ESTIMATING TRENDS ON THE EFFECTS OF BREASTFEEDING ON POSTPARTUM AMENORRHEA IN KENYA

By

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DFXLARATION

This research project is my own original work and has not been presented to any university for an award of a degree.

Signed _ / ^ ^ ^ e ^ / e r . Date 1 o l i ' 1 1 o o < }

Okoth George Odwe

This research project has been submitted for examination with our approval as University Supervisors:

Signed Date \1/11/2009

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Signed Date 12/11/09

Mr. Andrew Mutuku

DEDICATION

1 dedicate this work to;

My parents Barnabas and Rosemary Odwe

My brothers and sisters and to my fiancee Christine

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ABSTRACT

The duration of postpartum amenorrhea plays a dominant role in shaping the fertility behavior of any population. The main objective of this study was to estimate the duration of postpartum amenorrhea using data on duration of breastfeeding. Specifically, the objective of the study was to assess the fit of Bongaarts & Potter (1983) and Yadava & Islam (1994) models to Kenyan data and then use the appropriate model to estimate trends in breastfeeding effects on fertility in Kenya. Also, the study sought to examine the extent of heaping in the breastfeeding data, and then re-distribute the excess numbers on heaped point using a Three-point technique to produce a smooth distribution. The data used was from four Kenya Demographic and Health Surveys (KDHS) of 1989, 1993, 1998 and 2003. This study was focused on the breastfeeding experience of the mothers to their youngest child who has been ever breastfed.

Generally, the results of the distribution of breastfeeding data showed marked heaping of breastfeeding duration at 3, 6, 12, 18, and 24 months for all the four KDHS data sets. Srinivansan (1980) method of calculating digit preference indicate that approximately 32% to 35% of respondents preferred reporting duration of breastfeeding in 12 months in 1989, 1993, 1998 and 2003 KDHS. The results of the prevalence/incidence mean shows that the mean duration of breastfeeding for the last child in 1989, 1993, 1998, and 2003 KDHS is 23.91, 24.06, 23.95, and 24.46 months respectively. Hence, there was no significant change in the mean duration of breastfeeding.

In the Bongaarts and Potter (1983) equation, the estimated amenorrhea periods were much lower than the observed duration of amenorrhea for all the durations of breastfeeding less than 18 months. On the other hand, for durations of breastfeeding higher than 18 months, Bongaarts and Potter (1983) equation estimated amenorrhea periods higher than the observed duration of amenorrhea. In case of overall population average, Bongaarts and Potter equation gave an estimate of an amenorrhoea period as 16.92, 17.51, 16.96, and 17.39 months compared to the observed averages of 7.66, 8.62, 7.61 and 7.75 months respectively for 1989, 1993, 1998 and 2003 KDHS. In the Yadava

& Islam (1994) model the estimates for durations of amenorrhea period were much closer to the observed durations of amenorrhea periods except for breastfeeding durations <2 and 2-4 months. In case of overall population average, Yadava & Islam model gave estimates of the average amenorrhoea period as 13.22, 13.41, 13.23, and 13.38 months relative to observed averages of 7.66, 8.62, 7.61 and 7.75 months respectively for 1989, 1993, 1998 and 2003 KDHS. For the impact of the models, results indicate that Bongaarts and Potter (1983) equation over estimates the fertility inhibiting effect of breastfeeding by almost 24 percent for the four data sets, whereas Yadava and Islam overestimates by only 3 percent.

The study recommends that further testing be done to show the relationship among different status and frequency of breastfeeding, age, level of education and parity on postpartum amenorrhea.

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CHAPTER ONE

INTRODUCTION AND PROBLEM STATEMENT

1.1 Introduction

The positive association between breastfeeding and the length of postpartum amenorrhea is well documented (Chen et al., 1974; Knodel, 1977; Van Ginneken, 1978; Pinto Aguirre et al. 1998). Bongaarts and Potter (1983) found that changes in breastfeeding behavior during the 6 to 18 month period after a birth affect the duration of postpartum amenorrhea. In addition, the frequency and intensity of suckling, as well as the number of months an infant is fed, are important determinants of the length of postpartum amenorrhea (Labbok and Krasovec 1990). In the absence of breastfeeding, the average amenorrheic period may last between one and three months, but when nursing is initiated just after childbirth, the duration of amenorrhea increases with the duration of breastfeeding (Bongaarts and Potter 1983; Santow 1987)

Models in which the postpartum amenorrhea is viewed as a function of breastfeeding have been developed as a result of observed relation (Santow 1987). The analytical approach has been to relate duration of postpartum amenorrhea to duration of breastfeeding by using either individual data from a single survey or average duration from a number of different sources. According to Van Ginneken 1974, the findings have typically been presented as tables or diagrams relating mean or median duration of amenorrhea to corresponding duration of breastfeeding. This correlative approach has led to establishment of various relationships between duration of breastfeeding and duration of postpartum amenorrhea. The association has led to the prediction of average mean or median duration of amenorrhea as a linear, exponential or a more complex function of average duration of breastfeeding, or the prediction of the duration-specific proportion no longer amenorrhoeic from the proportion still breastfeeding (Salber et al., 1966; Lesthaeghe& Page, 1980; Bongaarts & Potter, 1983)

1.2 Statement of the problem

Among the biological factors affecting human fertility, the duration of postpartum amenorrhoea plays a dominant role in shaping the fertility behaviour of a population (Bongaarts, 1978; Bongaarts & Potter, 1983; Habicht et.al, 1985; Lesthaeghe & Page, 1980). The duration of post partum amenorrhoea (PPA) is the period taken to return of menses following a live birth or late term of abortion or stillbirth. This is a temporary infecundable period during which a woman is non-susceptible to pregnancy due to suspension of natural cycle of ovulation and menstruation. The attainment of first menstruation is treated as the termination of PPA. Breastfeeding is a primary determinant of birth interval in societies where contraceptive practice for birth spacing and limitation is low (Lesthaeghe & Page 1980; Habicht et.al, 1985). The fertility reducing effects of breastfeeding arises from its role in lengthening the period of postpartum amenorrhea and consequently extending the birth interval; prolonged lactation delays the return of ovulation and, thus, may extend the postpartum non susceptible period (Bongarts & Potter, 1983; Habicht et.al, 1985; Smith, 1985: Akin et.al 1986; Huffman et.al, 1987). Data have been collected on durations of breastfeeding and post-partum amenorrhoea and a strong link between the two has been thought (Jain et.al, 1979).

Sometimes data on postpartum amenorrhea is lacking or insufficient (Lesthaeghe & Page, 1980; Bongaarts & Potter, 1983; Habicht et.al, 1985; Yadava & Islam, 1994). Therefore, to get accurate direct measurement of duration of postpartum amenorrhea from data such as Demographic Health Surveys (DHS) is impossible. Thus, demographers often face problems in estimating it when its direct measurement is lacking. Researchers have developed models to estimate the duration of postpartum amenorrhea from data on duration of breastfeeding when data is lacking or insufficient. However, these models have shown some limitations due to the nature of breastfeeding and amenorrhea data such as duration heaping, usually 3, 6 12 18 20 and 24 (Lesthaeghe & Page, 1980). Thus far other researchers have come up with modified versions of the postpartum models to overcome these limitations.

Bongaarts and Potter in 1983 developed a model relating breastfeeding and postpartum amenorrhea on the basis of plotting a large diverse set of data from 21 populations on average duration of breastfeeding and amenorrhea. They observed that the relationship is a logistic type. Applying Bongaarts and Potter (1983) on individual level data (i.e. for within country variation), Yadava and Islam (1994), found that the equation give underestimates of amenorrhea period from smaller duration of breastfeeding and overestimate for longer duration of breastfeeding. Yadava and Islam (1994) proposed changes in the parameter value of the Bongaarts and Potter

(1983) equation by re-estimating the parameter values using Least-square method. They hypothesised that the new equation yielded more satisfactory estimates than the original Bongaarts and Potter equation. However, it remains unclear which is the best fitting model for the Kenyan data. The data generated through Kenya Demographic and Health Surveys (KDHS) provide us with a unique opportunity to evaluate the best fitting model for the Kenyan situation by comparing the estimated duration of postpartum and the observed ones. This study will therefore examine whether Bongaarts and Potter (1983) or Yadava and Islam (1994) system of estimation hold for Kenyan data.

1.3 Study objectives

The general objective of this study was to assess the fit of Bongaarts & Potter (1983) and Yadava & Islam (1994) models to Kenyan data and then use the appropriate model to estimate trends in breastfeeding effects on fertility in Kenya.

The specific objectives are;

i. To assess the extent of heaping in reported duration breastfeeding for 1989, 1993, 1998, and 2003 KDHS
ii. To assess the fit of Bongaarts & Potter (1983) system of estimating duration of postpartum amenorrhea from data on duration of breastfeeding duration for 1989, 1993, 1998, and 2003 KDHS.
iii. To assess the fit of Yadava & Islam (1994) model of estimating duration of postpartum amenorrhea from data on duration of breastfeeding duration for 1989, 1993, 1998, and 2003 KDHS
iv. To estimate trends in fertility inhibiting effects of breastfeeding by utilizing the appropriate fitting model.

1.4 Justification

Kenya still has got a high rate of population growth and persistent high fertility. Breastfeeding has been shown to be a major determinant of fertility levels especially where contraceptive use is low or lacking (Lesthaeghe & Page 1980). Under such conditions of natural fertility, an understanding of the biological and behavioural mechanism that extend the duration of postpartum amenorrhea is important for research and policy. In situations where increased childbearing is seen as a problem, the findings of this study will enable us to assess the actual or potential demographic impact of the past-partum variables (breastfeeding and amenorrhea). Accurate estimates of the contraceptive role of breastfeeding are required to measure these effects and plan for the delivery of modern contraceptives. The findings of this study will therefore go a long way in getting the accurate estimate of the contraceptive role of breastfeeding. These estimates will inform the policy makers and Family Planning and Reproductive Health (FP/RH) programs to plan for the delivery of modern contraceptives.

1.5 Scope and limitation

The study covered the whole country and it examined the effect of breast-feeding on post-partum amenorrhea as a fertility-inhibiting effect. In the 1989, 1993, 1998 and 2003 KDHS a question on duration of breastfeeding and postpartum amenorrhea was asked to all women aged 15-49 for the last and next to the last birth for the period three years prior to the survey. Data on duration of PPA and breastfeeding related to the last birth which occurred during last three years from the survey date was utilized. This study did not look at the effects of different breastfeeding states (full, partial, and none). For those who experience child death, the duration of breastfeeding was taken to be equivalent to the age of the child at death.

The study estimated the duration of postpartum amenorrhea from duration of breastfeeding; however, since breastfeeding beyond the resumption of menstruation cannot affect the duration of amenorrhea, estimates of the effect of breastfeeding in this study may be biased. Another limitation is women who continue to breastfeed until they have achieved recognizable pregnancy. However, the mentioned limitations will not have a significant effect on the results on the generally reasonable assumption that women do not breastfeed one child after the birth of the next.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter reviews literatures on the models used to estimate the duration of postpartum amenorrhea from data on duration of breastfeeding. We shall look at the strengths and weaknesses of the models and their empirical application. Finally this chapter looked at the summary of the literature review and the gaps.

2.2 Models relating breastfeeding and postpartum amenorrhea

The positive relationship between the duration of breast-feeding and the duration of post-partum amenorrhoea across populations is now well-established (Huffman et.al, 1978). Most models relating breast-feeding and post-partum amenorrhoea durations have considered only the total duration of any breast-feeding, rather than looking at full and partial breast-feeding separately. Bongaarts and Potter (1983) found that durations of post-partum amenorrhoea were influenced most by changes in breast-feeding behaviour during the 6-18-month period post partum, which is, after the end of full breast-feeding for most populations. It is now generally recognized that characteristics of breast-feeding, such as the frequency and intensity of suckling, as well as the number of months an infant is fed, are important determinants of post-partum amenorrhoea (Labbok and Krasovec, 1990)

In the past least-square regression analyses were used to estimate the duration of postpartum amenorrhea from breastfeeding data (Perez et.al, 1972; Jain & Bongaarts 1981). During these analyses, the total length of breastfeeding has been used as a regressor, both before and after the resumption of ovulation. One of the limitations of such method is that the model assumes that breastfeeding beyond the first ovulation after child birth can influence the duration of postpartum amenorrhea. This assumption is not true. Instead of performing ordinary least-square regression analysis, some investigators have presented mean duration of amenorrhea by duration of breastfeeding (Cantrelle et.al, 1978; Corsini, 1979). However, Habicht et.al, (1985) found that this technique is also inadequate just as the ordinary least-square regression due to the same limitation.

Habicht et al. (1985) developed a model of postpartum amenorrhea by integrating information about breastfeeding behavior with the underlying physiology of human lactation. According to Habicht et al. (1985), prolactin levels are higher in women who are breastfeeding than in women who are not, especially those who are also amenorrheic or annovulating. The model is based on current knowledge of blood hormone levels, breastfeeding and the duration of postpartum annovulation. The model proclaim that at birth (t = 0) prolactin hormone is at highest level, than at conception. Then prolactin levels fall quickly with no breastfeeding than with partial breastfeeding. Prolactin falls least rapidly during full (unsuplemented) breastfeeding.

One can observe from the model that all slopes from the time of discontinuation of breastfeeding and to resumption of fecundity is equal (Habicht et al. (1985). In other words the model assumes that the time to resumption of ovulation (or menses) once breastfeeding has been discontinued is the same no matter when during the postpartum period is stopped. When a statistical analysis is performed, an indirect estimate of 1 to2 months for the time from discontinuation of breastfeeding to first menses is observed. Also in the model, the nursing behavior is categorized in three groups representing full breastfeeding (unsupplemented), partial breastfeeding (when supplements are started) and none (cessation of breastfeeding) Habicht et al. (1985).

A study by Jones (1989) in Indonesia has been able to confirm empirically, using demographic data, certain important aspects of the Habicht model. The objective of his study was on the relationship between breastfeeding patterns and postpartum resumption of menses among Indonesian women. The result showed that women who weaned before menses had a median interval from weaning to menses of 3.42 months. Those with infant mortality before menses had a median wait time from infant death to menses of 2.14 months. Women in the groups who nursed both for longer episodes and more often during the day, or who nursed both for longer episodes and more often at night, significantly reduced their risk of menstruating early in the postpartum period. On average, the delay in return of menses for these 2 groups was 7-8 months longer than for women nursing less intensely.

Aguirre and Jones (2005) tested the assumptions in the model by using the data from the Institute of Nutrition of Central America and Panama's (INCAP) Longitudinal Study of Nutrition and

Mental Development carried out in a chronically malnourished population in four rural farming villages in Guatamala between 1968 and 1977. Life table method was applied by considering three types of estimates: (1) the survival function for postpartum amenorrhea, breastfeeding and full breastfeeding, (2) the median survival time (or median duration), and (3) the mean survival time (or mean duration) along with their standard errors. The estimated survival function for resumption of postpartum menstruation was identified for weaning group, breastfeeding group, all women group, infant mortality group and non-breastfeeding group (Aguirre & Jones, 2005). The result showed that the median time to resumption of menstruation was 16.3 months, 13.41 months, 14.34 months, 4.57 months and 2.75 months respectively.

The source of data to empirically test Habitch model can be from demographic health surveys DHS and clinical data. The data must contain information on duration of postpartum amenorrhea, duration of breastfeeding and breastfeeding practice (suckling frequency in the morning, at noon, in the evening and at night). Since data on the duration of postpartum annovulation cannot be detected directly, information on the interval from birth to the first postpartum menstruation is used as a proxy for the return of postpartum fecundity. Some of the limitations of this method are that it is deterministic and not stochastic; it assumes a threshold level for a key hormone above which nursing mothers are not fecund, and assumes that this hormone is prolactin.

While trying to solve the problem of heaping in breastfeeding and postpartum amenorrhea data, Lestheaghe & Page (1980) developed a model based on the logit transformation similar in structure to the two-parameter logit model of mortality developed by Brass (1975). According to Lesthaeghe and Page (1980), at a given duration (t) after a confinement, each woman may be categorized as still breastfeeding or not, still amenorrhaeic or not, still abstaining or not. The proportion of women remaining in the original state Y (t) can be calculated for each duration. The shape of Y (t) may often be described by a function similar to a logistic and an appropriate transformation for monitoring the underlying distribution is the logit;

$$Y(t) = \text{logit } P(t) = \tfrac{1}{2} \text{In} [P(t) / (1-P(dt))]$$

The transformation of Y (t) linearizes P (t) stretching out between +00 and -<». Using Ordinary Least square (OLS) to regress Y (t) on a set of standard logits Y_s (t), generated from the prospective data collected by Delgado et.al, (1975) in Guatemala;

$$Y(t)=a+p^{*}\ Y_s\ (t).$$

Lesthaeghe and Page (1980) were able to show that the relationship between duration of breastfeeding and postpartum amenorrhea is curvilinear and it is represented by the following equation;

$$d = -2.757 + 0.1833M - 0.00238M^2 \ldots\ldots\ldots\ldots (1),$$

Where, M is the median duration of breastfeeding. The two parameters of amenorrhea schedules -a/p and a are related as follows;

$$-a/p= -1.5013\ a - 0.275a^2 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2).$$

By means of these two equations, the median duration of amenorrhea can be estimated from the median duration of breastfeeding. They found that a drop in the mean duration of breastfeeding from 30 to 20 months reduces median duration of postpartum amenorrhea by 7 months. This model achieved its goal of eliminating heaping. In addition it is able to generate both unimodal and bimodal distributions of postpartum amenorrhea; however, the model tends to underestimate the proportion of women who experience very short duration of amenorrhea.

Salber et al. (1966) proposed the use of life table technique to analyze the probability that amenorrhea will continue beyond successive postpartum intervals depending on the length of breastfeeding. According to Hobcraft and Guz (1991), life tables are used to compute the rate of conception and of resumption of amenorrhea at different durations of exposure within each breastfeeding states and the effect of breastfeeding are estimated by comparing rates for different states.

Let the duration be measured as time into categories (that is 0-2 months, 3-5 months e.t.c) during which the risk of resumption of menstruation is constant for individuals with the same values of those covariates to be included in the model. The proportional hazard model represent an individual instantaneous probability of failing at any duration of observation as an underlying hazard function that is modified according to her value on a vector of initial characteristics Z and takes the form;

$$X(t;z) = \exp\ (zp)Xo(t)$$

Where X (t; z) is the instantaneous probability time (t) associated with the covariate vector z, f3 is the vector of the unknown parameters and A*, (t) the underlying hazard time t. The assumption here is that the effect of each covariate is constant over the entire range of failure time.

If the values of the covariate are allowed to change over time, for example a woman may breastfeed during the first three months and then stops. With time varying covariates, the model for the individual with covariate vector becomes;

$$X(t;z) = \exp\ [zP+yz^*(t)]Mt)$$

Where, z* (t) is a vector of covariates formed from the joint distribution of each of the fixed covariates for which proportionality is being questioned a function of time (Cox, 1972). Given the equation for the risk, it is now possible to construct the likelihood function and to employ maximum likelihood method to estimate the parameters and their standard errors (Trussel & Hammersluogh, 1983)

Guz and Hobcraft (1991) used the life-table method in a comparative study to the patterns and levels of rates of resumption of menstruation and rates of conception after the first menses related to breastfeeding states. They carried out the analysis on data from 12 countries which participated in World Fertility Survey. Three-monthly life table rates of resumption of menstruation for women in four breastfeeding state; 1. Full breastfeeding, (2) Partial breastfeeding, (3) No longer breastfeeding and (4) Never breastfeeding were found to be different (Guz and Hobcraft, 1991). The results show that the three month rates for full breastfeeders are rather low and fairly constant ranging from 0.10 to 0.20. For partial breastfeeders, their rates were found to be fairly higher and fluctuated around 0.45.

A research by Rodriguez and Diaz in 1993 used hazard models which are similar to log linear models for simple counts of events (first menstruations) listed by duration of exposure and categories of the covariates. They established that breast feeding patterns explained most of the effect of duration, partial breast feeding increased the risk considerably (even after adjusting for frequency of suckling), and high frequency of suckling reduced the risk for both full and partial breast feeding.

Life table analysis and the hazard models have the advantage that it can include data about women who are still amenorrheic or breastfeeding at the time of observation. However, these techniques are sensitive to strong assumptions about stochastic distribution of first menstruation and are not attractive in analyzing recall data on breastfeeding and amenorrhea, in which there is substantial error due to digit preference (Lesthaeghe & Page, 1980; Habicht et.al, 1985).

Ginsberg in 1973 proposed a bivariate stochastic model which relates duration of postpartum amenorrhea to the duration of different levels of breastfeeding. He distinguishes three possible states; full breastfeeding, partial breastfeeding and none breastfeeding and he assumes that the effect on postpartum amenorrhea on particular breastfeeding activity is independent on previous breastfeeding activity. In each state, the duration of annovulation is distributed to a gamma function;

$$f(t) = [A.(Xt)^{k"'}/ (k-l)!]*e^{"x}$$

Where, X depends on the intensity of the relation between breastfeeding and amenorrhea. For a given socio-economic context, there are thus three parameters X3 corresponding to each of the three states mentioned above. The time spent in each state (duration of full breastfeeding and duration of partial breastfeeding) is supposed to be distributed according to negative exponentials with 1/a and 1/p respectively. These parameters are estimated directly from the observed distributions.

Ginsberg was able to verify this model for population with short breastfeeding (Boston and Santiago). Its application to situations with long breastfeeding has not yet been fully tested, but it opens up interesting horizons. Even though Ginsberg's model fits his data excellently, it requires stringentFF assumptions about the distributions of duration of breastfeeding and the onset of menstruation.

2.3 Bongaart and Potter (1983) Model and Yadava and Islam Modification

By plotting a large set of data from 21 populations on average duration of breastfeeding and amenorrhea, Bongaarts and Potter (1983) observed that the relationship is a logistic type. They summarized the relationship by obtaining exponential type of equation for predicting the approximate average duration of amenorrhea in a population for which only breastfeeding data is available.

According to Bongaarts and Potter (1983), index of postpartum infecundibility C, is estimated as;

$$C_{,} = 20/(18.5+i)\text{months.}$$

Where, i is the average duration of postpartum amenorrhea. The average duration of postpartum amenorrhea can in turn be estimated by an equation derived empirically from length of postpartum annovulation and breastfeeding as follows;

$$I = 1.753 \exp(0.1396B - 0.001872B^2),$$

Where B is the mean or median duration of breastfeeding in months.

A critical view of the table produced by Bongaarts and Potter (1983), it is evident that the prediction of amenorrhea period from duration of breastfeeding by the equation above is quite satisfactory between 4 to 18 months. However, the model gives underestimates of amenorrhea period from smaller duration of breastfeeding and overestimate for longer duration of breastfeeding. A good number of research on duration of breastfeeding have established that breastfeeding frequently continues until a new pregnancy and in most developing countries, of which Kenya is among them, long breastfeeding prevails there due to cultural, health, and economic reasons (Chen et a!., 1974; Jain et al., 1979; Corsini, 1979). Secondly, if the pattern of breastfeeding is such that a large proportion of women do not breastfeed at all or breastfeed for only a small duration of time, then Bongaarts and Potter (1983) equation may predict a shorter duration of amenorrhea.

On evaluation of Bongaarts and Potter (1983) equation. Yadava and Islam in 1994, found out that in the absence of breastfeeding, the equation estimate average amenorrhea period to be 1.75

months, however, the data used by Bongaarts and Potter demonstrates a higher value which ranges from 2.3 months to 4.1 months indicating that the average may be higher than 3 months. Yadava & Islam (1994) concludes that the formula gives a low estimate of the amenorrhea period in the absence of breastfeeding. According to Panthak and Pandey (1984), for the first few months, generally the duration of amenorrhea exceed the duration of breastfeeding, that is, there is a minimum intrinsic amenorrhea for each woman which is independent of breastfeeding duration.

Using data from Philippines and India applied by Bongaarts and Potter (1983), Yadava & Islam (1994) found that the equation under estimate the average amenorrhea period in Philippines (i.e. the estimated value is 6.6 months whose observed value is 7.8 months) and over estimated the average duration of amenorrhea period on India (i.e. the estimated value is 15.98 months whose observed value is 11.71 months). From the foregoing under and over estimations of duration of postpartum amenorrhea captured by Yadava and Islam (1994), the following two problems are captured; In population where breastfeeding is a cultural practice; there is a possibility of overestimating the amenorrhea period by this indirect technique, which in turn overestimates the fertility inhibiting effects of breastfeeding; In population where women breastfeed for shorter periods, there is a possibility of under estimating amenorrhea period which in turn under estimate fertility.

In light of the above weaknesses Yadava and Islam (1994) proposed changes in the parameter value of the Bongaarts and Potter (1983) equation by re-estimating the parameter values using Least-square method. The method yielded more satisfactory estimates than the Bongaarts and Potter equation. The new equation proposed is $I = 3.186 \exp(0.0973B - 0.00158B^2)$, Where B is the mean or median duration of breastfeeding in months.

According to the new equation, the average duration of amenorrhea in the absence of breastfeeding is 3.2 compared to Bongaarts and Potter (1984) estimate of 1.75 against the observed value ranging from 2.3 to 4.1 months. Applying the second equation to Philippines and India data used by Bongaarts and Potter (1983), Yadava & Islam (1994), found the equation to be best fitting for all the duration of breastfeeding. In case of Philippines, for a breastfeeding of 3 months, the improved equation gives the estimate of amenorrhea as 4.3 against observed value of 4.5 whereas for the Indian case for a breastfeeding of 3 months, the improved equation gives the estimate of amenorrhea period as 4.21 against observed value of 4.44. On the other hand, Yadava & Islam (1994), found that for 30 months of breastfeeding in Philippines, the improved equation gives an estimate of duration of amenorrhea as 14.57 against the observed value of 12.45 (the original Bongaart and Potter equation estimate the duration of amenorrhea to be 21.4 months).

The distribution of amenorrhea period corresponding to the duration of breastfeeding reveals that the duration of amenorrhea increases significantly with the increase of breastfeeding up to certain extent after which the rate of increase becomes slow (Bongaarts & Potter, 1983). There is a steady increase in amenorrhea period up to about 18 months of breastfeeding after which the rate of increase becomes very slow (Yadava & Islam, 1994). This implies that the strength of interrelationship between breastfeeding and amenorrhea is completely different when the former is less than or equal to 18 months. By considering two types of relationships between breastfeeding and amenorrhea Yadava & Islam (1994) divided the distribution of breastfeeding into two parts;

1. The duration of breastfeeding less than or equal to 18 months
2. The duration of breastfeeding greater than 18 months

The two types of interrelationships yielded simple linear regression equations for the two parts of the breastfeeding duration. Thus from the knowledge of the duration of breastfeeding less than or equal to 18 months and greater than 18 months, the average amenorrhea periods can be estimated for the two parts by the equations from the knowledge of average breastfeeding duration corresponding to the two parts of the distribution, and ultimately the overall average duration of amenorrhea can be estimated as their weighted mean (Yadava & Islam, 1994)

2.4 Studies done in Kenya

Ferry and Page in 1984 did a study in Kenya to analyze the proximate determinant on fertility using data from Kenya Fertility Survey 1977. By using the Bongaarts and Potter (1983) model, the study found out that the relationship between data on breastfeeding and postpartum amenorrhea corresponds quite closely with what was observed by Bongaarts and Potter (1983). On comparing the proportion still amenorrheic by duration of breastfeeding, Ferry and Page (1984), found that among women not breastfeeding at the time of survey the proportion still amenorrheic was unity but it dropped by 20 percent among women whose child was already two months old, then decline more slowly. The results also found out that, for those still breastfeeding the proportion amenorrheic declined more slowly as we move from those with recent births to those whose births was longer ago. This scenario reflects the role of breastfeeding in prolonging postpartum amenorrhea beyond 1-5 to 2 months postpartum (Ferry & Page, 1984)

2.5 Summary of literature review

Three things emerge from the foregoing literature review on models of breastfeeding and postpartum amenorrhea. The first is that breastfeeding and postpartum amenorrhea are causally related. Secondly, the deterministic formula such as the regression equations, can be adequately characterized the relationship between breastfeeding and amenorrhea. The formula relating duration of breastfeeding and duration of postpartum amenorrhea predicts that the duration of breastfeeding exceeds the duration of postpartum amenorrhea. However, in the equations, the question of how breastfeeding after the return of the menses affect the duration of postpartum amenorrhea is ignored.

The third observation of the models is that the relationship between breastfeeding and postpartum amenorrhea is unidirectional, that breastfeeding affects amenorrhea, but that amenorrhea does not affects breastfeeding. Although there has been much concern about the potential effect of breastfeeding on postpartum amenorrhea, considerable less research has focussed on trends than on association. This imbalance is almost certainly due in part to the need for comparable data and analysis which relates to at least two points in time to discern trends. It remains unclear whether changes in the duration of breastfeeding in Kenya, suggest important changes in the duration of postpartum amenorrhea and hence fertility, particularly from the period 1989 onwards. The data generated through KDHs provide us with unique opportunity to understand breastfeeding and its influence on postpartum amenorrhea.

CHAPTER THREE

DATA AND METHODOLOGY

3.1 Introduction

This chapter presents a description of the data source, quality of the data and methods that were used to carry out the analysis to realize the research objectives.

3.2 Data Sources

The data for this study was taken from Kenya Demographic and Health Surveys of 1989. 1993, 1998, and 2003. Information was collected from women aged 15-49. A total of 7150 eligible females in 1989, 7540 in 1993, 7881 in 1998, and 8195 in 2003 were interviewed in the entire country. Information on duration of breastfeeding and postpartum amenorrhea relevant to this study was collected. In the 1989, 1993, 1998, and 2003 KDHS, data on duration of postpartum amenorrhea and duration of breastfeeding related to births occurring during the last three years from the date of the survey were obtained.

3.3 Data quality

Data on duration of breastfeeding and amenorrhea was collected retrospectively. For example, women aged 15-49 years were asked how long after the birth of their last child they resumed menstruation. There are often massive concentration at preferred durations, usually 3, 6, 12, 18, 20 and 24 months (Lesthaeghe and Page, 1980). The resultant heaping may not represent the true distribution of the return of menstruation or duration of breastfeeding. In order to determine the quality of breastfeeding and postpartum amenorrhea data, the extent of heaping was assessed by examining the plot of the proportion of women verses the reported duration of breastfeeding. In order to evaluate the extent of heaping in the reported duration of breastfeeding, we employed Srinivansan (1980) method of calculating digit preference. To smoothen the breastfeeding data we employed multiple of three-technique, in which the excess number of children which is concentrated at certain heaping duration are distributed to four surrounding durations, two below and two above.

3.4 Calculating the mean duration of breastfeeding from currcnt status data

Prevalence/Incidence method (Mosley et.al, 1982) was used to estimate the mean duration of breastfeeding. This technique was preferred because it does not have recall problem on retrospective reporting of duration of breastfeeding. We define the mean duration as the total number of births who are currently breastfeeding divided by the average number of births per month. The average number of births per month was calculated from the reported number of births over a period of three years (1-36 months preceding the survey). This approach has been found to produce reliable and consistence estimates.

The prevalence/incidence mean (P/I) require less detailed data, but its accuracy rests on stronger assumptions. The assumption is that there are a constant number of births by month. According to Grummer & Trussel (1993), this assumption is always not warranted and is the source of several types of bias, including secular trends, seasonal trends, and loss of data in the current month However, Ferry and Smith (1983) found that the estimate seem to compare favourably well with estimate derived from the more laborious methods, especially when the average number of births per month is based on births in the three years preceding the survey.

Let P be the number of women still breastfeeding at the time of the survey among all women who gave birth between time t and t+1 months before the interview date and let I be the number of births that occurred between t and t+1 months before interview date (including births before last). The mean duration of breastfeeding B, is estimated as;

$$B = P/I$$

3.5 Estimation of the index of postpartum infecundability (C,)

The index of postpartum infecundability measures the inhibiting effect of breastfeeding on fertility in the population. The index of postpartum infecundability is estimated using the effect of breastfeeding (lactation amenorrhea). According to Bongaarts and Potter (1983) the ratio of natural fertility in the presence and absence of postpartum infecundability therefore equals the ratio of the average birth interval without and with postpartum infecundability. If no breastfeeding and postpartum abstinence are practiced, the birth interval averages about 20 months, which is the sum of;

i. 1.5 months of minimum postpartum annovulation.

ii. 7.5 months of waiting time to conception.

iii. 2 months of time added by spontaneous intrauterine mortality.

iv. 9 months for a full term pregnancy.

Bongaarts and Potter (1983) states that, in the presence of breastfeeding and postpartum abstinence, the average birth internal equals approximately 18.5 months (7.5 + 2 + 9) plus the duration of postpartum infecundability. The index of postpartum infecundability (Ci) is estimated as;

$$C_i = \frac{20}{18.5 - i}$$

Where, C_i = the index of postpartum infecundability.

i = average duration of postpartum infecundability caused by breastfeeding.

In this study, the index of postpartum infecundability was estimated using the mean duration of breastfeeding and this was obtained from a question, which aimed at establishing the duration the most recent child was breastfed.

3.6 Bongaarts and Potter (1983) Equation

According to Bongaarts and Potter (1983) i can be modelled using the equation (1) below

$P = 1.753\ \mathrm{Exp}\,(0.1396L - 0.0018L^2)$ .... (1)

$R^2 = 0.96$

Where, P is the duration of postpartum amenorrhea.

L is the duration of Breastfeeding.

3.7 Yadava and Islam (1994) Modification I

Equation (1) above underestimates mean duration for L<=4 months and overestimates for L>=18 months as a result, the duration of PPA was re-estimated using equation (2) below as suggested by Yadava and Islam (1994)

$$P = 3.186 \, Exp\,(0.973L-0.00158L^2) \qquad (2)$$

Where, P is the duration of postpartum amenorrhea.

L is the duration of Breastfeeding.

3.8 Yadava and Islam (1994) Modification II

Duration of amenorrhea increases significantly with the increase of breastfeeding up to certain extent and after that the rate of increase becomes very slow. Consequently, the duration of PPA for the two types of relationship was estimated by applying Yadava and Islam (1994) Modification II as showed below.

$P=3.147+0.474L \quad L<=18$ Months……………………………………………………(3)

$P=8.431+0.182L \quad L.>18$ Months……………………………………………………(4)

Where,

P is the duration of postpartum amenorrhea.

L is the duration of Breastfeeding.

CHAPTER 4

ESTIMATION OF AMENORRHOEA PERIOD FROM BREASTFEEDING DATA

4.1 Introduction

In this chapter we examine the quality of data used in this study by identification of the extent of heaping and present the estimates of amenorrhea period corresponding to breastfeeding periods using Bongaarts & Potter (1983) equation and Yadava & Islam (1994) modification. The estimated amenorrhea periods are then compared to the observed amenorrhea period to determine the best fitting model for the estimation of amenorrhea period from breastfeeding data. To reduce the effect of heaping in this study, we introduce multiples of three technique as a modification of multiples of five technique, as suggested by Feeney (1979), for correcting heaping when studying the age distribution in the Indonesian population data. A Multiple of Three-technique is used to reduce the effect of heaping in the data by distributing the number of data for a particular heaping period to the period before and after it. The final section of this chapter demonstrates the implications of the models on trends in fertility inhibiting effect of breastfeeding.

4.2 Data quality

The breastfeeding data used in this study are based on retrospective study, as reported in the 1989, 1993, 1998 and 2003 KDHS. This study was focused on the breastfeeding experience of the mothers to their youngest child who has been ever breastfed. In order to access the quality of breastfeeding data, the number breastfed was plotted against the duration as shown in figure 4.1, 4. 2,4.3 and 4.4

The results show marked heaping of breastfeeding duration at 3, 6, 12, 18, and 24 months. In the analysis of breastfeeding duration data using the retrospective information from the mothers, Bracher and Santow (1982), Haaga (1988) and Klerman (1993) among others, have found that heaping occurs at 6, 12, 18 and 24 months. These heaps are caused by mothers who are unable to remember exactly how long they have breastfeed their babies. Such errors are not usually unexpected in developing countries where the great majority of the women are illiterate and hence dating of events is inherently difficult (Benham & Hogan, 1997). The distortions in the reported durations of breastfeeding could introduce biases when estimating duration of postpartum amenorrhea from data on duration on duration of breastfeeding.

4.3 Smoothening data on the duration of breastfeeding

In this study, breastfeeding duration was analysed based on current-status results on last child. To smooth irregularities in the pattern of reported duration of breastfeeding, we employed a modification of the multiple of five techniques to multiple of three techniques. This method was first used by Feeney (1979) for correcting heaping when studying the age distribution in the Indonesian population data. According to Mokhtar et.al, 2008, this particularly method is suitable for the data that have the heaped points for every six months periods during the duration. Based on this technique, a smooth distribution of breastfeeding durations is obtained.

In this multiple of three-technique, the excess number of children which is concentrated at certain heaping duration is distributed to four surrounding durations, two below and two above. A summary of the number of children who have experienced breastfeeding for a particular duration, say x months and the total number of children who have experienced breastfeeding for the durations of x, x+1 and x+2 months is denoted as x, x+3, as shown in Appendix 3.

When redistributing the effect of heaping at each heaping point, say x, we transfer the number of children from a given multiples of three duration to four surrounding durations by considering an adjustment index denoted as A_x and defined by:

$$\frac{4\ P_x - - P_x - P_x \bullet}{p_{x} - - p_x -} \qquad x = 3 \ldots\ldots\ldots\ldots\ldots 27 \qquad \textbf{(1)}$$

Where. P_x is the number of children being breastfed at duration x, P_x- is the total number of children being breastfed at the two durations immediately below duration x, P_x+ is the total number at the two durations immediately above duration x. The value of one for A_x indicates there is no heaping in the data, implying that the smoothing is perfect. The redistribution process is stopped if each value of A_x can be considered close to one. Based on the first order redistribution process, denoted as single prime ('), we have;

(2)

$$Pi- = P_{t}- - (A_{x} \sim i)[/>_{3}; -Ps].*=o \quad 27 \qquad (3)$$

$$P\backslash. = A.;_{r}\_3 - 1)P_{r}-»;r = 0.........27 \qquad (4)$$

$$1 \quad 5 \quad \frac{P^{1}_{»} \quad p^{1}_{V}- p^{1}_{r}.}{P^{1}_{r}- - p^{1}_{*»}-} \quad * = 0..........27 \qquad (5)$$

The above redistribution process is repeated, denoted as double primes o and so on until all values of A^{k}_{x} are considered close to one where the value of k is a positive integer. Application of this procedure for correcting the distribution of breastfeeding duration is as shown in Appendix 4.

To produce a smooth curve for the adjusted numbers at multiples of three, we first compute the estimated numbers at durations (x+1.5) using linear interpolation where the weights used are 0.7 and 0.3 for values before and after a particular multiples of three duration. For example as given the first table in Appendix 5, correction of the first entry is obtained by calculating 0.7 x 105 + 0.3 x 107 to give 106 (column 5). The interpolated values of the number of children being breastfed at durations x = 4.5, 7.5, ... ,25.5 are multiplied by 3 to obtain the adjusted number of children for the durations of 3-5, 6-8, ... , 24-26, as shown in Appendix 5, column 5. To make the resulting total of column 5 to conform to the recorded total of 3834, we multiply the values in column 5 by an adjustment factor, in this case 3834/3143, to obtain results as given in Appendix 5.

The corrected number of children being breastfed for a particular duration at multiples of three months and intermediate duration are provided in column 6 of Tables in Appendix 5. The averages provided in column 6 of Tables in Appendix 5 are plotted against the duration to give us the smoothen curve as shown in Fig. 4.1, 4.2, 4.3 and 4.4. However, for this study the curves are not completely smooth because the redistribution process was not complete. The redistribution requires several repeated processes beyond the scope of this study.

Having corrected for heaping in the data, the distribution found is more representative of the underlying distribution. Thus, the analysis made based on these corrected data could be considered to be more reliable.

Figure 4.1 **Distribution of Duration of Breastfeeding for 1989 KDHS**

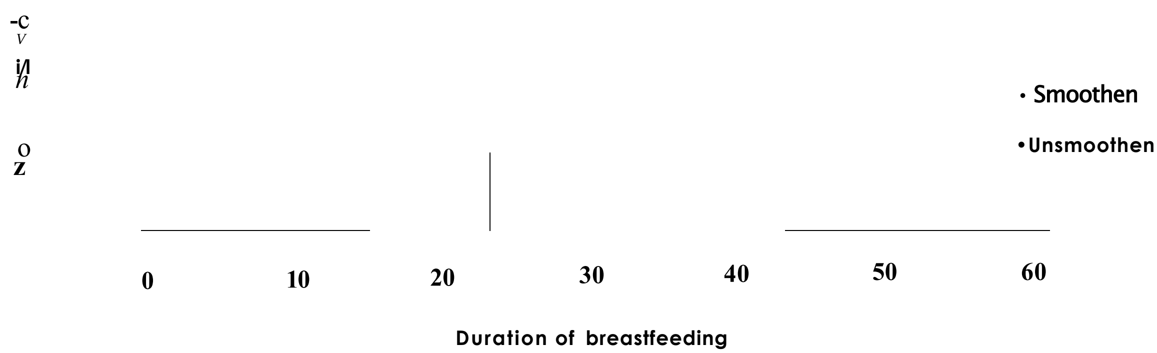


Figure 4.2 **Distribution of Duration of Breastfeeding for 1993 KDHS**

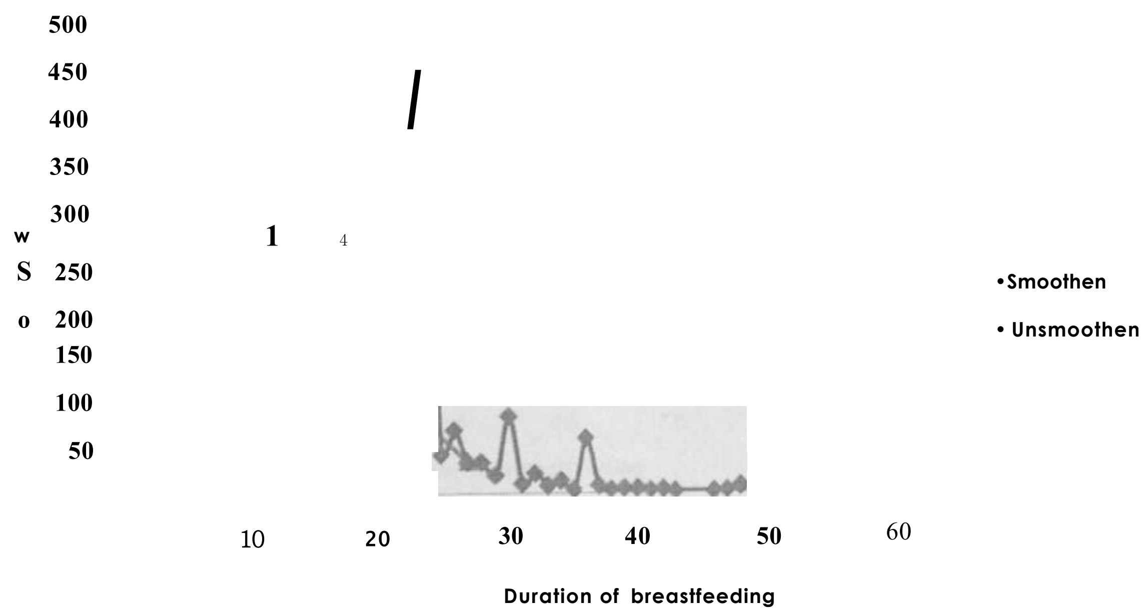


Figure 4.3 **Distribution of Duration of Breastfeeding for 1998 KDHS**

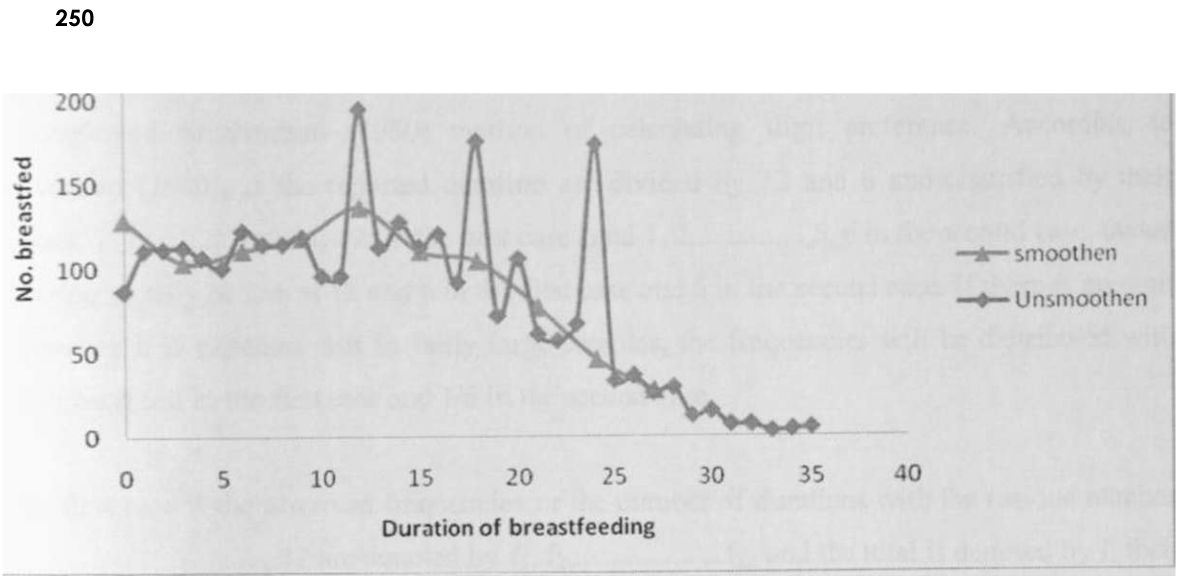
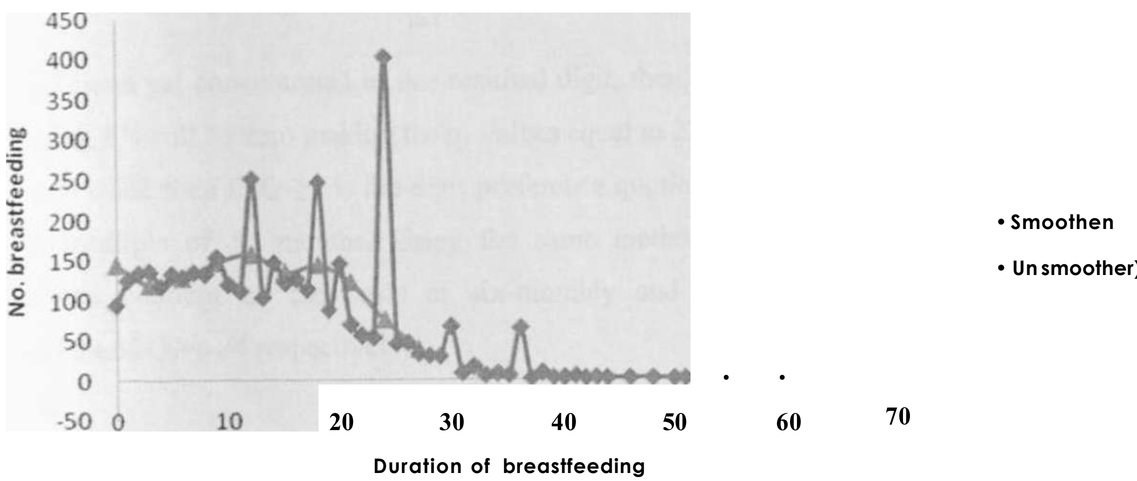


Figure 4.4 **Distribution of Duration of Breastfeeding for 2003 KDHS**



4.4 Digit preference

One objective of this study was to determine the extent of heaping in the reported duration of breastfeeding. In order to evaluate the extent of heaping in the reported duration of breastfeeding, we employed Srinivansan (1980) method of calculating digit preference. According to Srinivansan (1980), if the reported duration are divided by 12 and 6 and classified by their residues, 1, 2,.................11, 12, in the first case , and 1, 2,............,5, 6 in the second case, undue clustering usually occurs at 12 and 6 in the first case and 6 in the second case. If there is no digit preferences it is expected that in fairly large samples, the frequencies will be distributed with 1/12 in each cell in the first case and 1/6 in the second case.

In the first case if the observed frequencies or the number of durations with the residue number 1, 2,...........................,.12 are denoted by fi, f:,..................**fi2** and the total is denoted by f, then under the null hypothesis that there are no digit preferences, the quotient (see equation 1 below) should be approximately zero.

$$q_1 = \sum_{i=i}^{12} (12f_i - f)/f \quad (1)$$

If all of them get concentrated in one residual digit, then, one of the f, will equal to "f' and the remaining f,'s will be zero making the qi values equal to 22. Thus qi value range is 0<qi>22.

Let Qi = $q_{t/}22$ then 0<Qi>l is the digit preference quotient that is Qi =1 when all the durations are in multiple of 12 months. Using the same methodology, we can compute other digit preference quotient on the basis of six-monthly and three-monthly preferences based on Q:=q2/10 and Q3=q3/4 respectively.

Where,

$$q_2 = \sum_{l=1}^{6} (6f_i - f)/f \quad (2)$$

$$q_3 = \sum_{i=1}^{3} (6f_i - f)/f \quad (3)$$

Table 4.1 below shows the extent of digit preference in Q1Q2 and Q3 situations. For 1989, 1993, **1998,** and 2003 KDHS, preference for 12 month duration is 33%, 35% , 32% and 35% respectively, for 6 month duration, it is 56%, 57%, 55% and 57% percent respectively whereas for 3 month duration it is almost constant at 68%.

Table 4.1: Digit preference Quotients, Q1 (12 Monthly), Q2 (6 Monthly) and Q3 (3 Monthly) for duration of Breastfeeding in 1989,1993, 1998, and 2003 KDHS

KDHS	DPQi	DPQ_2	DPQ_3
1989	0.33 (4113)	0.56(4113)	0.68(4113)
1993	0.35(3866)	0.57(3866)	0.68(3866)
1998	0.32(3023)	0.55(3023)	0.67(3023)
2003	0.35(3951)	0.57(3951)	0.68(39951)

Note: Figures in brackets indicate the number for which the Digit Preference Quotient (DPQ) has been computed

Cognizant of this, we categorized the duration of breastfeeding based on the extent of digit preferences that exist in ungrouped distribution and are essentially done to reduce the biases and to facilitate further analysis of data. Figure 4.1, 4.2, 4.3, and 4.4 above shows marked heaping at 6.12, 18 and 24 months duration of breastfeeding. The grouping scheme chosen for this study is; none breastfed (NB), <2, 2-4, 5-7, 8-9, 10-13, 14-16, 17-19, 20-22, 23-25, 26-28, 29-31 and 32+ to take care of the heaping.

4.5 Estimation of mean duration of breastfeeding (Prevalence Incidcnce Mean)

To obtain the mean duration of breastfeeding using prevalence/incidence method, the following procedures has been followed;

T' step: Computation of Incidence, I

I = 1/36[A1I births 0-35 months preceding the survey + ½ of births occurring 36 months prior to the survey]

I, gives the approximate births/month

Step **2:** Computation of prevalence, **P**

P is the number of children currently breastfed irrespective of the age of the child.

Step 3: Computation of the mean duration of breastfeeding. B

Mean duration of breastfeeding, B = Observed Prevalence/Average number of births per month, B = P/I

A summary of the prevalence, incidence and mean duration of breastfeeding for the last child as captured in 1989, 1993, 1998 and 2003 KDHS is presented in Table 4.2 below. Based on the prevalence/incidence method, the mean duration of breastfeeding for 1989, 1993, 1998. and 2003 KDHS is 23.91, 24.06, 23.95, and 24.46 months respectively. The result implies that the mean duration of breastfeeding has not significantly changed over time.

Table 4.2: Prevalence, Incidcnce and Mean duration of Breastfeeding at National Level

Year	The prevalence (P)	Incidence (I)	Mean duration of breastfeeding (B)
1989	2336	97.71	23.91
1993	2074	86.19	24.06
1998	2039	85.14	23.95
2003	2116	86.52	24.46

Source: Computed from 1989, 1993, 1998 and 2003 KDHS

4.6. Observed and Estimated Duration of Postpartum Amenorrhoea

The observed durations of breastfeeding and their corresponding observed and estimated durations of amenorrhea are presented in Table 4.3, 4.4, 4.5, and 4.6. The data relate to Kenya Demographic and Health Surveys of 1989, 1993, 1998 and 2003. It is evident from the results that the estimated amenorrhea period for a given duration of breastfeeding by the Bongaarts and Potter (1983) equation is lower than the observed amenorrhea period for breastfeeding duration less than 18 months. The model gives under estimate of amenorrhea period for women not breastfeeding and over estimate for longer duration of breastfeeding. For women who do not breastfeed at all, or breastfeed for only a very short period of time, Bongaarts and Potter (1983) equation predict a small duration of amenorrhea. It can be pointed out here that in the absence of breastfeeding, the equation estimates amenorrhea period of 1.75 months while the observed values for 1989, 1993, 1998 and 2003 KDHS are 4.96, 5.27, 4.44, and 4.81 months respectively. On the other hand, the estimated amenorrhea period corresponding to breastfeeding duration more than 18 months is greater than the observed amenorrhoea periods. For instance, Bongaarts & Potter (1983) model estimated amenorrhoea period corresponding to breastfeeding between **20-22** months as 14.4 months where as the observed values for 1989, 1993, 1998 and 2003 KDHS are 10.38, 11.36, 10.39, and 11.19 months respectively.

According to equation II which is a modification of Bongaarts & Potter (1983) model, the average amenorrhoea period is found to be 3.19 months in absence of breastfeeding compared to Bongaarts and Potter equation which gives an estimate of the same as only 1.75 months against the actual value of 4 months and above. The application of the equation II to the observed data of **1989,** 1993, 1998, and 2003 KDHS, indicates an improved fitting. While Bongaarts & Potter **(1983)** original model is giving under estimate of the amenorrhoea period for duration of breastfeeding less than 18 months and over estimate for longer (greater than 18 months approximately) duration of breastfeeding, the equation with re-estimated values of the parameters i.e equation II is giving more closer estimate of amenorrhoea period for any duration of breastfeeding. This is also true for the overall average duration of amenorrhoea from the overall average duration of breastfeeding. For instance, for breastfeeding duration of 5-7 months, Bongaarts and Potter equation gives an estimate of amenorrhoea period as 3.79 months against the observed value of 5.23, 4.94, 4.96, and 4.91 months respectively for 1989, 1993, 1998 and **2003** KDHS, while equation II gives the estimate as 5.40 months. On the other hand, for breastfeeding duration between 26-28 months Bongaarts and Potter equation gives an estimate of amenorrhea period as 17 months against observed value of 11.38, 11.58, 12.01 and 12.22 months respectively for 1989, 1993, 1998 and 2003 KDHS, whereas equation II gives the estimate as **13.25** months. Also in case of overall population average, Bongaarts and Potter equation gives an estimate of an amenorrhoea period as 16.92, 17.51, 16.96, and 17.39 months for 23.91, 24.06, **23.95** and 24.46 months of average duration of breastfeeding respectively for 1989, 1993, 1998 and **2003** KDHS, where as equation II gives an estimate of the average amenorrhoea period as **13.22,** 13.41. 13.23, and 13.38 months respectively. Similar results are observed in case of other durations of breastfeeding except for durations <2 and 2-4 months where Bongaarts and Potter equation give more satisfactory estimates of amenorrhoea period.

Table 4.3: Observed and Estimated Durations of Amenorrhea period corresponding to the Duration of Breastfeeding for 1989 KDHS

Duration of Breastfeeding (L)	No. of Women	Percent	Observed PPA	Estimated PPA		
				I	II	III
NB	85	2.0	4.96	1.75	3.19	3.15
<2	405	9.6	2.25	2.30	3.85	4.10
2-4	259	6.2	3.25	2.62	4.21	4.57
5-7	460	10.9	5.23	3.79	5.40	5.99
8-10	418	10.0	6.96	5.29	6.73	7.41
11-13	548	13.0	8.69	7.15	8.16	8.84
14-16	411	9.8	9.2	9.34	9.61	10.26
17-19	517	12.3	10.09	11.79	11.00	11.68
20-22	243	5.8	10.38	14.40	12.25	12.25
23-25	446	10.6	11.38	17.00	13.25	12.80
26-28	105	2.5	10.67	19.41	13.93	13.35
29-31	98	2.3	13.57	21.42	14.24	13.89
>=32	206	4.9	10.94	22.46	14.22	14.26
TOTAL	**4,201**	**100.0**				
MEAN		**7.2**	**7.99**	**16.92**	**13.22**	**12.78**

Source; computed from 1989 KDHS

NB: Not Breastfeeding

I: $P=1.753EXP(0.1396L-0.001872L^2)$

II: $P=3.186EXP(0.09730L-0.001580L^2)$

III: $P=3.147+0.474L$, For L<=18 Months

$P=8.431+0.182L$, For L>=18 Months

Table **4.4: Observed and Estimated Durations of Amenorrhea period corresponding to the Duration of Breastfeeding for 1993 KDHS**

Duration of Breastfeeding (L)	No. of Women	Percent	Observed PPA	Estimated PPA		
				I	II	III
NB	73	1.9	5.27	1.75	3.19	3.15
<2	302	7.7	2.18	2.30	3.85	4.10
2-4	230	5.9	3.83	2.62	4.21	4.57
5-7	370	9.5	4.94	3.79	5.40	5.99
8-10	375	9.6	7.1	5.29	6.73	7.41
11-13	513	13.1	8.55	7.15	8.16	8.84
14-16	373	9.6	10.32	9.34	9.61	10.26
17-19	480	12.3	10.28	11.79	11.00	11.68
20-22	238	6.1	11.36	14.40	12.25	12.25
23-25	539	13.8	11.41	17.00	13.25	12.80
26-28	130	3.3	11.58	19.41	13.93	13.35
29-31	107	2.7	12.07	21.42	14.24	13.89
>=32	174	4.5	13.99	22.46	14.22	14.26
TOTAL	3,904	100.0				
MEAN		6.8	8.62	17.51	13.41	12.91

Source; computed from 993 KDHS

NB: Not Breastfeeding

I: $P=1.753EXP(0.1396L-0.001872L^2)$

II: $P=3.186EXP(0.09730L-0.001580L^2)$

III: $P=3.147+0.474L$, For $L<=18$ Months

$P=8.431+0.182L$, For $L>=18$ Months

Table 4.5: Observed and Estimated Durations of Amenorrhea period corresponding to the Duration of Breastfeeding for 1998 KDHS

Duration of Breastfeeding (L)	No. of women	Percent	Observed PPA	Estimated PPA		
				I	II	III
NB	76	2.5	4.44	1.75	3.19	3.15
<2	310	10.1	1.66	2.30	3.85	4.10
2-4	220	7.2	3.52	2.62	4.21	4.57
5-7	339	11.1	4.96	3.79	5.40	5.99
8-10	330	10.8	6.99	5.29	6.73	7.41
11-13	404	13.2	8.07	7.15	8.16	8.84
14-16	362	11.8	9.6	9.34	9.61	10.26
17-19	340	11.1	10.17	11.79	11.00	11.68
20-22	224	7.3	10.39	14.40	12.25	12.25
23-25	274	9.0	11.4	17.00	13.25	12.80
26-28	91	3.0	12.01	19.41	13.93	13.35
29-31	34	1.1	10.71	21.42	14.24	13.89
>=32	54	1.8	10.39	22.46	14.22	14.26
TOTAL	**3,058**	**100.0**				
MEAN		**7.81**	**7.61**	**16.96**	**13.23**	**12.79**

Source; Computed from 1998 KDHS

NB: Not Breastfeeding

I: $P=1.753EXP(0.1396L-0.001872L^2)$

II: $P=3.186EXP(0.09730L-0.001580L^2)$

III: $P=3.147+0.474L$, For L<= 18 Months

$P=8.431+0.182L$, For L>=18 Months

Table 4.4: Observed and Estimated Durations of Amenorrhea period corresponding to the

Duration of Breastfeeding (L)	No. of Women	Percent	Observed PPA	Estimated PPA		
				1	II	III
NB	97	2.4	4.81	1.75	3.19	3.15
<2	354	8.9	1.81	2.30	3.85	4.10
2-4	254	6.4	3.43	2.62	4.21	4.57
5-7	396	10.0	4.91	3.79	5.40	5.99
8-10	407	10.2	6.84	5.29	6.73	7.41
11-13	468	11.8	8.7	7.15	8.16	8.84
14-16	396	10.0	9.46	9.34	9.61	10.26
17-19	449	11.3	7.75	11.79	11.00	11.68
20-22	272	6.8	11.19	14.40	12.25	12.25
23-25	502	12.6	10.09	17.00	13.25	12.80
26-28	111	2.8	12.22	19.41	13.93	13.35
29-31	106	2.7	12.67	21.42	14.24	13.89
>=32	160	4.0	12.29	22.46	14.22	14.26
TOTAL	3,972	100.0				
MEAN		**7.1**	**7.75**	**17.39**	**13.38**	**12.88**

Source; Computed from 2003 K^DHS

NB: Not Breastfeeding

I: $P= 1.753EXP (0.1396L-0.001872L^2)$

n: $P=3.186EXP (0.09730L-0.001580L^2)$

in: $P=3.147+0.474L$, For L<=18 Months

$P=8.431+0.182L$, For L>=18 Months

4.7 Implication of the Modelling

In order to show the implications of using Bongaarts & Potter (1983) equation and Yadava & Islam (1994) modification on fertility estimation, the index of postpartum infecundibility was calculated from the values of mean duration of postpartum amenorrhea obtained above.

Table 4.7; The Index of Postpartum Infecundability (Cj)

		Ci = 20/18.5 + i		
Year	Observed PPA	I	II	III
1989	0.755	0.565	0.631	0.639
1993	0.737	0.555	0.627	0.637
1998	0.766	0.564	0.630	0.639
2003	0.762	0.557	0.627	0.637

W here, I is Bongaarts and Potter equation and II & III is Yadava and Islam modification

The application of Bongaarts and Potter (1983) equation suggests an average duration of amenorrhoea in 1989 of 16.92 months for an average duration of breastfeeding of 23.91 months which is 8.93 months higher than its observed value of 7.99 months. Table 4.7 above indicate that in estimating the fertility reducing effect of breastfeeding using the Bongaarts expression C, = 20/18.5 + i. Where, Ci = the index of postpartum infecundability and i is the average duration of postpartum infecundability caused by breastfeeding, we obtain the value of Ci for 1989 as 0.755 and 0.565 for observed and estimated values of amenorrhoea period (16.92 and 7.99 months) respectively. This implies that the observed fertility reducing effect of breastfeeding is 24 percent (1-0.755) and 43 percent when Bongaart and Potter system of estimation is used (1-0.565). This implies that Bongaart and Potter system of estimation is 19 percent higher than the observed value. When the same procedure is applied to model II, the fertility reducing effect is 27 percent (1-0.63) which is 3 percent more than the observed value. The same trend can be observed for 1993, 1998 and 2003 K.DHS data. We can therefore conclude that Bongaarts and Potter (1983) equation over estimates the fertility inhibiting effect of breastfeeding by almost 24 percent for the four periods, whereas Yadava and Islam overestimates by only 3 percent.

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CHAPTER FIVE
SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter presents a summary of the study findings, conclusions and give recommendations based on the objectives as spelt out in chapter one.

5.2 Summary

The objective of this study was to estimate duration of postpartum amenorrhea from data on duration of breastfeeding obtained from Kenya Demographic and Health surveys (KDHS). Specifically, the study sought to assess the fit of Bongaarts & Potter (1983) and Yadava & Islam (1994) models to Kenyan data and then use the appropriate model to estimate trends in breastfeeding effects on fertility in Kenya using 1989, 1993, 1998 and 2003 KDHS.

The estimation procedure was based on the use of duration of breastfeeding as reported in the 1989, 1993, 1998 and 2003 KDHS focusing on the breastfeeding experience of the mothers to their youngest child who had been ever breastfed. The quality of breastfeeding data for 1989, 1993, 1998 and 2003 KDHS was accessed by plotting the number breastfed against the duration. The results showed marked heaping of breastfeeding duration at 3, 6, 12, 18, and 24 months for all the KDHS data sets. Further, the study sought to examine the extent of heaping in the reported duration of breastfeeding by employing Srinivansan (1980) method of calculating digit preference. The results shows that approximately 32% to 35% of respondents preferred reporting duration of breastfeeding in 12 months in 1989, 1993, 1998 and 2003 KDHS. Data on duration of breastfeeding was categorized into; none breastfed (NB), <2, 2-4, 5-7, 8-9, 10-13, 14-16, 17-19, 20-22, 23-25, 26-28, 29-31 and 32+ in order to reduce biases occasioned by heaping and to facilitate further analysis of data.

Since the information on duration of breastfeeding obtained retrospectively is affected by heaping errors, the obtained schedules of reported duration of breastfeeding were further smoothen through the application of Three-point technique which is a modification of Five-point technique developed by Feeney (1979). In this multiple of three-technique, the excess number of children which is concentrated at certain heaping duration were distributed to four surrounding durations, two below and two above. The corrected number of children being breastfed for a particular duration at multiples of three months were then plotted against the duration to give us the smoothen curve.

Bongaarts & Potter (1983) equation and Yadava & Islam (1994) modification I&II described in chapter 3 were used to estimate the duration of postpartum amenorrhea from data on duration of breastfeeding. This further required the calculation of mean duration of breastfeeding. To estimate the mean duration of breastfeeding from current status data, Prevalence/Incidence method developed by Mosley et.al (1982) was used. The results of the prevalence/incidence mean shows that the mean duration of breastfeeding for the last child in 1989, 1993, 1998, and 2003 KDHS is 23.91, 24.06, 23.95, and 24.46 months respectively. The estimated duration of postpartum amenorrhea for each of the two models (Bongaarts & Potter equation and Yadava & Islam modification) were then compared to the observed duration of postpartum amenorrhea in order to evaluate the best fitting model for Kenyan data.

In the Bongaarts and Potter (1983) equation, the estimated amenorrhea periods were much lower than the observed duration of amenorrhea for all the durations of breastfeeding less than 18 months. On the other hand, for durations of breastfeeding higher than 18 months, Bongaarts and Potter (1983) equation estimated amenorrhea periods higher than the observed duration of amenorrhea. In case of overall population average, Bongaarts and Potter equation gave an estimate of an amenorrhoea period as 16.92, 17.51, 16.96, and 17.39 months compared to the observed averages of 7.66, 8.62, 7.61 and 7.75 months respectively for 1989, 1993, 1998 and 2003 KDHS. In the Yadava & Islam (1994) model the estimates for durations of amenorrhea period were much closer to the observed durations of amenorrhea periods except for breastfeeding durations <2 and 2-4 months. In case of overall population average, Yadava & Islam model gave estimates of the average amenorrhoea period as 13.22, 13.41, 13.23, and 13.38 months relative to observed averages of 7.66, 8.62, 7.61 and 7.75 months respectively for 1989, 1993, 1998 and 2003 KDHS.

Finally, this study demonstrates the implication each of the two models on the estimation of fertility by calculating the index of postpartum infecundibility (C,) from the observed and estimated average duration of amenorrhea. In order to achieve this, the study utilizes Bongaarts expression Cj = 20/18.5 + i. Where, Ci = the index of postpartum infecundability and i is the average duration of postpartum amenorrhea caused by breastfeeding. The result indicate that Bongaarts and Potter (1983) equation over estimates the fertility inhibiting effect of breastfeeding by almost 24 percent for the four data sets, whereas Yadava and Islam overestimates by only 3 percent for 1989, 1993, 1998 and 2003 KDHS.

5.3 Conclusion

From the foregoing conclusions, it is evident from the results that the estimation of amenorrhea period for a given duration of breastfeeding by Bongaarts and Potter (1983) equation is quite satisfactory for breastfeeding duration 1 to 4 months. However, it gives under estimates of amenorrhea periods for very small durations of breastfeeding and over estimate for longer duration of breastfeeding. Thus if the pattern of breastfeeding is such that a large proportion of women continue breastfeeding for a quite a long time then the application of the equation in such cases may provide over estimate of the amenorrhea period. The above situation is not very rare as Jain et.al (1979) and Corsini (1979) have documented that breastfeeding frequently continues until a new pregnancy.

Again, if the pattern of breastfeeding is such that a large proportion of women do not breastfeed at all or breastfeed for only a short period of time, then Bongaarts and Potter's equation may predict a smaller duration of amenorrhea. Bongaarts and Potter's estimate the amenorrhea period as 1.75 months for women who do not breastfeed in Kenya, but the data demonstrates a higher observed duration averaging 4 months and above. Hence, the formula gives a low estimate of amenorrhea period in the absence of breastfeeding.

The Yadava and Islam modified equation, gives the average amenorrhea period as 3.2 months in the absence of breastfeeding, which is much closer to the one observed from the data. Thus, Yadava &Islam modified equation gives an improved fitting for the four KDHS data.

5.4 Recommendations

This section presents recommendation for policy and research

Recommendation for further research

The results indicate that Yadava and Islam (1994) equation is giving more satisfactory estimates than Bongaarts and Potter (1983) equation. It is to be mentioned here that in fitting the two models, we have used data on the basis of observed durations of breastfeeding and amenorrhea as reported by mothers on their last children. Therefore, some of the women were still breastfeeding while others had stopped. We are proposing further research to be done based on different breastfeeding status to test the validity of the modified equation. Further testing is also required to show the relationship among types and frequency of breastfeeding, age, level of education and parity on postpartum amenorrhea.

Recommendation for policy

Our examination of the effect of breast-feeding on post-partum amenorrhea as a proxy for the fertility-inhibiting effect of breast-feeding has identified breast-feeding to be positively associated with the length of amenorrhea and thus contributes to a reduction in fecundability. Lactational amenorrhea offers breast-feeding women an excellent natural protection against pregnancy for up to 12 months post-partum. Therefore, frequent breast-feeding for up to 12 months post-partum should subsequently be followed by the use of modern contraceptives in order to derive the maximum benefits from breast-feeding as a family planning method, confirming the conclusion by Weis (1993). These findings hold the following implication for policy purposes: The Government and policy makers should take appropriate measures that will help to preserve the practice of breast-feeding where it is currently common, and encourage and facilitate breast-feeding where the practice is declining.

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APPENDIX 1

Births occurring 0-35 months, exactly 36 Months before the Survey and Number currently Breastfeeding by Age Group of the Mother for 1989 KDHS

Age Group	Births 0-35 months before the survey	Births exactly 36 months before the survey	Number currently breastfeeding
15-19	323	0	228
20-24	924	10	589
25-29	963	14	666
30-34	610	13	390
35-39	423	5	290
40-44	193	9	142
45-49	56	0	31
TOTAL	**3492**	**51**	**2336**

Source: Computed from 1989 KDHS

Births occurring 0-35 months, exactly 36 Months before the Survey and Number currently Breastfeeding by Age Group of the Mother for 1993 KDHS

Age Group	Births 0-35 months before the survey	Births exactly 36 months before the survey	Number currently breastfeeding
15-19	288	1	211
20-24	919	10	612
25-29	763	15	508
30-34	599	9	397
35-39	306	4	215
40-44	159	6	106
45-49	46	1	25
TOTAL	**3080**	**46**	**2074**

Source; Computed from KDHS 1993

Births occurring 0-35 months, exactly 36 Months before the Survey and Number currently Breastfeeding by Age Group of the Mother for 1998 KDHS

Age Group	Births 0-35 months before the survey	Births exactly 36 months before the survey	Number currently breastfeeding
15-19	320	0	229
20-24	895	8	598
25-29	820	8	529
30-34	512	9	345
35-39	353	6	235
40-44	126	4	84
45-49	32	1	19
TOTAL	**3058**	**36**	**2039**

Source; Computed from KDHS 1998

Births occurring 0-35 months, exactly 36 Months before the Survey and Number currently Breastfeeding by Age Group of the Mother for 2003 KDHS

Age Group	Births 0-35 months before the survey	Births exactly 36 months before the survey	Number currently breastfeeding
15-19	325	4	242
20-24	909	16	612
25-29	819	19	533
30-34	556	14	379
35-39	314	10	229
40-44	150	5	103
45-49	28	**1**	18
TOTAL	**3101**	**69**	**2116**

Source; Computed from 2003 KDHS

APPENDIX 2

Digit preference Quotients, Ql (12 Monthly), Q2 (6 Monthly) and Q3 (3 Monthly) for duration of breastfeeding 1989 KDHS

Duration of BF	Frequency	12Fi	(12Fi-F)/F	6Fi	(6Fi-F)/F	3Fi	(3Fi-F)/F
0	105	1260	-0.69	630	-0.85	315	-0.92
1	134	1608	-0.61	804	-0.80	402	-0.90
2	166	1992	-0.52	996	-0.76	498	-0.88
3	144	1728	-0.58	864	-0.79	Total	-2.70
4	115	1380	-0.66	690	-0.83	qs	2.70
5	173	2076	-0.50	1038	-0.75	Q3	0.68
6	150	1800	-0.56	900	-0.78		
7	137	1644	-0.60	Total	-5.56		
8	138	1656	-0.60	q2	5.56		
9	147	1764	-0.57	Q_2	0.56		
10	133	1596	-0.61				
11	102	1224	-0.70				
12	332	3984	-0.03				
Total	**1.976**		**-7.20**				
		qi	**7.20**				
F	**4,113**	**Ql**	**0.33**				

Digit preference Quotients, Ql (12 Monthly), Q2 (6 Monthly) and Q3 (3 Monthly) for duration of breastfeeding 1993 KDHS

Duration	Frequency	12Fi	(12Fi-F)/F	6Fi	(6Fi-F)/F	3Fi	(3Fi-F)/F
0	95	912	-0.76	570	-0.85	285	-0.93
1	125	1272	-0.67	750	-0.81	375	-0.90
2	134	1440	-0.63	804	-0.79	402	-0.90
3	136	1356	-0.65	816	-0.79	Total	-2.73
4	118	1404	-0.64	708	-0.82	q3	2.73
5	133	1332	-0.66	798	-0.79	Q3	0.68
6	128	1584	-0.59	768	-0.80		
7	135	1524	-0.61	Total	-5.65		
8	133	1608	-0.58	q2	5.65		
9	154	1656	-0.57	*Qi*	0.57		
10	120	1236	-0.68				
11	112	1368	-0.65				
12	252	3564	-0.08				
Total	**1,775**		**-7.76**				
		ql	**7.80**				
F	**3,866**	**Ql**	**0.35**				

Digit preference Quotients, QI (12 Monthly), Q2 (6 Monthly) and Q3 (3 Monthly) for

Duration of BF	Frequency	12Fi	(12Fi-F)/F	6Fi	(6Fi-F)/F	3Fi	(3Fi-F)/F
0	87	1044	-0.65	522	-0.83	261	-0.91
1	111	1332	-0.56	666	-0.78	333	-0.89
2	112	1344	-0.56	672	-0.78	336	-0.89
3	113	1356	-0.55	678	-0.78	Total	-2.69
4	107	1284	-0.58	642	-0.79	qs	2.69
5	101	1212	-0.60	606	-0.80	**Q3**	0.67
6	123	1476	-0.51	738	-0.76		
7	115	1380	-0.54	Total	-5.50		
8	115	1380	-0.54	q:	5.50		
9	119	1428	-0.53	Q2	0.55		
10	96	1152	-0.62				
11	96	1152	-0.62				
12	195	2340	-0.23				
Total	**1,490**	**17880**	**-7.09**				
		qi	**7.09**				
F	**3,023**	**Qi**	**0.32**				

Digit preference Quotients, QI (12 Monthly), Q2 (6 Monthly) and Q3 (3 Monthly) for duration of breastfeeding, 2003 KDHS ^

Duration of BF	Frequency F,	12Fj	(12F,-F)/F	6F,	(6Fi-F)/F	3Fi	(3Fi-F)/F
0	95	1140	-0.71	570	-0.86	285	-0.93
1	125	1500	-0.62	750	-0.81	375	-0.91
2	134	1608	-0.59	804	-0.80	402	-0.90
3	136	1632	-0.59	816	-0.79	Total	-2.73
4	118	1416	-0.64	708	-0.82	qj	2.73
5	133	1596	-0.60	798	-0.80	**Q3**	0.68
6	128	1536	-0.61	768	-0.81		
7	135	1620	-0.59	Total	-5.68		
8	133	1596	-0.60	qz	5.68		
9	154	1848	-0.53	Q_2	0.57		
10	120	1440	-0.64				
11	112	1344	-0.66				
12	252	3024	-0.23				
Total	**1,680**	**21300**	**-7.61**				
		qi	**7.61**				
F	**3,951**	**Qi**	**0.35**				

APPENDIX 3

Distribution of the number of children being breastfed in multiple of three month duration for 1989 KDHS

Duration x	x	x+1	x+2	x,x+3
0	105	134	166	405
3	144	115	173	432
6	150	137	138	425
9	147	133	102	382
12	332	114	151	597
15	136	124	133	393
18	281	103	123	507
21	71	49	45	165
24	371	30	45	446
27	25	35	22	82
Total	**1,762**	**974**	**1,098**	**3,834**

Distribution of the number of children being breastfed in multiple of three month duration for 1993 KDHS

Duration x	x	x+1	x+2	x,x+3
0	76	106	120	302
3	113	117	111	341
6	132	127	134	393
9	138	103	114	355
12	297	102	122	521
15	129	122	99	350
18	268	113	108	489
21	72	58	61	191
24	438	40	66	544
27	32	32	18	82
Total	**1,695**	**920**	**953**	**3,568**

Distribution of the number of children being breastfed in multiple of three month duration for 1998 KDHS

Duration x	x	x+1	x+2	x,x+3
0	87	111	112	310
3	113	107	101	321
6	123	115	115	353
9	119	96	96	311
12	195	113	128	436
15	113	121	92	326
18	176	72	106	354
21	61	57	67	185
24	174	33	36	243
27	26	29	12	67
Total	1,187	854	865	2906

Distribution of the number of children being breastfed in multiple of three month duration for 2003 KDHS

Duration x	x	x+1	x+2	x,x+3
0	95	125	134	354
3	136	118	133	387
6	128	135	133	396
9	154	120	112	386
12	252	104	147	503
15	122	127	114	363
18	247	88	146	481
21	70	56	54	180
24	402	46	47	495
27	33	31	30	94
Total	1,639	950	1,050	3639

APPENDIX 2

Redistribution of the number of children using multiple of three-technique for 1989 KDHS

Duration x	W	Px+	\x	P¹,	P\+	Ax	P¹,	r V
0	105	300	1	105	299	1.0000	105	320
3	144	288	0.9959	146	291	1.0695	105	329
6	150	275	1.0131	143	287	1.0610	107	312
9	147	235	1.0306	131	320	1.0251	116	326
12	332	265	1.3312	166	355	0.9938	171	362
15	136	257	1.0084	132	327	1.0272	113	342
18	281	226	1.2654	153	281	1.0175	142	286
21	71	94	0.9775	78	238	1.0023	77	228
24	371	75	2.5562	108	188	0.9545	127	354
27	25	57	0.9515	31	-3	1.9297	-141	-3

Redistribution of the number of children using multiple of three-technique for 1993 KDHS

Duration x	P*	P*+	A_x	P¹,	P',+	A x	P \	P V
0	76	226	1.0000	76	226	1	76	240
3	113	228	0.9991	113	231	1.0634	84	257
6	132	261	1.0160	124	273	1.0452	101	293
9	138	217	1.0310	123	297	1.0265	108	304
12	297	224	1.3388	148	307	0.9955	150	311
15	129	221	1.0319	115	291	1.0186	104	299
18	268	221	1.2851	142	277	1.0083	137	276
21	72	119	0.9694	82	277	0.9889	89	261
24	438	106	2.3573	133	246	0.9551	156	431
27	32	50	0.9641	38	-2	1.7959	-157	-1

. edistribution of the number of children using multiple of three-technique for 1998 KDHS

Duration x	P*		A_x	P^1,	$p'x^+$	A'x	P \	p V
0	87	223	1.0000	87	225	1.0000	87	240
3	113	208	1.0097	109	215	1.0652	80	239
6	123	230	1.0247	112	242	1.0462	91	265
9	119	192	1.0256	108	228	1.0497	85	242
12	195	241	1.1603	126	279	1.0118	120	297
15	113	213	0.9991	113	247	1.0521	86	270
18	176	178	1.1601	113	200	1.0415	95	215
21	61	124	0.9616	73	184	1.0372	58	193
24	174	69	1.5212	73	104	1.0111	70	173
27	26	41	0.9891	27	0	1.6516	-40	0

•Redistribution of the number of children using multiple of three-technique for 2003 KDHS

Duration x	P*	Px_+	A_x	P \		A'x	P \	p Y
0	95	259	1.0000	95	262	1.0000	95	280
3	136	251	1.0133	129	254	1.0653	96	284
6	128	268	0.9973	129	280	1.0539	101	304
9	154	232	1.0464	131	293	1.0340	111	306
12	252	251	1.2174	147	305	**1.0111**	140	320
15	122	241	0.9984	123	293	1.0369	101	310
18	247	234	1.2160	144	276	1.0209	132	282
21	70	110	0.9628	83	258	1.0018	82	247
24	402	93	2.3842	121	219	0.9559	142	375
27	33	61	0.9714	37	-2	1.7572	-127	-1

APPENDIX 2

The correction procedure using multiple of three-technique for 1989 KDHS

Duration x	Pxd)	Px+ (2)	fi+i.s(3)	3P'*(4)	3P*(5)	3P»(6)
0	105	320	106	405	494	165
3	105	329	110	318	388	129
6	107	312	133	330	403	134
9	116	326	153	398	485	162
12	171	362	122	460	561	187
15	113	342	123	365	446	149
18	142	286	92	368	449	150
21	77	228	47	276	337	112
24	127	354		141	172	57
27	-141	-3		82	100	33
Total				**3143**	**3834**	**1278**

The correction procedure using multiple of three-technique for 1993 KDHS

Duration x	Px(1)	P*+ (2)	fx+1.5 (3)	3P\(4)	3P,(5)	3P,(6)
0	76	320	79	302	365	122
3	84	329	90	269	324	108
6	101	312	103	310	374	125
9	108	326	121	362	437	146
12	150	362	136	409	494	165
15	104	342	114	341	412	137
18	137	286	123	368	444	148
21	89	228	109	326	394	131
24	156	354	62	187	225	75
27				82	99	33
Total				**2956**	**3568**	**1189**

The correction procedure using multiple of three-technique for 1998 KDHS

Duration x	P*(D	P*+ (2)	fx+1.5 (3)	3P\(4)	3P*(5)	3P,(6)
0	87	240	85	310	388	129
3	80	239	83	250	313	104
6	91	265	89	268	335	112
9	85	242	95	286	358	119
12	120	297	110	329	411	137
15	86	270	89	266	333	111
18	95	215	84	252	315	105
21	58	193	62	186	232	77
24	70	173	37	111	139	46
27	-40	0		67	84	28
Total				2324	2906	969

The correction procedure using multiple of three-technique for 2003 KDHS

Duration x	Px(1)	P.+ (2)	fx+1.5 (3)	3P\(4)	3Pj(5)	3P*(6)
0	95	280	95	354	435	145
3	96	284	97	291	358	119
6	101	304	104	312	383	128
9	111	306	120	360	442	147
12	140	320	128	385	473	158
15	101	310	110	331	406	135
18	132	282	117	352	432	144
21	82	247	100	300	368	123
24	142	375	61	184	226	75
27	-127	-1		94	115	38
Total				**2963**	**3639**	**1213**