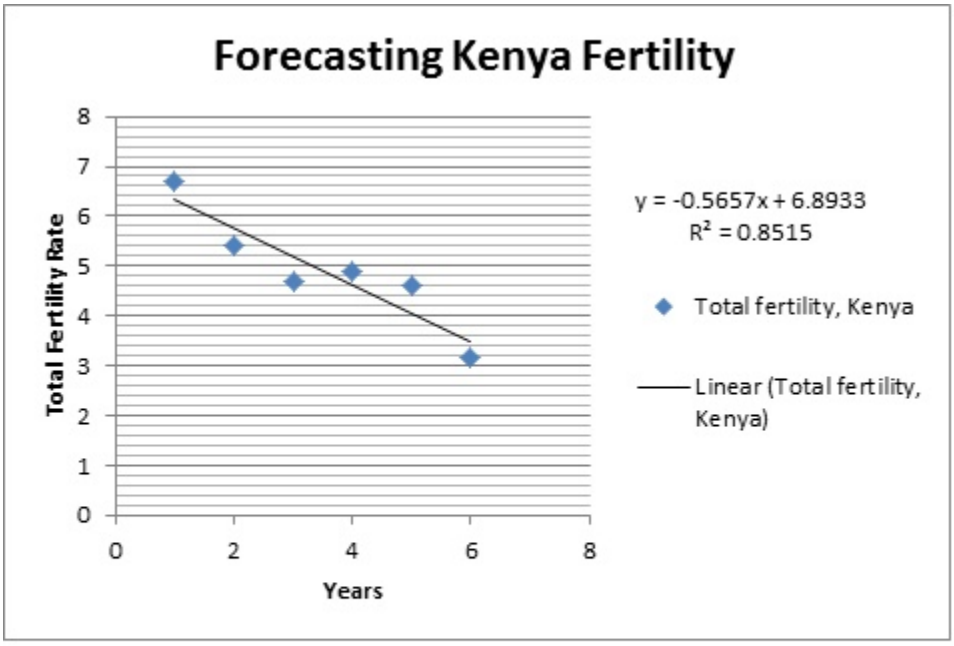


Figure 4.13: Forecasting fertility in Kenya

5 DISCUSSION, CONCLUSION AND RECOMMENDATION

5.0.1 Introduction

This chapter presents conclusion drawn and recommendation made based on this study finding.

5.0.2 Discussion and Conclusion

This study set out to estimate fertility level in Nairobi County and Mombasa County and to determine fertility by socio-economic factors. The fertility trend in Kenya generally has been on the decline and the TFR estimated for the year 2014 is less than the previous years. Nairobi and Mombasa County follows the same trend of decline in TFR.

Contraceptive use among female with no education is 3percent with teenagers being percent, attention should be more to teenagers as they are yet to be more informed. Kenya society attitude toward contraceptive use among teenagers may be a hindrance and a contributor to current state of low percentage use of contraceptive among teenagers. Parents object to information on contraceptive being made available to their children and fail to educate them on birth control methods at the same time. Study by Karungari (Kiragu,1995) and Laurie S of students in a secondary school in Kenya found that 27 percent of females were sexually experienced while earlier study by Susan F. Newcomer and J Richard Udry (Newcomer and Urdy,1985) found that girls taught by their mothers concerning birth control were more likely to use contraceptive.

Education among girls reduces the number of children women are having as the education level increases. In Mombasa the decrease in fertility from women having no education compared to women with higher education is 55percent while in Nairobi the fertility rate difference is 56percent from women with no education to women with higher education. A high percentage of women in both counties have primary education. The basic primary education is better compared to having none though higher levels can be encouraged more

Limitation

Data for women living with partner was too little making it impossible to estimate their fertility rate. The survey method of no replacement limited those who were not found within their household during the data collection

5.0.3 Recommendation

The different type of contraceptives such as implants, injections and pills that are popular should be encouraged while informing on other contraceptive methods that are available.

Policies to encourage education of women beyond primary education should be put in place while doing away with unavailability of education to women of all age groups.

Appendices

The standard used for estimation were that UNFA

Age Group	e(x)	g(x)	Ys(x)
19.5	1.3311	-1.4527	-0.7753
24.5	1.4167	-0.7426	-0.0411
29.5	1.2957	-0.0364	0.6305
34.5	0.9615	0.8405	1.3925
39.5	0.4409	2.1799	2.483
44.5	0.001	4.5315	4.5323
49.5	0.000		13.8155

Age Group	e(i)	g(i)	Ys(i)
15-19	1.285	-1.7467	-1.0829
20-24	1.424	-1.0159	-0.3124
25-29	1.3717	-0.3349	0.3541
30-34	1.1404	0.4406	1.0579
35-39	0.7022	1.5162	1.9561
40-44	0.2705	3.2238	3.4225
45-49	0.000	6.0922	6.0922

NUM represent values are that are not computable; they lie outside the range of 1 or 0.

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