

REPRODUCTIVE CHANGE IN GHANA : EVIDENCE FROM TWO
NATIONAL SURVEYS



By

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DECLARATION

Except where it is indicated otherwise, this thesis
is my own work

A handwritten signature in black ink, appearing to read 'Benjamin E. Amenuvegbe', written over a horizontal line.

Benjamin E. Amenuvegbe
April, 1994.

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ABSTRACT

This analysis examines various aspects of human reproductive change based on the Ghana Fertility Survey (GFS) and the Ghana Demographic and Health Survey (GDHS). It compares the data on transition to parenthood, birth spacing and durations of breastfeeding, postpartum amenorrhoea and abstinence and the factors influencing them. The study also dealt with the use of modern contraception as well as the relationship between the survival status of a child and the time to the next birth. The consistency in the measurement of selected variables in both surveys was also examined.

There was considerable agreement in the measurement of birth intervals and the effects of factors affecting them. Consistency has been demonstrated in the measurement of the second, fifth and sixth birth intervals and also in the effect of selected independent variables examined in the two surveys. Age at first marriage, first birth and the first birth interval do not appear to be comparable in the two surveys; this is also the case with the third and the fourth birth intervals. This finding is not surprising because of problems of measurement of marriage data in Africa which result from the fact that it is often a process rather than an event at a point in time.

The finding of inconsistency of measurement of age at marriage and the first birth interval implies that these data may not be pooled from the GFS and the GDHS to obtain a larger and possibly more stable series; also it is necessary to exercise caution in interpreting observed differences when such data are compared for the GFS and GDHS. On the other hand the consistency found shows reliability of the data though at aggregate level, and thus considerably increases our confidence in the comparative results.

The study found general stability in the pace and quantum of fertility. The overall distribution of the second birth interval is only marginally different for the two surveys; first, third and fourth interval distributions are not significantly different between surveys.

The distribution of the second to the fourth intervals are fairly symmetrical though the younger cohorts appear to show slightly longer delays for these births.

Age at first marriage and age at first birth also appear to be generally stable within and between surveys though small increases are observed for later periods and younger cohorts. The only significant differential for age at first birth is education: women with 11 or more years had higher ages at first birth in both surveys.

Median durations of breastfeeding and postpartum sexual abstinence either are stable or have increased slightly between the GFS and GDHS. A positive relationship is found between birth interval length and breastfeeding duration and also between fertility on the one hand and amenorrhoea and abstinence on the other indicating the importance of these postpartum factors for fertility. Median durations of postpartum amenorrhoea are found to generally exceed those of postpartum sexual abstinence. This suggests that amenorrhoea is more important for birth spacing than sexual abstinence among the respondents.

Since failure time data from large-scale surveys are usually heavily tied, the grouped proportional hazard model is applied to determine important factors influencing age at first birth, birth intervals as well as breastfeeding and postpartum amenorrhoea and abstinence. Ethnicity, place of residence and education are found to be significantly related to breastfeeding and postpartum sexual abstinence in both surveys.

Finally, the analysis showed a positive relationship between breastfeeding and birth interval length which indicates the contraceptive effect of breastfeeding, and implies that the long periods of breastfeeding in Ghana are advantageous not only for the sake of infants' health but also for birth spacing. Since effective contraceptive use is low, and the women tend to bear children throughout the reproductive life-span, long breastfeeding durations are important for fertility reduction.

This analysis concludes that there is only a weak evidence for reproductive change. Few and generally weak differentials were observed within and across surveys. Also, lack of significant association between postpartum variables and age and parity indicates stability of fertility decline. Except for the weak evidence mainly associated with recent periods and also younger cohorts, the pace and quantity of fertility appear to be stable.

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CHAPTER 1

INTRODUCTION

This study compares several aspects of reproductive change in the Ghana Fertility Survey (GFS) conducted in 1979 and the Ghana Demographic and Health Survey (GDHS) conducted in 1988, which were both representative samples of the population of Ghana. In particular, it deals with family formation, birth spacing and related socio-cultural factors and emphasizes the advantages and disadvantages of using multiple surveys for measuring such change. The main approach adopted is to compare transition times to specified fertility events as well as the effects of selected background variables in the two data sets. With the additional data provided in the GDHS, it is possible to examine elapsed time for making specific transitions as well as trends in effects of the background variables. Specifically, the study seeks to determine whether on average the pace of closing specific birth intervals is increasing, decreasing or uniform and whether the effect of the selected background variables on the transition times as well as some other reproductive events is the same or different for the two surveys.

The analysis discusses the quality of age data, birth reporting, and data on exposure to the risk of childbearing and compares the consistency of measuring aspects of average reproductive experience for the same birth cohorts of women who are in both surveys. Besides comparing the consistency of time to occurrence of selected reproductive events, the consistency of the measurement of the effects of independent variables for birth interval distributions are also examined. Key dependent variables in the study are birth interval distributions, age at first marriage and first birth and use of modern contraception, which are analysed for selected groups in the population. Breastfeeding with post partum sexual abstinence and with use of modern contraception are examined, as are the different effects of variables like education, ethnicity, region, religion and

residence, which have been variously shown to be related to fertility in many demographic studies.

An important aspect of the study is the estimation of the quantum and tempo of fertility for categories of selected covariates. Two aspects of birth intervals are studied: the first, to obtain and compare selected summary indices for distributions of completed and incomplete intervals using life-table techniques; and the second, to use hazard modelling to study the factors associated with lengths of intervals. Also, time series analysis is used to compare changes in the average length of birth intervals over time. This procedure involves pooling all intervals individually for the surveys, together with the year the interval was closed, and using statistical tests to determine if there were significant variations in average interval length by year of closure by survey and by selected durations

1.1 Birth interval and fertility dynamics

The role of birth intervals in the causal chain of factors which determine the birth rate has been described by Bogue and Bogue (1980). According to this explanation, socio-cultural, economic and psychological factors influence the methods, duration and regularity of contraception, which in turn influence the conception time to live births and the open birth interval. Also the exposure to pregnancy, influenced by these socio-cultural, economic and psychological factors, in turn affects birth intervals. A third factor, fecundability, influences both the practice of contraception and birth intervals. The length of the closed and open birth intervals determines the birth rate.

Fecundability is the probability that a conception will occur in a given month. Variation in fecundability consists of variation from one woman to another as well as variation over time for a particular woman and is the result of several factors which interact with one another simultaneously. Bogue and Bogue (1980) enumerated the conditions for a

successful pregnancy: normal ovulation during a menstrual cycle, timing of sexual intercourse, sperm count and absence of structural or other obstacles that could prevent the union of sperm and ovum, the capacity of the uterus to retain and nourish the fertilized ovum and the viability of the growing foetus. The authors contended that these factors are difficult to quantify separately since they are numerous and are subject to individual variation. On the other hand the socio-cultural and economic factors which influence reproductive behaviour are relatively more measurable in surveys and can contribute to differences in observed time that elapses between marriage and conception and also between successive high-order births. The present study deals only with these latter factors.

1.2 Some problems of human reproductive research in Africa

There is an increasing need to know and monitor the changing pattern of the birth rate and other reproductive behaviour, particularly in sub-Saharan Africa. This region shows the least sign of fertility decline although there is now a notable downward trend in South Africa, and recently in Zimbabwe, Botswana, and Kenya (see McNicoll, 1992). This has important implications because of the increasing consensus that the control of population growth is a prerequisite for freeing resources for economic development. For example, participants at a recent African Development Bank conference pointed to rapid population growth as one of the main obstacles to Africa's development and recommended, among other things, research into related attitude and behaviour changes in Africa (see *West Africa*, October, 18-24, 1993).

Problems of effective research in understanding attitude and behaviour changes that affect reproduction in Africa include the scope of the research and the nature of the data required. Specific issues that arise concern the accuracy as well as adequacy of the data. Both problems arise because of the nature of the data collection system: for example, errors in the data are often due to the fact that the data are obtained retrospectively by

means of memory recall. Also, large-scale surveys by their nature are usually not able to obtain the depth of information required to understand fertility dynamics. Caldwell (1985) argued that among other things, all large-scale surveys have three problems: insufficient density of questions, difficult questions asked too quickly and forced answers. These problems often arise because of the difficulty of balancing the goals of economy, efficiency and accuracy in survey practice and there does not appear to be any easy solution at the present time.

McNicoll (1992) pointed out that differences in socio-political organization, economic conditions, culture and policy direction have resulted in different paths for fertility decline in the Third World; unresolved issues include the relative import of structural and cultural dimensions in the decision making process and what causes these to change. This implies that an effective measurement of fertility dynamics can be greatly facilitated if measurement instruments adequately record these relevant dimensions of human reproduction, that is, determinants of fertility in the Third World. For example, he notes that though there exists a great deal of demographic literature on the determinants of fertility in the Third World, much of research fails to recognize and treat social change as a central issue.

One aspect of this difficulty is that many social phenomena are difficult to measure directly and often one can only contend with measuring some proxy of the phenomenon. We have noted the criticism of the inability of large-scale surveys to measure factors that explain fertility change. Indeed McNicoll (1992) noted that the contribution of fertility surveys including the GFS and the GDHS to understanding of fertility is controversial, as some feel that these surveys reveal little beside a fringe of proximate determinants; and he argued that the emphasis on comparability of data has been detrimental to experimentation and creativity except for technical demographic measurements. He also argued that though these surveys did establish differentials according to a few standard socio-economic variables, which can be linked with fertility-related behaviour more

precisely than has hitherto been possible, influences on fertility at deeper levels of socio-economic and cultural systems continue to be obscure.

Another issue is the cross-sectional nature of fertility surveys. Single cross-sectional survey data are known to have limited potential for measuring change; one reason for this is that these surveys take only snapshot pictures of the phenomena at one point in time. Furthermore retrospective data which have the potential of better elucidating change are often distorted by memory errors. When two or more demographic surveys with retrospective reproductive data become available for the same population at different points in time, it becomes possible to evaluate the nature of fertility change better than can be done with one survey. This point is discussed further in the next section. The analysis in this study uses the advantages offered by two Ghanaian national surveys, the Ghana Fertility Survey (GFS) and the Demographic and Health Survey (GDHS) to examine the process of recent reproductive change in the country. Finally, the availability of the two surveys is exploited to examine the consistency in the measurement of several reproductive events.

1.3 Advantages of multiple surveys for measuring reproductive change.

Several researchers have noted the advantages in using sufficiently comparable sequences of cross-sectional fertility surveys to evaluate fertility change more efficiently than is possible with a single cross-section (Hobcraft and Rodriguez, 1982; Swicegood, Morgan and Rindfuss, 1984; Caldwell, 1985; Pullum, Casterline and Shah, 1987; Stoto, 1988). Such multiple data sources provide a good opportunity to study recent developments in trends in reproductive behaviour and changes in trends as well as concomitant factors that tend to influence the observed trends. This is possible because the event history data on reproduction obtained at two different periods in time can be used to map out change in patterns of child bearing by age, marriage duration, parity, and intermediate variables. Furthermore the retrospective information makes available to

the analyst overlapping event histories which can be used to check the consistency with which average fertility change is captured by the various surveys. The GFS was conducted in 1979; the GDHS in 1988. Cohorts which were first observed in 1979 were by 1988 nine years older, and had further experience in their reproductive careers. The GDHS data gives the opportunity to have a second look at these and to examine the manner and the extent to which fertility has changed. An important part of the analysis is to determine how consistent the measurement of aspects of recent reproductive change are in the two surveys. This is essential for comparative analysis of data from the surveys. Further discussion of data quality and comparability is done in chapter four of the study. In the next section, some findings about issues related to reproduction in Ghana are provided.

1.4 Overview of some recent findings about reproduction in Ghana

Several analyses of recent fertility change in Ghana based on the GFS data have indicated some fertility decline from about the 1970s. The GFS data (Central Bureau of Statistics, 1983) and its evaluation report (Owusu, 1984) showed that Ghana's total fertility rate (TFR) declined by about half a child from the early 1970s. Shah and Singh (1985) showed that the decline in the level of fertility at the national level was about 10 per cent in the period 1960-4 to 1975-9 with most of the change (6.5 per cent) occurring in the period 1970-4 to 1975-9. This decline in fertility was more noticeable for age group 15-19 and for those aged 30 or above and appeared to be more rapid for higher birth orders. This analysis suggested that lasting fertility decline may have begun in Ghana. There has been some speculation about the nature of the possible effect of Ghana's economic problems in the 1970s on this observed fertility decline. The period was characterized by declines in earnings from its principal export crops, political upheavals and out-migration of mainly young men and women to work in neighbouring countries. While the decline in fertility that has been observed immediately before the GFS survey could be due to the 'Potter effect', that is, the result of birth misplacement which concentrates births in the

period 5-15 years before the survey resulting in an apparent rise of fertility in earlier periods and a decline in the more recent ones, it could also be due to the out-migration in the period (see Shah and Singh (1985)). However, no categorical statements can be made about the effect of this exodus since its magnitude is unknown.

The GDHS data however showed no conclusive evidence of a continuing decline in fertility in the 1980s (Ghana Statistical Service, 1988). Age-specific fertility rates for five-year periods preceding the GDHS suggest a small overall decline during the past 20 years. For women in the 15 - 19 age group fertility appears to have declined steadily at the rate of 7 - 8 per cent in each five-year period over the last 25 years. Among women currently in their twenties, smaller declines ranging from 1 to 5 per cent are observed for each five year period except the period between 20 - 24 and 15 - 19 years before the survey where fertility appears to have been stable or to have increased slightly. Women who were in their thirties at the time of the survey showed slightly larger fertility declines in the period between 5 - 9 and 0 - 4 years before the survey. In general, the GDHS data showed fertility levels similar to those of the GFS. The TFR for women aged 15-44 years in the five years preceding the survey is 6.1 in the GDHS and 6.3 in the GFS.

1.4.1 Differentials in trends

In the GDHS, the TFR in the five years before the survey increased from about 3.6 for women with more than middle school education to 6.8 for women with no education (Ghana Statistical Service, 1988). The most significant differences are observed between women who have higher education and all other women. Similarly, in the GFS, substantial differences (more than two births) were observed only for women with higher education. The decline in fertility for this survey was not always uniform as a woman's educational level rose; several instances of curvilinear relationships were observed with rising fertility up to primary and at times middle school level followed by a fall (see Shah and Singh, 1985).

A similar pattern of differentials in fertility is observed for administrative regions which coincide somewhat with ethnic residential patterns. The regions also have somewhat different levels of development, with Greater Accra, Ashanti Central and Eastern regions being probably the more developed than Volta, Western, Northern and Upper regions. In the GFS differences in fertility levels for regions for the period 1975-9 have been found to be relatively small, except that Greater Accra with 5.0 children had the lowest average total fertility compared with 7.1 for Western or Central and 6.5-6.7 for the other regions. Regional differentials in fertility levels in the five years before the GDHS indicate that Greater Accra had the lowest level of fertility (TFR, 4.6), followed by Eastern and Ashanti Regions with TFRs below 6.0, while the other regions recorded TFRs between 6.1 and 6.9. Fertility differentials in education and ethnicity can be influenced somewhat by differences in practices relating to age at marriage, breastfeeding and other postpartum practices as well as differences in contraception. They may also be influenced by individual as well as community reaction to infant and child deaths. Some previous findings for these factors in Ghana are noted below.

1.4.2 Age at marriage

As in most Third World countries, marriage is universal in Ghana. Aryee (1985) found that changes in age at marriage for different cohorts vary only moderately from older to younger cohorts and that age at marriage among highly educated women (that is, 10 years and above of schooling) as well as among women with no schooling, has been increasing from older to younger cohorts. The median age of first marriage for women between 20 and 49 was 18 years according to both the 1979 and the 1988 surveys. While in the GFS, 31 per cent of women aged 15 - 19 years were ever married, the equivalent figure was about 25 per cent in the GDHS data; this suggests a slight decrease in early marriage. Further evidence from the 1979 survey shows that while about 66 per cent of women aged 20 - 29 entered marriage before age 20, for the two oldest age-

groups 72 to 77 per cent were in union before age 20. Corresponding figures for the GDHS are 65 per cent and 73 to 77 per cent (Ghana Statistical Service, 1988).

1.4.3 Contraception

Knowledge of methods of contraception is widespread and is on the increase in the country: for example, 69 per cent of currently married women in the GFS and 79 per cent in the GDHS claimed to know some method of contraception. However, both ever use and current use are relatively low: both being about 40 per cent in GFS and 37 per cent in GDHS (Ghana Statistical Service, 1988). These data also show that the proportions of currently married women using a method to prevent pregnancy increased slightly from 9.5 to 12.9 per cent. Abstinence remains the most favoured method, increasing from 4 per cent to 6 per cent. The GDHS data also showed that urban, more educated women and women with higher parities are more likely to use contraception. Current use in the 1988 survey increases from 5 per cent for women aged 15 - 19 to 18 per cent for women aged 40 - 44 and then falls to 8 per cent for women in the 45 - 49 age group. This latter pattern suggests that younger women want to have children, while the older ones either want to space or prevent further births. Appiah (1985) noted that current age and the number of children living were relatively unimportant for contraceptive knowledge and use and suggested that contraceptive use is as much for spacing as for stopping childbearing.

1.4.4 Breastfeeding

Breastfeeding can inhibit ovulation and lengthen post partum amenorrhoea and thereby reduce fertility; hence its importance to demographers. Breastfeeding also has a favourable impact on the health of children. Breast milk is usually sufficient for all the child's nutritional requirements in quantity and in composition for the first few months of

life and reduces the risk of the child taking in harmful agents that cause gastro-intestinal problems for infants. These reasons make breastfeeding an important issue meriting the concern of health-related institutions in Ghana. The GDHS recorded an average breastfeeding duration of 20 months for births occurring one to three years before the survey. This is a small increase on the 18 months average duration reported in the GFS (Ghana Statistical Service, 1988). This evidence firmly suggests that breastfeeding durations have not declined. The mean duration is inversely related to the woman's level of education.

1.4.5 Infant and child mortality

The estimates of mortality for the five years preceding the GDHS are significantly higher than the GFS estimates. Owusu (1984) suggested that the GFS estimates were underestimates. The 1988 survey found a marked decline in infant and childhood mortality since the mid-1970s: for example the estimated infant mortality rate of about 100 per 1000 in 1973-77 declined by approximately 22 per cent in the period 1983-87. Both the GFS and the GDHS data found similar regional patterns in mortality rates with the Western and Central regions experiencing twice as high a death rate as all regions except the Northern and Upper regions.

1.5 Objectives of the study

Shah and Singh (1985) suggested that the pattern and components of fertility decline found in the GFS data are consistent with the start of a long-term decline. They observed that the decline was concentrated initially at high parities and among modern groups and showed the usual patterns of socio-economic differentials of high fertility among subgroups which are lower on the socio-economic scale. On the other hand, the preliminary analysis of the GDHS data recorded similar or higher fertility and infant and

child mortality rates for the mid to late 1970s and concluded that the stable breastfeeding practice, scant increase in contraceptive use in the years following the GFS and the stability in age at marriage do not indicate a long-term trend (Ghana Statistical Service, 1988).

The current study examines the comparability of the data on birth spacing and factors affecting it and seeks to obtain relevant indices of birth interval length and estimates of the associated effects. Specific objectives are to determine to what extent the two data sources provide consistent estimates of birth spacing patterns and the determinants of various aspects of reproductive change. Also an analysis of the changes in birth spacing is presented. The aim is to determine the average times to having specific births and whether these are different in the two data sets and the direction of change if any. The association between infant and child mortality and birth spacing is also examined. The study also addressed the question whether the average ages at first marriage and first birth are consistent across the two surveys for the same cohorts and whether common covariates have the same effect on age at first marriage and first birth across the two data sets.

1. 6 Rationale for the study

This study makes possible the use of the extra data that have become available, to assess the nature of the change in aspects of human reproductive activity in Ghana. As the surveys under comparison cover different points in time, it is possible to monitor aggregate change first in the socio-economic context, and in the context of infant and child mortality and proximate determinants. Also, in the absence of important study effects it is possible to pool the samples to obtain a larger series and thus better evaluate trends and patterns. I have referred to studies in section 1.3 which indicate that when data from successive surveys are combined in this way, more detailed analysis of common phenomena becomes possible. Individual-level relationships can be examined

across more periods, cohorts, and durations, which constitutes a better analysis and thereby provides a richer context in which to examine change.

Finally, the examination of the consistency with which the same fertility experience is measured by surveys at different points in time is crucial because it has serious implications for substantive conclusions that researchers will draw from these surveys about the subject matter of interest. The presence of significant study effects can lead to very different conclusions being drawn about the same subject. According to Watkins (1987) differences in the explanation of fertility transition from one study to another can often be attributed to differences in the data, measures and methodologies. This analysis sheds some light on aspects of this problem. The findings in Chapter 4 provide some indication about which inter-survey differences may not be emphasized as a result of possible incomparability of the data from the two surveys.

1.7 Outline of main analytical procedures

The approach to measuring fertility dynamics used in this study is based on the concept of the parity progression ratio. For a particular cohort of women, this is the proportion who, having reached a particular parity, go on to have one or more subsequent births. The concept has been extended to the domain of cross-sectional data analysis (see for example, Rodriguez and Hobcraft, 1980) and a further extension to incorporate regression techniques is made possible by the Cox (1972) proportional hazards model. Some concepts involved in these two procedures are now briefly introduced. Further details about the application of these procedures as well as other procedures are provided in the relevant chapters.

1.7.1 Notation

Let T denote a random variable which represents failure time and t some specified value of T , where T is assumed to be a continuous random variable. Also let the probability density function and the cumulative density function for t be denoted by $f(t)$ and $F(t)$ respectively. The function $f(t)$ gives the unconditional probability that the event of interest occurs at duration t while $F(t)$ gives the cumulative probability of the occurrence of the event by duration t . The relationship between $f(t)$ and $F(t)$ is given by:

$$F(t) = \int_0^t f(x)dx$$

The complement of $F(t)$ defined as $S(t) = 1 - F(t)$ is called the *survivor function* and gives the probability that the event of interest did not occur by duration t . Another important related concept is the *hazard function*, $h(t)$, which represents the conditional probability that the event of interest occurs at time t given that it did not occur before time t . This function $h(t)$ may be expressed in terms of $f(t)$ and $S(t)$ as:

$$\begin{aligned} h(t) &= \lim_{\Delta t \rightarrow 0} P(t < T < t + \Delta t / T > t) / \Delta t \\ &= f(t) / S(t) \end{aligned}$$

It can also be shown that

$$S(t) = \exp \left[- \int_0^t f(x)dx \right] \dots\dots\dots(1)$$

and $f(t) = h(t) \exp \left[- \int_0^t f(x)dx \right] \dots\dots\dots(2)$

1.7.2 Life table methods

Life-table methods express the survival probability as a product of conditional probabilities. Consider the time axis to be partitioned into k intervals (a_j, a_{j+1}) for $j=1, \dots, k$. The survival probability $S(a_j)$ can be expressed as:

$$\begin{aligned} S(a_j) &= P(T > a_j). \\ &= P(T > a_1) P(T > a_2 / T > a_1) \dots P(T > a_j / T > a_{j-1}) \\ &= P_1 P_2 \dots P_j \dots (3) \end{aligned}$$

where $P_j = P(T > a_j / T > a_{j-1})$. Estimates for each P_j are derived separately and then multiplied together to estimate S .

Hobcraft and Rodriguez (1980) suggest three summary indices to describe the life-table results for a birth interval, namely the proportion of women having a subsequent birth within five years (the quintum), the trimean and mid-spread (inter quartile range) of the distribution of intervals to the births. Following Tukey (1977), the trimean is estimated from the distribution of birth intervals between the first and third quartiles. The trimean is estimated as:

$$\text{Trimean} = (T_{25} + 2(T_{50}) + T_{75}) / 4$$

where T_{25} , T_{50} and T_{75} are quartiles of the life table. When calculation of the trimean is based on standardized quartiles, for intervals closed within five years of their initiation, we have standardized trimeans.

Where the time taken between the attainment of the first quartile and the second quartile, and between the second quartile and the third quartile is the same, the trimean would be equal to the median, and the distribution will be said to be symmetrical

between the 25th and 75th percentiles. If the trimean is greater than the median, it indicates that closure of the interval is slower after the median is attained than before it, and if the trimean is smaller than the median, a faster pace of closure of the interval before the median is attained is indicated. While the trimean or median is an indication of tempo, the range or spread also gives an indication of the time it takes between the attainment of T₂₅ and T₇₅ and can also be taken as an indication of the speed of reproduction. The quantity T₅₀ gives the duration at which 50 per cent of women have given birth and for the standardized median, T₅₀ provides the duration after which 50 per cent of those who closed a specific interval within five years of its initiation did so.

In the case of a closed interval where all women do in fact go on to have a subsequent birth, the interpretation of the quantum or indeed of any birth functions would be slightly different. The birth functions would refer to the cumulative proportions of women having a birth by a given duration among all women who have gone on to have a subsequent birth. Since all women go on to have a subsequent birth, it is unnecessary here to choose a summary measure to serve as an indicator of the proportion of women who go on to have a subsequent birth after a reasonably long duration.

In the implementation of the life table methods, a statistic D is calculated from the survival scores using the algorithm of Lee and Desu (1972), and distributed in large samples as the chi-square with $g-1$ df, where g denotes the number of groups, under the null hypothesis that the subgroups are samples from the same survival distributions. A large D implies that there is a greater likelihood that the subgroups come from different survival distributions.

1.7.3 Life-tables and regression

The objective is to determine whether observed population heterogeneity as expressed by various exogenous variables has a statistically significant influence on the length of time

to the occurrence of the event of interest, as for example, time till a woman has a second birth given that she has had a first birth. One approach to introducing heterogeneity into the life table is to subdivide the sample before calculating the life tables. This procedure, however, leads to a rapid reduction in the sample size with increase in the number of controls and a consequent loss of reliability for the life table estimates. These problems are largely overcome though the application of hazard models which handle censored data as well as provide estimates of covariate factors without the need to physically split the samples into subsamples.

1.7.3.1 The proportional hazards model

The Cox (1972) model is a popular procedure for modelling failure time distribution as a function of independent variables. The model is usually implemented in terms of the hazard function since this yields a more tractable parametric form and is easier to manipulate mathematically. In the multiplicative form, the hazard model is expressed as the product of two functions: the baseline hazard expressed as a function of only time, and a function which expresses the effect of the covariates on the hazard rate. Let $Z = (z_1 \ z_2 \ ...z_p)$ denote a vector of p covariates and $B = (B_1, \ ... \ B_p)$ a vector of unknown parameters that enable us to quantify the prognostic influence of the covariates on the transition process. The general multiplicative hazard model is given as:

$$h(t;Z) = h_0(t)g(Z;B).....(4)$$

where $h_0(t)$ models the variation in the rate as a function of time and $g(.,.)$ (which denotes $g(Z;B)$) models the variation in the hazard rate for individuals having different characteristics. Given a non-zero value for Z , the value of the factor $g(.,.)$ gives the relative risk for the group characterized by z relative to the standard group i.e. $Z = 0$ group. The hazard function enables us to describe the manner in which the instantaneous (transition rate) failure rate for an individual changes with time.

Cox (1972) suggested the form $\exp(Bz)$ for $g(Z;B)$ and also that $h_0(t)$ be left arbitrary without any restriction of its functional form, particularly where the main concern is the exploration of prognostic effect of the covariates or where there is no reasonable parametric form of the distribution of failure time. The hazards of different individuals are assumed to be proportional though the baseline hazard of individuals can vary arbitrarily over time. In the Cox model, estimates of $h_0(t)$ can still be obtained by replacing B by B^* obtained from the partial likelihood estimator, and then deriving a maximum likelihood estimator for $h_0(t)$. A log-linear parametrization of the hazard rate ensures positiveness of estimators as well as computational simplicity.

1.7.3.2. Parametric versus non-parametric proportional hazard models

The Cox model may be estimated as a fully parametric or a semi-parametric model. When a parametric form is assumed for the baseline hazard function, we have a parametric proportional hazards model. An exponential distribution specification assumes time constancy of the hazard rate; the Weibull and Gamma distributions for example allow for the non-constancy of the hazard rate but assume a monotonic increase or decrease with time while the log-normal, the logistic or the log-logistic permit modelling where the hazard rate is thought to increase initially, reaches the peak and slowly declines. On the other hand, if $h_0(t)$ is left unspecified, that is, if no distributional assumptions are made about it, a non-parametric version of the model is obtained. It was noted in section 1.6.3.1 that the method of partial likelihood (Cox, 1975) yields estimates of B but not $h_0(t)$. If an adequate distribution can be determined for the baseline hazard, estimation is enhanced. Since interest in the application in this study is in the prognostic effects of the independent variables, only the non-parametric version of the Cox model is used.

1.7.3.3 Grouped data proportional hazards model

When failure time data are grouped or heavily tied the likelihood functions for continuous time are often inappropriate. Note for example, that age or duration data in fertility surveys are usually obtained in completed units of time or are often grouped. Thus, for a reported age of 10 years, for example, the actual value of T will lie in the interval $10 < T < 11$ years. A number of extensions to the Cox (1972) model have been suggested for discrete or grouped failure time data. The approach used in this study assumes that the failure time data have been grouped from an underlying continuous failure time distribution (see for example, Prentice and Gloeckler, 1978; Kalbfleisch and Prentice, 1980).

1.7.3.4 Derivation of the likelihood function for grouped data

Consider the grouping of the time scale into intervals $A_j = [t_{j-1}, t_j)$, $j = 1, \dots, k$ such that $0 < t_1 < \dots < t_k < \infty$. Let p_j , s_j and h_j denote the probability mass, the survivor and the hazard functions for the discrete distribution. Now,

$$\begin{aligned} h_j &= P(T \in A_j / T > t_{j-1}) \\ &= p_j / s_j \\ \text{and } s_j &= \prod_{v=1}^{j-1} (1 - h_v) \dots \dots \dots (5) \end{aligned}$$

An individual may be censored or die at t_j . Let C_j denote the censoring indicator and h_{ij} the hazard for the i th individual in the j th interval. The likelihood function over all individuals is: (see for example, Aitkin et al., 1989)

$$L = \prod_{j=1}^s \prod_{i \in R_j} h_{ij}^{c_{ij}} (1 - h_{ij})^{1 - c_{ij}} \dots \dots \dots (6)$$

where R_j is the set of individuals at risk in the k th time interval. For the proportional hazards model, h_{ij} is:

$$1 - \exp(-e^{Bx_i + \theta_j})$$

$$\text{and } \theta_j = \log (S_o(t_j) - S_o(t_{j-1}))$$

The likelihood function in (5) is a product of Bernoulli likelihoods, one for each individual in each interval. The probability of failure in the j th interval for the i th individual is h_{ij} , and

$$\log\{-\log(1-h_{ij})\} = Bx_i + \theta_j \dots\dots\dots (7)$$

To fit the model in (7) the observations in each time interval are assumed to be independent across intervals. The censoring indicator is the response variable with a Bernoulli distribution, and a complimentary log-log function. The fitted regression model contains the regression coefficients for the explanatory variables and the interval parameters θ_j .

1.8 Outline for the thesis

The rest of the thesis is organized into seven chapters. Chapter 2 reviews various attempts to explain factors likely to cause fertility to decline. Chapters 3 and 4 compare sample characteristics and data quality respectively for the two surveys while Chapter 5 presents the analysis of the age at first marriage and first birth and the first birth interval. A comparative analysis of aspects of birth interval distributions is given in Chapter 6 while Chapter 7 deals with postpartum variables that are related to birth interval lengths. Conclusions are presented in Chapter 8.

CHAPTER 2

EXPLANATIONS OF FERTILITY DECLINE : AN OVERVIEW

2.1 Introduction

This research deals with the nature of recent fertility change in Ghana. In Chapter 1 it was noted that various paths of fertility decline have emerged in the Third World as a result of differences in socio-cultural, economic and political systems (see McNicoll, 1992) and that an adequate understanding of fertility dynamics in any setting requires effective measurement and analysis of the dimensions of these factors. It is thus intuitively appealing at this stage to review some past attempts to explain when and how fertility decline comes about in human communities based on various aspects of these factors. The concern here is about fertility as a macro-level phenomenon whose change is mediated through individuals or groups of individual actors who contribute to the aggregates that are observed. These aggregates are the result of a process and so far it has not been easy to determine a unified system of variables, macro or micro, which affect individual and perhaps subgroup motives, choices and action with regard to this process, to the extent that fertility begins to decline. This review indicates that in spite of the wide range of knowledge that has been accumulated on the subject, the mechanism of fertility decline does not appear to have been fully understood; and there is need for continuing investigation of its subject matter.

2.2 Theories of fertility decline

2.2.1 The classical fertility transition theory

Notestein (1945) provides one of the earliest formal explanations why couples find it beneficial to conceive fewer children to the extent that fertility rates fall overall.

Notestein's theory was set out primarily to explain the demographic changes in Europe in the nineteenth century; it specifies three stages in which fertility and mortality levels develop.

At the first stage, fertility and mortality rates are high, because birth rates are sustained by norms that favour high birth rates while death rates are not effectively controlled. In the second stage, death rates come under human control as a result of modernization and therefore fall. With the high fertility rates, this fall in mortality levels leads to rapid population growth. In the final stage, after a response time, the birth rate begins to fall as couples deliberately make efforts to have fewer births. This decline in fertility leads eventually to a new equilibrium in which both the fertility and mortality rates are low. This classical viewpoint stresses that modernization, which comes about as a result of changes in macro-level variables such as urbanization, industrialization and literacy, removed props for pronatalist norms. For example, these changes caused a shift from dependence on family and community institutions to dependence on larger specialized socio-economic and political units.

With the decline in the dominance of the familial mode of production as these specialized units grew and absorbed the functions of the family, the benefits that were previously derived from having many children lessened. Added to this, the cost of children increased partly because they interfered with the emerging non-traditional functions in the modernizing society and partly because the children became more costly in terms of the rising aspirations of parents for them, as a result of improvements in the standard of living through the process of modernization. The factors ultimately led to the decline in fertility.

What this viewpoint implies is that fertility will be high in poor, pre-modern societies because of high mortality and the lack of opportunities for individuals to make progress, and because children have high economic value. As the society modernizes, the traditional values that favour large family size will change and this will in turn lead to a

decline in fertility. The theory combined economic, social and psychological factors to explain fertility decline. This classical view has recently been criticized widely and revised extensively especially as more data became available for analysis. One criticism of this explanation of fertility decline is that it has not been possible to point out specific levels of groups of developmental variables which were attained before the onset of European fertility decline, therefore the theory is not adequate for predictive purposes.

2.2.2 The Threshold Hypothesis.

The 'Threshold Hypothesis' (United Nations, 1965), which derives directly from the classical viewpoint, holds that fertility will decline from traditional high levels in developing countries only if a certain economic and social level of development is reached. However, studies of European fertility transition have found no common threshold levels for infant mortality, literacy or urbanization at the onset of marital fertility decline. Furthermore, they found that many areas that were similar in culture experienced fertility change together without the required changes in socioeconomic developmental conditions that were critical in the fertility transition theory (Coale, 1973; Teitelbaum, 1975). Coale (1973) noted in relation to the 'Threshold Hypothesis' that for a decline in marital fertility to be sustained, beliefs and norms of the society should favour small families; reduction in fertility should be advantageous to couples economically and effective means for reducing fertility must be accessible.

2.2.3 Micro-economic theories of fertility decline

The 'Demand Theory' explanations of fertility decline (for example, Becker, 1960, 1965; Schultz, 1980, 1981) stressed decision making by parents regarding the costs and benefits of childbearing. They assume that couples have a level of living in relation to which they calculate the utility and disutility of having additional children. Thus a

couple attempting to maximize its utility consumption has to weigh the rewards of bringing up additional children in terms of educational costs and also in terms of the amount of their time that the children will consume. In these theories, children are regarded as durable goods which have to compete with similar other goods for the parents' resources. To explain the observed inverse relationship between fertility and income, Becker (1960) introduced the concept of the quality of children stating that a rise in parents' incomes is accompanied by the desire for higher standards of living for their children. This implies that children are seen as 'inferior goods' so that fewer of them are obtained as the parents become rich. The demand explanations play down the constraints imposed on individual decision making by the norms in society or by institutions. Berelson (1972) pointed out several differences between children and durable goods: among other things children do not come in several competing brands or products and are not available for trial or a quick evaluation. They cannot be returned or exchanged once they are born and they themselves take an active part in the deliberations of the household.

Jones (1982) noted that the contribution that the introduction of time makes to the adequacy of the theory, is obscured by the inability of the theorists to classify in detail the mother's time use at home, particularly separating income-generating uses of the home time from all other uses. Also, the importance that is attached to the opportunity cost of mothers' time in rearing additional children appears to be largely irrelevant in rural areas of developing countries because mothers can either leave their children in the care of family members while they go to work or they can carry their children to their work place. He also noted that the concept of 'household utility maximization' is largely unrealistic given the structure of households and mutual obligations among kin. Furthermore, the role of children as productive agents and source of security outweigh their role as consumer durables while the lack of easily accessible effective birth control methods implies that couples will have difficulty in having approximately the required number of children.

The demand theories treat the effect of changing tastes in fertility as given. Jones (1982) gives two reasons why tastes need to be explicitly accounted for. He says, first, there is enough evidence that indicates that fertility transition is very much related to changes in taste across geographical, class, cultural as well as temporal barriers and secondly, that tastes are related to income in ways which change over time and with economic structure. Leibenstein (1974, 1975) dealt with this problem by arguing that a rise in income leads to a change in tastes for both children and other goods that compete with them. As the parents' social status rises as a result of income rise, they are thrust into a new socio-economic reference group which partly imposes new costs of childbearing. Leibenstein also noted that higher education results in lower fertility not because of higher opportunity costs to the mother but because it leads to changes in taste for the parents. The theory is also criticized for not taking into account factors relating to the supply of children. These factors can only be ignored if they can be shown to act equally across all subgroups in a population over time. For example, the theory is silent on premarital and extramarital fertility where the demand for children may not exist. It also ignores biological constraints which make it impossible for couples to attain their desired number of children (see Jones, 1982).

Easterlin (1975) proposed the extension of the economic framework of fertility analysis to cover factors that influence the potential output of children. He argued that the determinants of fertility need to be seen as working through the demand for children given that there are no costs for fertility regulation, and the potential output of children in the absence of conscious efforts to control fertility. Easterlin is of the view that the immediate factors that affect the demand for children are the income of parents, the price of children compared to those of other goods, and the subjective preference for children relative to other goods. He also sees the potential number of children a couple has as depending on natural fertility, the chances of survival of infants to adulthood, and the cost of fertility regulation which includes subjective costs, monetary costs and opportunity costs in terms of the time required to learn about the methods and use of specific methods.

2.2.4 Sociological theories

Sociological explanations of fertility decline unlike the demand theories, emphasize constraints imposed by cultural factors and social norms. Bourgeois-Pichat (1967) noted that couples in pre-industrialized countries have the number of children that biology and society give them. He was of the view that once this socio-biological network is known, it is possible to predict the outcome. Aspects of societal norms which have been identified as affecting fertility have included religion, social structure and kinship groupings. For example, Lorimer (1954) suggested that patrilineal and matrilineal societies with corporate kinship groups are oriented towards high fertility. Kirk (1971) suggested the need to concentrate on 'cultural regions' in attempts to explain fertility decline so that the heterogeneity of circumstances among cases may be reduced. The sociologists give several other reasons why the economists' equation of children to consumer goods is untenable. Blake (1968) for example argued that couples do not always have the complete freedom to choose the number of children they desire as they are often subject to social pressure to marry, start families and give their children some acceptable level of living standards, and that parents cannot completely choose the quality of their children because this depends on the genetic as well as socio-economic factors. She noted that if parents become dissatisfied with the number and quality of their children they cannot easily dispose of them or change them and that parents may not use their children as they please. Also, the interpretation of cost of children which produces a positive relationship between income and fertility is most unlikely.

2.2.5 Ideational theories

Other theorists emphasized the role of motivation in the explanations of fertility change (e. g. Knodel, 1977; Freedman, 1979; Cleland and Wilson, 1987). This viewpoint is largely influenced by new evidence on the importance of cultural factors in European

fertility decline over the past century as well as the poor correlation of recent developing country fertility declines and the sheer speed of some of the recent declines. The formulation stresses the spread of ideas about the availability and methods of modern birth control practices as important factors for the initiation as well as the sustenance of the tempo of fertility transition. But an important limitation of this viewpoint is that it does not consider the factors that generate the desire to limit families and those that make the idea of family control the right thing to do (see Guest and Chamrathirong, forthcoming). The fact that socio - economic changes in a given society can bring about changes in fertility norms has been well articulated (see for example Lesthaeghe, 1991).

Freedman (1979) proposed that subsets of objective developmental change much smaller than those that characterized the West can provide motivation for lower fertility, and that under modern conditions ideas and aspirations for a different way of life transcending what is actually available are also important in motivating lower fertility. He observed it is not known how much change and what subsets of conditions are sufficient to motivate fertility decline.

2.2.6 Intergenerational wealth flow theory

Caldwell's (1976; 1982) wealth flow theory links the concept of economic demand for children with the cultural transmission of Western ideas and values which eventually tend to undermine the former. According to Caldwell, high fertility prevails when the net lifetime flow of wealth favours those who are in a position to make decisions relating to fertility, and low fertility will constitute rational behaviour among the decision makers when the direction of net flow is disadvantageous to them. He notes that in European societies, changes in modes of production which resulted from capitalism brought about changes in family structure because of the need to invest more in children to prepare them for the market economy and also because the returns from

the investment in children brought in decreasing returns as the children resisted exploitation. Caldwell suggested that fertility will change in developing countries with the introduction of mass education and ideas about the structure of the Western nuclear family, and the change in family structure from the extended type to the nuclear type will lead to the reversal of wealth flow and the decline in fertility.

2.2.7 Institutional factors

The importance of the influence of institutional factors in fertility related decision making has also received attention in the literature (see for example McNicoll, 1980). McNicoll (1993) defined institutions as clusters of behavioural rules that govern human actions and relationships in recurrent situations. These rules may be written or unwritten but are public knowledge even if unexpressed and sanctions may be externally or self-imposed. They can have cultural or material antecedents or both and can be inherited though subject to continual modification by those whom they affect. According to McNicoll, new institutions can be designed, though the manner in which they will work cannot be fully predicted and the way they evolve depends on how they got to where they are and on expectations and efforts at redesign. He noted that among the institutions that are related to change are those that define family systems as for example, conjugality, sexuality, socialization of children and the care of the aged.

McNicoll saw fertility-adaptive behaviour as being eventually governed by the patterns of institutional and cultural change in society and noted that such changes impinge on fertility through three routes: shifts in social and administrative pressures bearing on fertility-related behaviour; changes in people's internalized values concerning marriage and family; and changes in the array of economic benefits and costs associated with marriage and fertility. According to McNicoll (1980; 1993) these changes will affect the fertility of different cultural and economic groupings in a given population in different ways. Thus family, community and state roles have led to different patterns of

fertility transition. In sub-Saharan Africa, for example, lineage influence appears to be predominant.

In a comparison of fertility declines in Europe and the Third World, Watkins (1987) noted that sustained fertility transitions resulted from changed behaviour within marriage. She observed that the onset of fertility transition is usually but not always compatible with the degree of economic development. In general, however, the more urban, the more educated and the more industrial areas, as well as areas with lower infant and child mortality, tended to lead the fertility decline. Watkins (1987) also observed that areas that led the decline are those that emphasize institutional and ideational change. She pointed to the difficulty of distinguishing between the socio-economic progress of the individual and households and institutional and ideational change; she argued that these do not operate independently of one another. Thus while economic advance stimulates and supports expanded government programs, these in turn change the social and economic conditions facing individuals and can speed up the adoption of new ideas or insulate the population from outside influences.

In a review of WFS findings about recent declines in marital fertility in many developing countries and the lack of decline in others, Cleland (1985) concluded that subject to the limited range of data collected in these surveys, there is little support for any of the major theories. He noted that the evidence in these data consistently points away from those theories that emphasize fundamental macro- or micro- economic change as being essential before the onset of fertility. At the same time, he found support for theories that emphasize the influence of new ideas and aspirations.

2.2.8 Proximate Determinants

Davis and Blake (1956) listed eleven possible intermediate variables through which any personal or cultural factors that affect fertility must pass. These proximate determinants,

as they are called, are classified into three groups of factors that affect exposure to intercourse, conception and gestation and successful parturition. To allow for a simpler quantification, Bongaarts (1976) reduced the list of eleven intermediate variables to seven which together directly influence fertility. He suggested two criteria for choosing the important variables: the degree of sensitivity of the fertility rate to changes in the determinant and also the variability of the determinant among populations and over time. His analysis showed that four proximate determinants, age at marriage, postpartum infecundability, contraception and induced abortion, constitute the most important intermediate variables that determine levels of fertility. Breastfeeding and contraceptive practice influence fertility through lengthening birth intervals, while changing age of marriage can either raise or lower fertility depending on the direction of change.

2.3 Infant and child mortality and fertility decline

Another factor which often attracts researchers' interest in fertility dynamics is the effect of infant and child mortality on fertility. The remainder of this chapter reviews some of the ideas concerning the relationship between fertility change and mortality. The association between infant and child mortality and fertility decline has long been of interest to demographers. Among the several reasons for this is the complex nature of this relationship. For instance, while it is known that high levels of infant and child mortality have some effect on the level of fertility through biological as well as social mechanisms, it is also observed that high fertility levels in turn contribute to the sustenance of high infant and child mortality. In the last two decades it has been generally believed that mortality decline has preceded fertility decline and mortality reduction may be a prerequisite to a decline in fertility (United Nations, 1975). What this view implies is that fertility decline is not likely to occur in the wake of high infant and child mortality. Yet other views noted that reducing mortality levels may not be an effective means of reducing fertility (see Preston, 1975). While research in the last 20

years or so have indicated some weak evidence of the existence of a relationship between infant and child mortality and reproductive behaviour, it has not been possible to establish any definitive causal links between the two phenomena.

In the theory of the demographic transition it was argued that the decline in mortality would, though after a lag period, reduce the social needs for many births. The lag period is because there is not likely to be rapid change in social norms which previously influenced reproductive behaviour to offset the effect of high infant and child mortality. Infant and child mortality is expected to affect fertility through three main means: biological mechanisms which operate through the shortening of breastfeeding leading to a quicker return to ovarian function as a result of child death; individual couples' response to perceived mortality in their community or the response to experience of past child death; and the society's means of coping with high probability of child death. Often, social institutions exist to ensure the maintenance of high reproductive goals.

The individual couple's responses to perceived and actual child loss lead to what are termed insurance and replacement effects. The insurance argument is that the reproductive goal of the couples is to have surviving children mainly as insurance in their old age. The replacement theory assumes that couples have reproductive goals and are able to control their fertility once these goals are achieved. The methods used to study the replacement effect involve comparisons of contraceptive use and the desire to stop childbearing among women who have experienced child deaths and those who have not.

Several studies of the relationship between infant mortality and fertility at the individual couple level have shown that the length of postpartum amenorrhoea has a positive correlation with the duration of breastfeeding, and that because the early death of the child interrupts lactation the period of postpartum amenorrhoea is considerably shortened following neonatal death (see Wyon and Gordon, 1971; Chowdury, Khan and Chen, 1976). In order to establish a relationship between infant and child mortality and

the demand for subsequent births, Heer (1966) suggested the need to examine subsequent behaviour by trying to assess possible behavioural effects of a reduction in infant and child mortality while the influence of this biological effect is held constant.

2.3.1 Actual infant and child mortality and fertility decline.

One group of studies address the question of sequential responses to actual deaths experienced by the individual couple. In these studies a number of attempts have been made to determine whether the number of previous deaths to a married couple have a positive association with their demand for subsequent births and how this is affected by parity and the sex composition of the children. For example, Heer and Wu (1975, 1978) found the number of additional children desired by couples with two surviving sons to be 60 per cent less than those of whom one or both of two sons have died. They also found that the effect of prior child loss in Taiwan depended heavily on the sex of the child. Similar findings are reported by Rizk, Stokes and Nelson (1980). Pebley, Delgado and Brineman (1979) found significant positive association between the number of prior child deaths and the desire for additional children at parities of 3 and 4, and of 5 or more.

Iskander and Jones (1977) also tested the relationship between a woman's own experience of infant mortality and her subsequent birth spacing for Indonesian data and concluded that infant mortality had a tendency to raise parity-specific fertility rates, at least at parities 2 and 3, by shortening the spacing for the subsequent birth. Preston (1975, 1978) suggested that the effect of prior child loss on subsequent fertility (replacement effect) could be assessed through stopping probabilities. This procedure involves calculating for women of each parity the difference between stopping probability for women who have not lost a child and those who have and dividing the result by the stopping probability of those who have not lost a child. The overall result will be seen as the proportion of women who would have stopped childbearing but who have been induced to continue as a result of child death. Heer (1983) suggested that for

developing countries where child deaths are common and family planning relatively uncommon the difference in stopping probabilities should be divided by the proportion of women who have lost a child and go on to have another child. The result could then be interpreted as the proportion of women who would have gone on to have another child but are induced to stop because their last child survived.

2.3.2 Perceived mortality and fertility decline.

The other notable approach to the analysis of the relation between infant and child survival and prior child deaths relates to the behavioural effects of perceived level of child survival in the community. For example, on the basis of Heer and Smith's (1967) computer simulation models, Iskander and Jones (1977) estimated that given an awareness of life expectancy at birth of 45 years, the average Indonesian couple who want to be 95 per cent sure that they will have one son alive by the father's 65th birthday, would need to have more than five children. Heer and Wu (1975, 1978) found for women who had three or more children that those who perceived that child survival was less than 85 per cent went on to have 0.24 more children than those who perceived 95 per cent survival or more. However in the Pebley et al. (1979) analysis, the perception of child survival did not appear to have any significant effect.

2.3.3 Family planning, child mortality and fertility decline.

Evidence of substantial interaction between the prevalence of family planning and the impact of prior child survival on subsequent fertility has also been demonstrated in a number of studies. The Chowdhury et al. (1976) study analysed the dependence of the mean length of closed birth intervals on the survival status of the previous child and the next to last previous child in a country with almost non-existent family planning, and found a strong impact of death of the last previous child because of the shortened

period of postpartum amenorrhoea. However the death of the next to last previous child had no effect on subsequent fertility. Park, Han and Choe (1979) also analysed the probability of an additional birth given the survival status of the previous child and the next to last child and observed that the death or survival of the next to last child had no effect on the probability of an additional birth if the last previous child had been born before the introduction of vigorous family planning but a significant effect after its introduction.

2.4 Conclusion

In spite of the extensive research in fertility, there is still no general agreement about what causes fertility to decline. The fertility transition theories generated the expectation that education, decline in infant mortality and higher living standards would reduce the number of children preferred and thus with the availability of contraception, fertility rates would fall; but this did not happen (see Abernethy, 1993). Abernethy (1993) argued that optimism and prosperity make fertility rise and that deteriorating conditions make it fall. According to Abernethy (1993), African fertility increased to six or more children in the 1960s when infant mortality fell, health-care availability increased, literacy rose and there was general optimism in many sectors of its economies.

The European fertility transition which occurred in the nineteenth century, and the fertility transition in developing countries which is now under way, show marked contrasts: the main difference being the effective technology that is now available for controlling both fertility and disease and hence infant mortality. For example, while mortality decline in Europe was gradual and appears to be related to socio-economic development, the decline in developing countries, where it occurred, has been rapid with consequent decline in population growth rates. Furthermore, government intervention and the introduction of modern contraceptive technology have led to sharp

falls in fertility in some developing countries. According to Jones (1993), lack of education, poverty, low status of women, relatively high mortality, lack of family planning programs and lack of social welfare schemes and old-age security do not provide absolute barriers to fertility decline. For example, substantial fertility declines have occurred in Burma, North Korea and some Latin American countries where official policy was hostile to or did not support family planning. Jones (1993) argues that while economic development and fertility declines are associated, the correlation is far from perfect; and that the attainment of high levels of education was not a prerequisite for ensuring that fertility would decline. He notes for example, that even though education levels in the Philippines have long been the highest in South-East-Asia, and that educational levels in Indonesia in the 1970s and 1980s were well below those of the Philippines, fertility decline in Indonesia was more pronounced, so that by 1990 the total fertility rate in Indonesia was one child lower than that in the Philippines.

Potter (1989) notes that debate concerning factors underlying the rapid fertility change in many parts of the developing world is still in progress and there is still uncertainty about the trajectory that fertility will follow in sub-Saharan Africa where no appreciable change has been seen to date. With regard to the heterogeneity of factors that could influence fertility in Africa and their possible effects on demographic trends, Lesthaeghe et al. (1981) noted:

On a continent where gathering, nomadic and agricultural-artisanal modes of production exist side by side, where Islam and Christianity have further diversified social structures and culture, and where substantially different degrees of economic development and urban growth add to the already existing heterogeneity, one would not expect demographic trends to follow a uniform pattern. Fertility transitions starting from very different levels and generating lags of varying durations are likely to become part and parcel of the overall modernization process (Lesthaeghe et al., 1981: 20).

Kirk (1971) pointed out that a possible initial effect of modernization (for example, improved health conditions) in Africa may be to raise rather than reduce fertility. Similarly, Frank (1983) observed that sub-Saharan Africa's fertility had yet to reach its

peak. Her expectation of increasing rates of growth was based largely on an anticipated decrease in infant mortality and the reduction in infertility. McNicoll (1993) argued that Africa will probably trace a demographic path of its own, and this will reflect its distinctive family systems and its kin-based pattern. According to McNicoll (1993), the rapid population growth means that increasing parts of Africa are beginning to experience movement from labour scarcity to land scarcity and the resulting privatization of land and reduced demand for rural labour will begin to change the pronatalist attitudes usually associated with the continent. He argues that even though the lineage influence over land and family behaviour still persists in parts of Africa tending to counter these economic pressures, the trend toward demand for fewer children will soon dominate it.

On the whole, a unified system of explanation for fertility decline, which will take into account the various factors that affect the mechanism and which can be applied anywhere, appears to be illusory. According to Jones (1982), for fertility theories and models to be useful aids in understanding fertility, they must be designed within particular contexts: general forces influence fertility everywhere, but these are strongly mediated by the particular setting; hence the search for a general theory had better wait until there is an improved understanding of the determinants of fertility levels and trends. McNicoll (1980) also argued for the need to discover or devise appropriate parameters of the fertility decision-making environment that would reduce the unmanageable complexity to a semblance of order. It is clear from these assertions that the complex mechanism of fertility is not yet fully understood, neither are the factors involved and the nature of their role.

The fertility transition theory however provides us with a framework within which to study fertility change in any setting. While there are competing explanations there are also, in the above summary, many common features and many variables that a number of theories acknowledge as important, so that without making judgements about the relative merits of different theories, it is possible to produce evidence which might be

interpreted within various theoretical contexts. The effort towards further understanding of fertility continues and the present piece of research is part of this effort. In the analysis, the theories play a large role in the choice of variables to be examined. The next chapter describes the samples and the characteristics of the respondents on which the analyses in this study are based.

CHAPTER 3

THE SAMPLES AND THE CHARACTERISTICS OF RESPONDENTS

3.1 Introduction

The data for the analysis in this thesis are based on two probability samples with national coverage: the Ghana Fertility Survey (GFS) and the Ghana Demographic and Health Survey (GDHS). Both surveys are self-weighting in that the ultimate sample units are equiprobable. Also both samples covered women aged between 15 and 49 years. This chapter presents a description of the samples and also the characteristics of the respondents based on the selected background variables. The background variables are more or less proxies for some of the socio-economic and cultural factors that can variously affect fertility decline in different settings as was noted in Chapter 1. These socio-economic and cultural factors have received considerable attention in the attempts to explain fertility decline outlined in Chapter 2. The manner in which these factors combine may be important for the observed differences in fertility, hence the need to consider the association among them. The following section outlines the organization and the execution of the surveys which generated the data used in the current thesis. Chapter 4 examines aspects of the quality of the data.

3.2 The surveys

3.2.1 *The GFS*

The GFS was conducted as part of the World Fertility Survey (WFS) in the period 1979-80. The survey used a two-stage sample design involving the selection of 300 census enumeration areas (CEAs) in the first stage with a target of 7,500 households in the second stage. The fieldwork for this survey started in February 1979 and ended in

March 1980 and a total of 6,125 successful interviews out of 6,363 eligible respondents was obtained yielding an individual response rate of 96.3 per cent.

The survey obtained data on fertility differences and patterns as well as factors that affect fertility behaviour (Central Bureau of Statistics, 1983). The GFS questionnaire is in two main parts: one for households and the other for individual women. The household questionnaire was used partly to identify women who were living in the selected households and aged 15-49 years. The survey also obtained data relating to distributions of age, sex, and marital status. The individual-level data contained in-depth interviews aimed at obtaining marital and birth histories. The WFS has two versions of the standard questionnaire: the individual core questionnaire which obtained data on marriage and birth histories, child survival and fertility control; and a module which obtained more country-specific data relative to abortion, fertility regulation, factors other than fertility affecting contraception, community-level variables, economic issues and mortality. Ghana used both the core and the module on factors other than contraception affecting fertility which obtained data on the postpartum variables frequency of sexual relations, and family planning including contraception. Since countries modified the WFS questionnaires to suit the local context, the WFS produced a standard recode file which makes for easier comparative analysis.

3.2.2 The GDHS

The GDHS is a multistage stratified sample consisting of 150 census enumeration areas (CEAs) covering both the urban and rural sectors. The sample was drawn from 200 CEAs selected for the Ghana Living Standards Survey (GLSS). The GLSS sample was made up of 72 urban and 128 rural CEAs which were stratified according to ecological zones and according to rural and urban areas. The ecological zones consist of the Coastal savannah, the Forest and the Northern savannah, and are largely related to economic activity. To obtain an optimum sample of 40 women per CEA in the rural

areas and 20 women in the urban areas, all of the urban CEAs and 78 of the rural CEAs were selected for the GDHS sample. A probability sample of 4574 individual women aged between 15 and 49 who spent the previous night in sampled households were selected for interview. Out of this number 4488 were successfully interviewed, yielding a response rate of about 98 per cent. Three questionnaires were used in the GDHS: the Household Questionnaire, the Individual Questionnaire and the Husband's Questionnaire. The household questionnaire obtained a listing of household members together with basic data on age, sex and so on which was used, among other things, for identifying eligible individual women household members and their husbands. The individual questionnaire collected data on background characteristics, reproductive behaviour and intentions, knowledge and use of contraception, family planning and breastfeeding and health.

3.3 Background variables

The socio-economic and demographic background variables obtained in the GFS and the GDHS include age, ethnicity, level of education, religion, region of residence, current and childhood residence as well as data on respondents' work. The distribution of the two samples by these characteristics is compared next. For this study, several of the background variables have been recoded to obtain uniform coding systems where the two surveys used different numerical coding systems or where the classification of categories is different. As an example, the variable, 'place of residence' is classified in the GFS as 1 for 'rural' 2 for 'urban' and 3 for 'large urban' while in the GDHS it is 1 for 'urban' 2 for 'rural'. For the GFS data the 'urban' and 'large urban' categories have been collapsed into the 'urban' category and the 'rural' category is recoded as 1 and 'urban' as 2 in the GDHS. The comparability of the original classification of background variables and the feasibility of recoding them to ensure comparability was an important consideration for inclusion of the variables in the analysis.

3.3.1 Ethnicity

The ethnicity variable was recoded for inter-survey uniformity: the Fante, Twi and other Akan groups have been regrouped under the name Akan in both surveys. Another advantage of this regrouping is that output of models involving this variable will be relatively simple to interpret and since all these groups identify themselves as Akan and are culturally very similar, it is expected that there should be little if any loss of information as a result of this step. The Akans constitute 54 per cent of GFS and 53 per cent of the GDHS samples (see Table 3.1). The ethnic composition of the rest of the samples is as follows: the Mole-Dagbani, 13 and 11 per cent; the Ewes, 12 and 16 per cent; the Ga-Adangbe, 7.5 and 8.9 per cent, and the Guans, 3 and 2.3 per cent. The final ethnic differentiation is the 'Other' group which constitutes about 10 per cent in the GFS and 8.8 per cent in the GDHS, and encompasses other sample members who could not be classified under any of the above groups. One aspect of the differences in family organization which characterize these groups is the system of inheritance. While the Akan group inherit matrilineally the other major groups do so patrilineally. How this may be related to some aspects of reproduction is discussed in later chapters. The data for ethnicity indicate relatively adequate coverage in both the GFS and the GDHS.

3.3.2 Religion

From Table 3.1, it can be seen that Christians constitute about 65 per cent of the GFS and 70 per cent of the GDHS. While almost the same proportion of women indicated they were Moslem in the two surveys (that is, 10.8 per cent in the GFS and 9.9 per cent in the GDHS), the proportion professing traditionalism is smaller in the later survey by more than half. There are also slightly more atheists and fewer Catholics in the later survey. Those who claimed to have no religion make up about 8.1 per cent of the GFS and 12.1 per cent of the GDHS.

Table 3.1 Percentage distribution by background variable by survey

Variable	Survey	
Ethnicity	GFS	GDHS
Akans	54.1	53.0
Ga-adangbe	7.5	8.9
Ewe	12.2	16.0
Mole-Dagbani	13.1	11.0
Guan	3.0	2.3
other	10.1	8.8
Religion		
Catholics	18.7	17.1
Other xtian	46.5	53.1
Moslem	10.8	9.9
Traditional	15.9	7.8
No religion	8.1	12.1
Education		
None	51.5	39.7
1-10yrs	41.0	53.3
11+	4.6	6.9
Residence		
Rural	66.1	66.1
Urban	33.9	33.9
Childhood residence		
Rural	57.6	47.1
Urban	42.4	52.9
Region		
Western	7.5	8.7
Central	7.6	10.3
Greater Accra	11.9	13.3
Eastern	16.5	15.7
Volta	9.8	11.1
Ashanti	24.0	18.3
Brong Ahafo	7.9	11.1
Northern	14.8	11.3

Also, Catholics formed about 19 per cent in the GFS and 17 per cent in the GDHS. It is worth noting that Catholic attitudes to human reproduction are quite pronatalist and the same could be said of the traditional and the Moslem religions thus reproductive performance is likely to be affected by significant shifts with respect to religion in the composition of the population of women in the reproductive ages. Indeed where religion directly affects such factors as the status of women and the use of contraception it can constitute a potent factor in human reproductive performance (Caldwell, 1993).

3.3.3 Education

The effect of education on reproductive behaviour may be direct or indirect. One clear direct effect is when women postpone marriage and childbirth until after some formal educational level has been attained. On the other hand, education may modify people's views to such an extent as to change their value judgements of traditionally held views about reproduction. Lesthaeghe (1980) noted for example that individuals use factors like education to claim their freedom from traditional control. The respect accorded to elites because of their exposure to ideas and knowledge that is not easily available in the traditional domain probably enables them to adopt foreign models with less opposition from the rest of the traditional society (see Nadel, 1956; Ofosu, 1992).

The education variable is often measured by 'highest type of school attended' or 'highest number of years of schooling'. The highest number of years is used in this analysis to avoid any possible misclassification that may have resulted from recent educational reforms in Ghana in which the former 'Middle Schools' were replaced by Junior Secondary Schools. However the years of education have been grouped to correspond as much as possible to the 'None', 'Primary', 'Middle' and 'Secondary and above' classifications. Table 3.1 indicates an increase in the years spent in formal schooling between the GFS and the GDHS. For example, there is a decrease of about 11

percentage points in the group who had no education and an increase of about 2 percentage points in the group who had at least some secondary education.

It should be noted that Ghana implemented an accelerated program of education soon after independence and this has generally resulted in a substantial increase in formal education for both sexes. For example, the proportion of women aged 15-24 who did not have any formal education dropped from 79 per cent in 1960 to about 38 per cent in 1984.

3.3.4 Place of residence

The effects of the urban environment in modifying traditional behaviour may be a cause for rural-urban differentials in birth spacing (see McCall, 1961). Family planning facilities may be more readily available in the urban areas than in the rural ones. Also rural dwellers may stick to tradition more than their urban counterparts because of more ethnic homogeneity and the greater adherence to prescribed norms which often have religious undertones. Urbanization often removes individuals from the traditional setting. According to McCall (1961), urbanization provides exposure to new cultural values and traits some of which are imported. It can therefore contribute to changes in life-style which shift emphasis away from traditional aspirations relating to reproduction. Caldwell and Caldwell (1987) observed that as with education, the effect of urbanization on the perceptions and behaviour of town residents is strengthened by peer group effect and that legitimacy of new behaviour is derived from this peer effect. However, care is needed in emphasizing rural or urban differences, particularly in comparative studies, because of definitional problems. For example, criteria chosen to distinguish urban areas from rural ones may be quite arbitrary. The problem may be more complicated for childhood residence where the task of classification has to be left to the respondent.

The variability of criteria for distinguishing between rural and urban areas may bias findings about their effects, more importantly in comparative studies involving the use of information on place of residence as an explanatory variable. Both the GFS and GDHS used similar numerical criteria to distinguish between residence types. In the GFS, localities with fewer than 5,000 people were classified as 'rural'; localities with 5,000 to 9,999 people were classified as 'small urban' while those with 10,000 or more were designated 'large urban'. The GDHS did not distinguish between the 'small' and 'large' urban areas. As indicated in Table 3.1 the urban sample of women constitute about 34 per cent of both the GFS and GDHS surveys. Considered together, the 'small' and 'large' urban areas have 28.9 and 31.3 per cent of total population (both sexes) in the 1970 and 1984 censuses. From Table 3.1, it can be seen that the distribution according to this variable is the same for both samples. Another problem is that most surveys do not provide information on the duration of the respondent's residence in the urban area; neither is there information to distinguish between newly-developed urban environments and the older large towns.

3.3.5 Type of work

It has been noted that only background variables for which comparisons could easily be made across the two samples are considered in the analysis. It is well known that many rural women particularly are able to carry their babies with them at their place of work even if it is outside the home. Details of this are available for the GDHS only. Also, the effect of type of work of women on the pattern of family formation is not unambiguous. While studies in developed countries have shown a negative relationship between fertility and labour force participation (Simmons, 1985) this is not true for the developing countries. Some authors have thus suggested that there is a role conflict between reproduction and labour force participation (see Singh and Casterline, 1985). Other considerations include the high degree of uniformity in the rural samples with regard to the work variable and the tendency of this variable to be correlated with education and

place of residence particularly in developing countries. This association could mean that much more may not be gained by considering the work variable besides the education and place of residence. This variable is not considered any further in the analysis.

3.4 Association between background variables

The association between background variables is often of substantive interest to data analysts. For example, it is a frequent observation that the highly educated women, particularly in developing countries, tend to live in urban areas. As Ohadike (1967) noted, the role of education in causing change stems from the fact that not only are educated people often the ones exposed to new ideas, but they are also located where other modernizing factors are important. If Christianity in Africa may be considered as a factor of modernization, then with the exception of the pronatalist attitude of Catholic Christians, the relatively large and possibly increasing proportions of respondents observed to adhere to this religion (see section 3.2.2) could signify a favourable impact on future fertility behaviour in Ghana. However, as is well recognized, most social behaviour tends to be influenced by a multiplicity of factors. Human reproductive behaviour being a socio-biological phenomenon it is thus influenced by several factors. In our sample, the effect of Christianity will depend on how the large proportion of Christians observed are distributed over the categories of education for example. In Chapter 2, the possible factors and the ways in which they may cause fertility decline have been discussed. It was also observed in Chapter 1 that different combinations of these factors have led to different patterns of fertility change; to determine which factors are significantly related to fertility in a particular setting, it is often more enlightening to consider them simultaneously and for this, knowledge of how the factors are interrelated is important.

There are also purely statistical reasons for considering the association among background variables. The problem of association between background variables may be

considered at two levels (see Rockwell, 1975). At the mathematical level, it is required that the correlation matrix of background variables be non-singular, so that it can be inverted to obtain solutions for the regression equations. This requirement is self-enforcing since no solutions can be obtained for regression equations if the correlation matrix is singular. The other aspect of the problem is when non-trivial correlations exist but do not violate the mathematical requirement of non-singularity. The condition is referred to as 'multicollinearity' and its effect is to increase the variance of the estimates of the regression coefficients and the confounding of the effects of the correlated variables. This means that the high levels of association between background variables will make it difficult to separate the independent effects of the closely related variables. One objective in the subsequent multivariate analysis is to investigate the effect of several background variables on the duration of breastfeeding of some specified child through the inclusion of several of the background variables in an appropriate statistical model.

If place of residence and education are very closely related, it may be difficult to separate the independent effect of place of residence from that of education. Often, a viable solution is to use factor analysis to produce uncorrelated background variables. But these can be very difficult to interpret.

It is therefore essential to examine the relationship among background variables to be used in multivariate analysis because of possible substantive associations between the variables and also because of the statistical problems that some of these associations may present. First, the distributions for cross-tabulations of pairs of the variables are considered and compared for the two surveys. In section 3.4, measures of the strengths of the association (and where appropriate the direction of the association) between pairs of the background variables are examined.

3.4.1 Ethnicity and religion

Table 3.2 gives the percentage distribution of religious groupings among the ethnic categories. It can be seen that Christianity is more popular among the Akans, Ga-Adangbes, Ewes and the Guan women while Islam is most popular among the Mole-Dagbani and the Guans. Catholicism is only common among the Akans and the Ewes while Protestant Christianity is least popular among the Mole-Dagbani, being only 1 per cent in the GFS and 4.3 per cent in the GDHS. Also consistent across the surveys is the finding that more Mole-Dagbani and Ewe women were reported to be adherents of the traditional religion. For the GFS, about 51 per cent and 23 per cent were recorded as Traditionalists among the Mole-Dagbani and the Ewe respectively while in the GDHS, the corresponding figures are 21.5 per cent and 19.5 per cent. It can also be seen that while the proportions professing Protestant Christianity appear to have increased in the GDHS, Catholicism and Traditionalism seem to have declined. For the Moslem religion, the percentage increased slightly among the Mole-Dagbani (from 30.8 to 34.1 per cent) but decreased among the Guans from about 18 to 14 per cent.

Table 3.2 Percentage distribution of respondents by ethnicity, religion and survey

Survey/ Ethnic Groups GFS	Catholic	Other Christians	Moslems	Trad.	No Religion	N
Akan	21.3	63.1	3.4	3.8	8.4	3312
Ga-Adangbe	6.5	72.8	3.9	10.2	6.5	460
Ewe	31.4	35.8	0.9	22.7	9.1	745
Mole- Dagbani	11.7	1.0	30.8	51.2	5.2	804
Guan	8.6	44.9	17.8	15.1	13.5	185
GDHS						
Akan	20.4	66.9	3.1	1.3	8.3	2376
Ga-Adangbe	4.3	83.4	2.0	1.8	8.6	397
Ewe	19.1	47.1	0.7	19.5	13.6	718
Mole- Dagbani	13.6	4.3	34.1	21.5	26.4	492
Guan	5.8	68.3	13.5	2.9	9.6	104

3.4.2 Ethnicity and residence

From Table 3.3, the least urbanized ethnic groups in terms of current residence are the Mole-Dagbani and the Ewes. In the GFS only about 27 per cent of the Mole-Dagbani and 28 per cent of the Ewe women were reported to be dwelling in urban areas and in the GDHS this value is about 26 per cent. On the other hand some 34 per cent of the Akan women and 50 per cent of the Ga-Adangbe were reported to be living in the urban areas in either survey. The pattern is similar for childhood residence where the Mole-Dagbani followed by the Ewe women are more likely to report a rural childhood residence than the Ga-Adangbe and Akan women. The residence pattern is similar to the finding for religion. It was found in section 3.3.1 that relatively more respondents among the Mole-Dagbani and the Ewe claimed to adhere to the traditional religion. This finding is consistent with the common observation that rural dwellers are more likely to remain attached to tradition than urban women.

Table3.3 Percentage distribution of respondents by ethnicity, type of place of residence by survey

Survey Ethnic Groups GFS	Current	residence	Childhood	residence
	rural	urban	rural	urban
Akan	65.5	34.5	56.1	43.9
Ga-Adangbe	47.8	52.2	42.9	57.1
Ewe	72.2	27.8	59.9	40.1
Mole-	73.5	26.5	72.3	27.7
Dagbani				
Guan	46.2	53.8	38.9	61.1
GDHS				
Akan	65.8	34.2	42.8	57.2
Ga-Adangbe	53.4	46.6	42.3	57.7
Ewe	69.2	30.8	47.9	52.1
Mole-	74.4	25.6	67.1	32.9
Dagbani				
Guan	53.8	46.2	35.6	64.4

3.4.3 Region and ethnicity

Table 3.4 shows the distribution of ethnic groups in the regions. It can be seen that the Akan live mainly in the Western, Central, Eastern, Ashanti and Brong-Ahafo regions while the Ga-Adangbe live in the Greater Accra and the Eastern regions, the Ewes in the Volta and the Mole-Dagbani in the North. The data also show that the percentage of women of Akan origin (34 per cent in the GFS and 35 per cent in the GDHS) who were reported to be currently living in the Greater Accra region is similar to the Ga-Adangbe respondents who reside in the region (that is, about 32 per cent in the GFS and 37.5 per cent in the GDHS). The ethnic group with the next largest proportion currently residing in the Greater Accra region is the Ewe with about 17 per cent in the GFS and 14 per cent in the GDHS. The main town in the Greater Accra region is also the national capital and is thus cosmopolitan, and most ethnic groups (other than the Ga-Adangbe) who are reported to be currently living in the Greater Accra region are likely to be living in or around the national capital. Apart from urban influences different ethnic groups who live together in these areas are likely to be subject to some cross-cultural influences.

They may adopt or incorporate parts of practices relating to marriage, births and deaths. This may depend on length of residence and even on what generations they belong to. It may also depend on level of education, the particular event and its perception by the adopting individual. For example, some individuals may be influenced by the perceived modernity of a practice. Often, the ethnic groups living together tend to stick to their own ways of doing things, especially those belonging to the older generations, and the extent to which inter-ethnic influences can affect on reproductive behaviour will be subject to a number of other factors.

Table 3.4 Percentage distribution of respondents by region of residence by ethnicity by survey

Survey/Regio	E t h n i c i t y					
	Akan	Ga-Adangbe	Ewe	Mole-Dagbani	Guan	Other
GFS						
Western	79.0	1.1	5.9	5.7	2.2	6.1
Central	80.0	1.9	0.6	1.3	10.8	4.5
G. Accra	34.0	31.8	17.0	3.2	2.6	11.4
Eastern	63.8	18.9	11.3	1.5	2.7	1.9
Volta	2.7	0.2	73.1	0.7	2.7	20.7
Ashanti	83.5	1.2	1.7	6.2	1.4	6.0
Brong Ahafo	84.0	0.8	2.5	5.3	1.2	6.2
Northern	3.4	0.0	0.2	67.7	4.2	24.5
GDHS						
Western	83.	2.0	6.9	5.1	0.3	1.8
Central	81.0	2.6	7.5	1.1	5.2	2.6
G. Accra	35.0	37.5	13.7	5.0	0.8	7.9
Eastern	55.3	19.8	12.4	1.1	7.4	4.0
Volta	0.8	1.0	85.4	0.4	0.4	12.0
Ashanti	85.4	0.6	2.4	5.5	0.4	5.7
Brong Ahafo	72.2	0.4	6.6	12.6	2.6	5.6
Northern	2.0	0.4	1.4	62.8	0.8	32.7

3.4.4 Age, current residence, religion and education

Table 3.5 gives the distribution of the respondents by education, age, current residence and by religion. Only 2 per cent of the older women in the GFS and 4 per cent in the GDHS have 11 or more years of education; however, the trend is increasing as expected.

Similarly, the urban women are better educated at all ages than the rural women: while about 59 per cent of the rural women in the GFS sample are reported to have no education, only about 2 per cent had 11 or more years of schooling. For the GDHS the corresponding percentages are 46 per cent with no education and 4 per cent with 11 or more years of education, which again indicates some increase in education over time, as would be expected.

Table 3.5 Education by age, type of residence and religion

		Level of education			
Variables	Survey Total		None	1-10 yrs	11+ years
Age					
15-24	GFS	29.7	65.4	4.9	42.3
	GDHS	25.1	67.9	7.0	38.7
25-34	GFS	54.6	38.9	6.6	29.6
	GDHS	37.7	52.9	9.4	33.7
35-49	GFS	81.0	17.1	1.9	28.1
	GDHS	62.0	34.0	3.9	28.0
Current residence					
Rural	GFS	59.3	38.9	1.9	66.1
	GDHS	46.4	49.9	3.7	66.1
Urban	GFS	36.3	53.9	9.8	33.9
	GDHS	26.7	60.0	13.0	33.9
Religion					
Catholics	GFS	35.1	59.7	5.2	18.7
	GDHS	27.1	64.4	8.5	17.1
Other Chris.	GFS	35.0	57.9	7.2	46.5
	GDHS	26.6	63.8	9.7	53.1
Moslem	GFS	73.0	25.3	1.4	10.8
	GDHS	67.9	29.9	2.5	9.9
Traditional	GFS	92.4	7.3	0.2	15.9
	GDHS	78.6	21.4	0.0	7.8
No religion	GFS	74.4	25.4	0.6	8.1
	GDHS	67.0	32.0	0.9	12.1
Total	GFS	51.5	44.0	4.6	100
	GDHS	39.7	53.3	6.9	100

More uneducated women are reported among the Moslem, 'traditional' and 'no religion' groups than for the Christians in both surveys, but the proportions are relatively smaller in the later survey. At the other end of the education scale more women among the Christians have reported 11 or more years of education and the trend is generally rising as expected.

3.4.5 Ethnicity and education

Considered next is the level of education among the various age and ethnic groups. From Table 3.6 it is clear that the older women are less educated than the younger ones across all ethnic groups for both surveys and that the Mole-Dagbani have recorded the highest proportions for the no-education category for all ages and consistently for the two data sets. Also the percentages reported for the 11 years and over group are generally higher for women in the 25-34 age group than the 15-24 year group for all the ethnic groups in both surveys except for the Mole-Dagbani in the GDHS and Guans in the GFS. A number of reasons may be given for this: for example this result can be observed if post-elementary education is lagging behind recent population increases, or if through age misreporting a number of 25-34 year olds have been transferred to the younger age group or if the age misreporting is biased towards longer years of education. A more plausible reason is the possible under-representation of the women with 11 and more years since many of these may have been boarding in educational institutions at the time of the surveys (see Ofosu, 1989). In the next section, different indices for measuring the strength of relationships discussed are examined.

Table 3. 6 Age by ethnicity, education and by survey

Ethnicity	Education	Survey	A	G	E	
			15-24	25-34	35-49	
Akan	none	GFS	17.7	43.6	78.9	
		GDHS	15.5	23.9	54.7	
	1-10	GFS	76.9	48.6	19.1	
		GDHS	76.0	65.8	40.3	
	11+	GFS	5.4	7.8	2.0	
Ga-Adangbe	none	GFS	21.4	33.8	66.4	
		GDHS	19.4	23.3	45.4	
	1-10	GFS	67.9	51.0	27.3	
		GDHS	70.6	60.5	49.1	
	11+	GFS	10.7	15.2	6.3	
		GDHS	10.0	16.3	5.6	
Ewe	none	GFS	28.9	45.2	70.9	
		GDHS	26.2	35.0	56.6	
	1-10	GFS	67.5	50.2	28.2	
		GDHS	69.0	52.7	40.4	
	11+	GFS	3.5	4.5	0.9	
Mole-Dagbani	none	GFS	74.0	91.8	97.0	
		GDHS	64.0	83.2	91.0	
	1-10	GFS	23.8	4.8	3.0	
		GDHS	32.2	15.6	8.4	
	11+	GFS	2.2	3.3	0.0	
		GDHS	3.3	1.2	0.6	
Guans	none	GFS	37.2	62.3	87.3	
		GDHS	17.1	19.4	55.3	
	1-10	GFS	60.3	35.8	10.9	
		GDHS	82.9	64.5	42.1	
	11+	GFS	0.0	16.1	2.6	

3.5 Measures of the strength of association among background variables

The analysis in the preceding section indicates important associations among several background variables. More educated women are found for the Christian religion in both surveys than for all other religious groups. It has also been noted that if there are statistically significant associations among the variables, these will influence results of multivariate analyses involving such variables. In the following section, measures of the interrelationships between pairs of selected background factors are obtained. First, a description of the nature of variables which determine which measures may be

appropriate for particular pairs of variables are presented. The coefficients reported in Table 3.7 are obtained using the SPSS package.

3.5.1 Nominal and ordinal variables

The background variables discussed are either nominal or continuous and continuous coded as ordinal, for example age and years of education. The statistics that are usually used to determine association between nominal and ordinal variables are briefly discussed. Our interest is to determine whether any of the background variables in the study are related and what the strength and nature of the relationship is. For example, if education is related to residence we wish to determine how strong this relationship is. The chi square statistic shows whether two variables in a cross-classification are independent or not, but they do not give insight into the nature of the relationship. The chi-square value gives little indication about the strength and type of association between the two variables. Furthermore this statistic is influenced by the size¹ of the sample and hence it is not very useful for use with different data sets having different sample sizes (see Norusis, 1988).

For describing and comparing the association between nominal variables for the two surveys, measures based on *proportional reduction in error (PRE)*, which are based on how well a dependent variable can be predicted when the value of an independent value is known, are used. With this measure the error made in predicting values of one variable based on the values of another is compared with the error made in predicting the values of the one variable without considering the information on the other. The statistic measures how much decrease in error rate is achieved by using information on the second variable to predict the first one. If there is a perfect relationship between the variables, knowing one will lead to a perfect prediction of the other, for example, if the

¹ The application of the chi-square based Cramers V to the analysis of the associations between background variables for this analysis yielded highly significant results of variables considered.

statistic is zero, then the independent variable is not useful for predicting the dependent one.

If neither of the variables can be considered as dependent and the other independent, a symmetric *lambda* coefficient is appropriate and the first variable can be predicted from the second, and vice-versa. To obtain the symmetric *lambda*, the sum of differences resulting from misclassification when the first variable is predicted with and without information on the second, and when the second is predicted with and without information on the first, is divided by the total number of cases misclassified in the absence of any additional information (Norusis,1988).

The order information that exist for variables may be used to obtain the direction of association in addition to its strength. Thus if the variables have an order, one can talk about increasing or decreasing values of the relationship between them. A measure of association which takes into account the order information available in the variables in a cross-classification is the Goodman and Kruskals *gamma*² (Norusis, 1988). This statistic measures the proportion of qualitative variation in a dependent variable contingent upon its association with an independent variable. If the two variables are statistically independent the *gamma* statistic takes on a value of zero; however, where all the cases within a category of the independent variable also belong in one category of the dependent variable, the statistics take on the value of one. With the symmetric variant of this statistic the *i*th variable is predicted half of the time while the *j*th variable is also predicted half of the time, using proportional prediction and therefore eliminating the need to guess which of the variables is dependent on the other in their association

Both the symmetric *lambda* and the Goodman and Kruskals *gamma* measures were obtained using the SPSS package. The measures are presented in Table 3.7. Measures

² The Goodman and Kruskal's *gamma* gives not only the measure of the strength of the relationship but also the direction. For example, when the values of one variable increase while the values of the other also increase, a positive value is obtained. On the other hand, if the values of one variable increase while the values of the other decrease, a negative value is obtained for *gamma*.

for the relationship between 'age', 'years of education' and 'place of residence' are based on *gamma* since there is a sense of ordering in these classifications.

Table 3.7 gives measures of association between pairs of background variables in the samples. The association between education and type of place of residence and that between age and education appear to be quite strong and similar across data sets: the measure of the strength of the relationship between education and age is -0.58 in the GFS and -0.40 in the GDHS; that between education and place of residence is 0.45 in the GFS and 0.42 in the GDHS. These figures suggest that there is considerable association between education and age and that this association is inverse in that the younger women tend to be more educated than the older ones.

Table 3.7 *Lambda* and *gamma* measures* of associations between pairs of independent variables by survey

survey	ethn & educ	relig & educ	region & ethnicity	resid & relig	ethn & resid	age & resid	age & relig	age & educ	resid educ
GFS	0.19	0.18	0.35	0.02	0.01	-0.09	0.02	-0.58	0.45
GDHS	0.10	0.16	0.34	0.00	0.05	-0.06	0.01	-0.40	0.42

* The coefficients for age and current residence, age and education, and residence and education are *gamma* coefficients.

The data also suggest a fairly strong association between region of residence and ethnicity, the *lamda* value being 0.34 in the GFS and 0.35 in the GDHS. The association between religion and ethnicity, religion and education, and ethnicity and current place of residence appear less strong with the *lambda* value being below 0.2 for each pair of variables. These results are generally as expected. For example, the inverse relationship

between education and women's age in Ghana may be deemed to be reasonable, partly because of the relative recency of formal educational opportunities and partly because once introduced, the level of formal education tends to rise till it becomes universal.

3.6 Conclusion

This chapter has examined selected background variables that will be used to explain differences in dependent variables relating to aspects of reproductive performance contained in the GFS and the GDHS data. It has been noted that some original categories that were provided on the data files had been regrouped. Grouping or regrouping of explanatory variables in surveys often has some arbitrariness and may also lead to the loss of information. But this must be seen against the resulting simplification in the computation and interpretation of multivariate models. It may also become necessary to avoid the occurrence of small subgroups and subsequent unstable parameter estimates. Finally, we note that different categorizations can result in the observation of different relationships, hence the need to obtain uniformity for categorizations across the samples.

The analysis in this chapter has shown evidence of significant associations among some of the background variables used in this study. For example, education and place of residence, education and age, and region and ethnicity show statistically significant associations. It is reasonable to expect in general that, because of differences in opportunities and aspirations, women in urban areas will be more likely to spend more years in formal education than rural women thus making education increase with the degree of urbanness. On the other hand, predictive associations between place of residence and religion and education and religion are shown to be weak. Although many of the associations may not be of any substantive interest, knowledge of them may become useful for gaining insight into possible joint effects that they may have on dependent variables of interest.

It is also found that the measures of correlation between the pairs of variables examined are generally similar across the surveys. For example, the association between age and place of residence, age and education and place of residence and education show similar magnitude and direction. For the association between residence and education, for example, this means that in both surveys, there is a fairly good chance that the more educated a respondent is, the more likely it is that she is located in the urban area.

CHAPTER 4

ASPECTS OF DATA QUALITY

4.1 Introduction

The effects of the problems associated with data quality, particularly for comparative studies are well recognized. For example, as has been noted in Chapter 1, some differences that are observed in several comparative studies for common factors can be attributed to problems of measurement and data quality. The purpose of this chapter is to examine aspects of data quality and to assess the consistency of the data for comparable cohorts from the GFS and the GDHS data sets by comparing events that are covered by both surveys for comparable cohorts of women. The chapter also discussed the sources and the nature of some of the common problems that are usually associated with surveys. Examples of problems considered here include those that arise from inaccurate measurement or the inability to correctly measure relevant variables. Other types of problems deal with the limitations of single cross-sectional surveys and the merits and demerits of the use of multiple surveys for measuring change.

4.2 Sampling and non-sampling error

Two sources of error, sampling error and non-sampling error, are usually associated with any survey data. Sampling error originates from the fact that data were collected from only part of the population. The magnitude of this error is a function of the size of the sample and for large sample surveys, it is relatively unimportant. It however increases with diminishing sample size, so that the smaller the subgroup being looked at, the larger the sampling error. As the researcher pushes for more detail by way of continued breakdown of the survey results, sampling error increases. Non-sampling error depends

on the variable being measured and also on the method of questioning. Recall of dates, especially among the older respondents, may be associated with larger error (see Andrew et al., 1992). But questions on ethnic group or religious affiliation, for example, would have very little non-sampling error, especially when the answer categories are read out to the respondents. However, as noted in Chapter 3, these and many other variables that are obtained in surveys of human populations are proxies and as such their accuracy also depends on how closely they approximate the concepts that they represent.

Non-sampling errors are more likely to be important in large-scale surveys. In general these involve any errors in the observation process ranging from the stage of planning for data collection to the stage of data analysis. These include interviewer error through misinterpretation, improperly designed questions, respondents' misrepresentations of the actual situations either deliberately or through lapses in recall, and errors originating from data processing. Of these sources of error, the respondent-based errors are perhaps least under the control of the data collection machinery. For fertility data they are also probably the ones that most significantly affect the analysis of reproductive change. Thus, close attention must be paid to these reporting errors, such as misreporting of background variables, omissions, and misdating of births, infant and child deaths and other fertility-related events particularly in African surveys. Aspects of these problems are now discussed with respect to the GFS and GDHS data sets.

4.2.1 Quality of age data

A number of studies of errors in age estimation have suggested substantial problems in age estimation in West Africa (Caldwell, 1966; Caldwell and Igoun, 1971; Paulet, 1974). Age misreporting consists of rounding or preference for ages ending in certain digits and the avoidance of ages ending in others, and systematic mis-statement of ages of women in certain age categories. Caldwell (1966) showed evidence of bias towards overstating the ages of children up to six years old; he suggested that the tendency to round off ages

rather than truncating them to the number of completed years is a possible explanation for the exaggeration in the children's age. Caldwell and Igoun (1971) noted that the number of children will affect age estimation since the age of young females with no children is often underestimated. Other studies have found that education has a positive effect on the error in age estimation, and that proxy reporting of age leads to poor age estimation (see Byerlee and Terera, 1975).

The extent of digit preference or avoidance can be determined by examining the deviations between expected and observed terminal digits, and the overall degree of rounding by the Myer's index. For the GFS data Owusu (1984) reports evidence of preference for ages ending with digits 5, 0, 2, and to a lesser extent 4. Preference in the ages ending in 0, 5, and to a lesser extent 2 and 8 was reported for the GDHS data. Ages ending in digits 1, 7 and 9 tended to be avoided (Ghana Statistical Service, 1988).

A commonly used procedure for checking the accuracy of data is to compare them with relevant data from external sources. For example, survey data may be compared with related census data. However in a comparative analysis of several data sets from different surveys, comparisons with external data source are meaningful only if they can be made with a common external source. The GFS is based on the 1970 census while the GDHS is based on the 1984 census. Thus the comparison of selected data in the two surveys with data from the respective censuses on which they were based can only give an idea of how closely the surveys estimate corresponding values in the respective censuses. From the data in Table 4.1 Appendix B, it can be seen that both the GFS and the GDHS fairly closely estimate the percentage distribution of women in the reproductive age groups as obtained in the respective censuses. The differences for the GFS range from an underestimate of 2.6 percentage points for the 30-34 age group to an overestimate of 3 percentage points in the 15-19 age group. For the GDHS, the differences range from an underestimate of 2.5 percentage points for the 15-19 age group to an overestimate of 1.3 percentage points for the 25-29 age group.

Errors in age reporting may also lead to under or over-estimation of women in certain age categories. When erroneous reports of age on the household schedule of women occur near the boundaries they lead to biases of eligibility for inclusion in the fertility questionnaire. In order to estimate the amount of exclusion, age and sex ratios are calculated for the five-year age groups straddling the boundary ages. If women have been displaced from cohorts just inside the boundaries to cohorts immediately outside, the age ratio for the former will be low and the sex ratio will be high provided that males have not been selectively displaced in the same way; the reverse will be true for the cohorts just outside the boundaries. In the GFS, the age ratio for this group is a little less than 90. A more refined index, combining the upper and lower boundary effects allowed classification of countries by the degree of the boundary effect: the GFS was indeed classified as having a strong boundary effect (see Singh, 1987). A closer analysis was made to determine which age groups were deficient or excessive. Ghana was among countries that had no problematic five-year age groups or only had a deficiency in the oldest or youngest group. A common error was that the 45-49 group was deficient, and also that the 30-34 group was deficient. In contrast the 25-29 cohort was much more likely to be inflated than deflated in size.

Arnold (1990) found that the degree of total boundary effect distortion was greater in the GFS than in the GDHS. He also found that lower boundary exclusion effect was greater in the GFS but the upper boundary exclusion was greater in the GDHS. Rutstein and Bicego (1990) obtained indices for age-group distortion for the age range 25-29 to 40-44 for the GDHS and GFS and observed that the index for the GDHS is 10 points higher than that for the GFS and concluded that age reporting was better in the GFS. Similar comparisons are discussed elsewhere in the thesis. There do not appear at present to be clear procedures for relating these errors to the effects on comparative analytical statistics. There is however evidence of the distorting effect of measurement error in the literature (e. g. Hauser and Goldberger, 1971; Bohrnstedt and Cater, 1971). Schoenburg (1980) noted that such errors can destroy any gains in delineating comparable samples. The extent and exact effect of these on comparisons are difficult to

determine. By comparison of intervals for selected overlapping segments of the data in both surveys, some insight may be obtained about these differential survey effects; otherwise they are confounded with any real differences that may exist and must be borne in mind in the interpretation of results of an analysis.

Ewbank (1981) observed that two types of basic patterns of distortion caused by age mis-reporting and age selective omission had been identified through stable population analysis: the first pattern is typical of African and Southern Asian populations while the second is typical of Latin America. The African pattern for females showed a surplus at 5-9 and a deficit at 10-14 and 15-19 followed by a surplus in the main childbearing ages between 25 and 34. The observed patterns were attributed to the tendency to exaggerate the ages of children between 0 and 4 years and of girls between 10 and 14 who have reached puberty, and the tendency to understate ages of those who have not; and finally the tendency to exaggerate the ages of women between 15 and 25 to be consistent with marriage and fertility. According to Ewbank, these analyses do not show detailed knowledge of the reasons for the distortions nor is there adequate information about the impact on analytical techniques other than stable population analysis.

Ewbank (1981) also noted, however, that ages of infants and children are more likely to be accurately reported than those of adults because the ages of the former are reported by parents or adults who remember them and also because the rapid physiological and psychological changes during childhood make it easier to guess children's ages with reasonable accuracy.

Some problems associated with age reporting necessitate age imputation, which is an important step in the management and cleaning of demographic survey data. Trussell (1987) noted however that its proper application depends on knowledge of the form of reporting which is common in a given society (reporting in rounded, completed or projected years), and the wrong assumption can cause errors. However, he showed by means of simulation experiments that imputation made less difference to general

substantive conclusions than to quantitative results. He suggested that the use of procedures that reflect real reproductive behaviour would prevent the introduction of systematic bias. In comparing data from different surveys different imputation strategies are a potential source of additional bias. Furthermore, differences in the extent of imputation in the surveys, whether involving the same or different strategies, are also likely to affect the analysis.

Since the focus of this study is on birth intervals and age at first marriage and first birth, the discussion of problems of the quality of data deals mainly with the types of error that are more likely to affect these events. For example, problems related to age recall and estimation are relevant to the analysis of age at first marriage, age at first birth and birth interval analyses, particularly those related to the age of the mother. Also, omission of births and the misdating of births affect birth interval data and any differences in the extent of these problems between surveys may affect comparative analysis.

4.3 Quality of birth reporting

Since misreporting of dates of births is due mainly to the difficulty of recalling events in the past, it is often worse among older women or among women with several children or for early births, which are further back in time. Recent births are likely to be dated more accurately, even by older women, because of the recency of the events, but also because errors would produce relatively large age misstatements of young children. Displacement in which births are moved forward, closer to the date of the survey, called the 'Potter effect', results in a concentration of births in the period 5-15 years before interview. There is therefore an apparent rise in fertility in earlier periods, followed by a decline in more recent periods.

Another common finding in retrospective fertility data is that the more distant births from the date of the survey are more prone to error, often because of greater recall lapse. Since birth-history data in fertility surveys are usually recorded in a chronological

sequence starting with the first birth, misdating of this birth may lead to adjustments in the dates of subsequent births in order to maintain a correct interbirth interval. This may involve moving all births systematically in one direction either towards or away from the interview, or introducing compensatory adjustments in the dates of subsequent births in order to correctly place the more recent births. The resultant distortion in the birth-history data is expected to be positively correlated with the degree to which exact month and year of birth are not available for the recorded births. Potter (1977) and others have noted that if the birth-history record was obtained by recording information for the last birth first, misplacements of the last birth away from the date of interview might result in impossibly low ages at first birth.

There is some evidence of birth misplacement from the comparison of data from the GDHS and the GFS data sets. The GDHS suggested that some births were shifted to the years 1979 and 1980, eight to nine years before the survey. The First Report for GDHS notes that these years were probably used as reference points for dating births as Ghana experienced dramatic political and economic changes in those years. The GFS recorded a small fertility decline in the five year period before the survey. The GDHS data support the findings about underestimation of infant and child deaths in 1979 and this could be a factor in the higher fertility rates it recorded for this period.

4.3.1 Omission of births

There are several techniques for the detection of the effect of omission in fertility data: for example, the examination of sex ratios for societies in which sex preference is known to exist, comparison of the proportion of children reported dead according to the age of mother, and plotting mean numbers of children ever born against age at interview. The rationale for this procedure is that unless numerous deaths are known to have occurred in the recent past, these proportions are expected to rise with the mother's age or else children who died young may have been omitted.

The evaluation results of the birth-history data in both the GFS and the GDHS suggest that both surveys are generally of good quality (see Singh, 1987; and Arnold, 1990). However, a number of differences in data quality have also been noted. For example, completeness of reporting of children's dates of birth is much better in the GDHS than in the GFS, as only about 25 per cent of reported dates of birth require imputation in the GDHS while about 37 per cent had to be imputed in the GFS (Arnold, 1990). Arnold suggested that the likely reasons for the difference in the completeness of birth reporting in the two surveys are the effect of improvements in educational attainment, modernization and increased emphasis on age and timing of events, leading to better knowledge of age, and finally the pressure on the GDHS interviewers to obtain a date for each child even if the respondent could not easily give the answer at first.

Problems associated with the quality of birth-interval data arise mainly from incorrect dating of births because respondents have either forgotten the exact timing of these events or deliberately lie about them. Misreporting of dates of births and deaths, and dates of starting and ending marriages, and omission of birth events constitute important sources of error in birth interval data. For example, omission of births and misdating of reported births within the same survey may lengthen or shorten birth intervals. However, misdating of events produces biases only when it displaces events in particular directions. Also imputations of marriage data can affect the first birth interval data.

4.4 Quality of data on exposure to the risk of childbearing.

Two events which are used to mark the start of exposure to the risk of childbirth are age at first intercourse and the start of marriage. The use of the start of first marriage to mark the onset of exposure to the risk of childbearing is considered largely valid only where childbirth outside matrimony is either non-existent or insignificant. In addition, where there are significant sexual relations before ceremonies formally marking marriage

are performed, the risk of exposure will be underestimated. Marriage is performed in stages among certain ethnic groups in Ghana and the point at which sex within marriage starts is open to individual interpretation. Consequently, the dates or ages at which this event first occurs do not represent the same thing among the various respondents (see Meekers, 1991). Also since fertility data are obtained for women aged 15 and above in both samples, they are biased against women who marry before age 15. In the GFS data 12.3 per cent of the respondents were recorded as having married before age 15. The alternative use of age at first intercourse to mark the start of exposure to the risk of childbearing is not possible in this analysis since this information is not available for the GFS. The problem of age at first marriage is dealt with further in Chapter 5.

4.5 Problems of differential data quality

The errors discussed derive mainly from the retrospective nature of the surveys and the dependence upon the recall of events and dates of events in the past; they are generally common among populations with low levels of modernization. Knowledge of the exact date of birth in many parts of the developing world is likely to be uncertain and therefore this is often incorrectly reported. In the absence of effective systems of registering births and where little importance is attached to knowledge of exact age, there is often only a weak basis for reckoning increment in age with time (see Singh, 1987; Owusu, 1988).

These problems are present to various degrees in all large-scale fertility surveys. Some, for example truncation effects, can be reduced by using appropriate demographic controls and appropriate time restrictions on the data to be analysed. There are, however, no general procedures for dealing with most of these types of errors. The main reason for alluding to them here is to emphasize that to the extent that they are present in any data, findings from the analysis of such data need to be interpreted with care. For multiple surveys it is desirable to assess the comparability of the surveys when possible. It is important to determine whether possible differences in the dependent variables or differences in effects are confounded with or distorted by differences in the survey. Swicegood, Morgan and Rindfuss (1984) noted that when most people compare data in

one survey with those in another, they usually proceed as if these differences do not exist.

The organization of the GFS and the GDHS involved several steps that were designed to minimize the incidence of reporting errors. These include efforts in questionnaire development, training of field staff, and data cleaning. In the GFS, questionnaires were translated from English beforehand into the main local languages to limit errors that might arise from on-the-spot translation by interviewers. Pretests were also carried out to evaluate the efficiency of translations, interviewing problems and respondent reaction to 'sensitive' questions.

Editing of the GFS data involved both manual and machine methods. In the field, supervisors conducted checks to ensure that only eligible units are included in the sample. Furthermore, reinterviews were done to assess quality and consistency of reporting. Efforts were also made to obtain important missing information for dates of births, inconsistent birth intervals and so on. Office editing involved checking for completeness and consistency of identification, birth history and date and age information. The Data Editing, Imputation and Recoding (DEIR) program was used to check for the consistency of union and birth histories and to impute values for missing calendar months. Procedures for the GDHS were similar to those in the GFS in several respects.

These efforts do not however, completely eliminate errors from surveys. The magnitude of errors that remain in the data will be different from one survey to the other. Therefore if any two surveys are to be compared, biases will result if significant differences exist in the data as a result of these errors. Even though methods do not exist for the moment to determine what proportion of discrepancies in conclusions drawn from multiple data sources is attributable to which error sources, it is still possible to use checks for these errors to decide how comparable is the information in the data sources.

4.6 Comparability of data in the GFS and the GDHS surveys

The limitations of single cross-sectional surveys (CSS) in the measurement of change in socio-biological phenomena like fertility and intelligence have been discussed widely in the literature (see Baltes, 1968; Balan, Browning and Telin, 1973; Davis, 1987). An important aspect of the problem is that by the nature of their design these surveys normally provide only one observation per subject. Problems that derive from this are well known: for example, the confounding of cohort and age effects when one is interested in age-related functions. There are also such problems as the determination of the direction of causation and spurious effects caused by failure to collect data on all relevant variables (see Davis, 1987).

As a partial solution, data on sequential behaviour can be obtained in a retrospective manner in cross-sectional surveys; fertility data are often collected in this way. But budgetary constraints and considerations of feasibility impose limitations on the scope for detail as well as for operations to minimize error (see Caldwell, 1985). Thus the constraints for particular surveys determine the quality of data obtained. Reference was made to the usefulness of multiple surveys for measuring change. However, when sequences of surveys are used to measure change, the analysis can be contaminated by the differences in data quality which are reflections of the varying conditions of data collection.

4.6.1 Limitations of CSS for measuring change

Single cross-sectional survey data have several limitations for measuring change. These include problems of possible confounding of age and cohort effects, direction of causation as well as problems due to omitted variables. Age effects are generally studied by the examination of samples of different age levels in order to obtain age-functional

relationships. For the cross-sectional method, samples of different ages are observed for the same dependent variable at the same time of measurement, and the group differences are attributed to age. This is valid if the differences between age groups can be interpreted exclusively as age effects (see Baltes, 1968). But methodological problems posed by selective survival and generation effects cause the different age samples to differ with respect not only to age but also to several other factors. The errors that arise from generation effects impair the internal validity of cross-sectional studies. If cohort effects are present, cross-sectional age differences in samples will be confounded with cohort effects. These cohort effects thus become alternative explanations for the sample differences and may or may not occur in the same direction or to the same degree. An example is synthetic life tables that are constructed from current age specific mortality rates on the assumption that these rates vary only by age but not over time; according to this assumption, the cohort of men who are currently aged 30, for example, will after 20 years have the mortality rates of those currently aged 50 (see Balan et al., 1973; Davis, 1987).

Another problem with CSS data is that it is not always possible to determine the direction of causation when such a relationship is observed. An example of the problem of direction of causality for duration data that are obtained in cross-sectional data is that as the duration of unemployment increases, those with moderate ill-health problems will become under-represented while those with severe health problems will be over-represented. A cross-sectional study may therefore indicate that unemployment causes severe ill-health (see Elandt-Johnson, 1980).

Other problems may arise as a result of omitting relevant background variables from the study. When observational data are used to decide whether there is dependence between two or more outcomes, statistical control by means of disaggregation is used to eliminate spurious effects that may be caused by both outcomes being the result of other common outcomes. In cross-sectional data, it is not possible to control for all the other potential causes of the relationship observed (see Goldthorpe et al., 1968; Warr, 1984; Main,

1985). Spurious relationships occur when a variable that is correlated between outcomes, or an outcome that influences the observed outcome, is omitted from the analysis.

The preferred solution to the collection of data on changing phenomena is the use of survey designs that incorporate repeated observations on the same units. However, such designs are difficult and costly to implement and the resulting data often difficult to analyse. A commoner approach is to collect such data in retrospect. But such historical data on changing behaviour in cross-sectional surveys only partly solve the problem. It is not usually possible to obtain the required details on the changing levels of covariates. Neither is the information recalled after a period of time always a reflection of the true state of affairs.

With regard to fertility information, however, the collection of birth histories is important. They give demographers the opportunity to analyse the effect of intermediate variables on fertility data as a sequential and time dependent process. This enables a better analysis of the effect of intermediate variables (see Rindfuss, Palmore and Bumpass, 1982). But the precision of these analyses depends on how accurately the required events have been recalled.

4.6.2 Advantages of successive fertility surveys

Caldwell (1985) noted that comparison of data in fertility surveys with a second round of surveys will provide a better opportunity for measuring fertility decline, because such comparisons will be able to show changed patterns of childbearing. Sequences of such surveys that contain birth histories provide very good opportunities to study recent trends since the second survey offers a second chance to view the cohorts that were first seen in the first survey. It is also possible to examine the extent to which there have been changes in fertility, particularly changes that are not attributable to changes in

explanatory variables that may vary over time (Chesher, 1985). Also, a series of cross-sectional surveys can be used to estimate transition probabilities which may be either cross-sectional or hypothetical cohort multistage life tables which can be used to examine fertility change over time. Whatever the desirability of combining sequences of cross-sectional surveys for a better evaluation of trends as well as differentials, this can only be effective if related data in the surveys are consistent (see Swicegood et al., 1984).

When data are pooled from two or more surveys for analysis, differences in data quality may be confounded with differences in the multiple data sets or they may vitiate any comparisons made (Swicegood et al., 1984; Pullum et al., 1987). Several studies of similar phenomena from multiple data sources have shown that differences in methods of data collection and processing can produce conflicting results about common study phenomena (see Smith, 1978, 1982; Turner and Krauss, 1978; Santi, 1980; Swicegood et al., 1984). These inconsistencies may result from differences in question wording and order, sampling, interviewer training, and field supervision.

The degree of inconsistency depends on the subject matter. The relevant research indicates that although subjective social indicators have reasonable reliability (see Sudman and Bradburn, 1974; Smith, 1982) those that are ambiguous can produce high levels of discrepancy (Turner and Krauss, 1978). On the other hand, objective phenomena and inventory-type questions are less likely to be affected by study effects.

Discrepant results in sequences of surveys may be due to sampling variation and non-sampling error. Sampling variability gives different results in the sense that every sampled individual contributes a different value to the measurement of the phenomenon of interest and different individuals get selected into the different possible samples. Data quality problems constitute non-sampling error. Finally, if the surveys are conducted at different points in time, an additional source of discrepancy may be real change in the phenomenon. These differences resulting from change over time will depend on the

nature of the phenomena under study and in several instances can be controlled for. In the case of fertility change such a control may be effected by restricting the analysis to the same time-defined cohorts (Swicegood et al., 1984).

Surveys carried out by different institutions and people are more likely to differ in their mode of execution and the associated errors. These study effects will depend on the extent of differences in coverage, response rates, ways of obtaining similar data, imputation and editing procedures.

Techniques for comparing the imprecision and biases of measurements by one measuring instrument with another by means of statistical tests of significance are well developed in the physical sciences (see Grubbs, 1973; Christensen and Blackwood, 1993). Assessment of the instruments is usually based on data obtained by using each instrument to measure a common set of items, and the quality of measurement is evaluated in terms of the precision and accuracy of the different instruments. The extension of these concepts to surveys usually requires that the same units of observation be surveyed in the multiple surveys to be compared. In sequences of surveys where the units of observation are not necessarily the same the surveys may be examined for consistency by checking for the presence of significant study effects by a systematic comparison of results across the surveys. If possible, common items may be defined for observations in such a way that any differences can be attributed to sampling error or to the circumstances of the conduct of the survey. Often, biases may be minimized by careful identification of areas of major differences and where possible restricting the analysis to comparable segments of the data.

Swicegood et al. (1984) suggested that although demographic behaviour is an objective phenomenon, because such relevant indicators as fertility, marital and contraceptive histories are often obtained retrospectively, the accuracy of the reports tends to decline over time and thus data obtained from comparable samples at different periods in time may produce inconsistent results. They noted that if differences in survey results due to

study effects or response error were insignificant or absent, and if the effect of sampling variability was negligible, then by restricting different surveys to the same cohorts and the same retrospective questions about early life-cycle events, one ought to get similar results. They compared several aspects of first-birth timing, for the same birth cohorts in several surveys. The samples were constrained such that the particular cohorts of interest and the fertility events included were those that could have occurred before the earliest of the surveys. The test for the consistency of mean levels involved the application of appropriate statistical tests. For example, to determine the consistency in the effect of independent variables, their interaction terms with the survey variable coded as a dummy variable were tested for statistical significance in regression models.

4.7 Data and methods

4.7.1 The data

The type of fertility-related data collected in the GFS and the GDHS surveys was comparable and included respondent's demographic and social background, maternity and marriage histories, breastfeeding, contraceptive knowledge and use, marriage, fertility preferences, background work of women as well as husband's background. A complete live-birth history was also obtained from each respondent including the sex and date of birth of each child, its survival status and if dead, age at death. Data on age at first intercourse were, however, collected only in the GDHS. Event-history data were obtained retrospectively in each survey.

Even though these two surveys were conducted under the auspices of the same local statistical organization, they differ in certain respects. For example, they differ with respect to sampling frame in point of time, the time of the survey and also the principal investigator. The GFS relied on the 1970 census while the GDHS relied on the 1984 census to provide a sampling frame.

4.7.2 The method

The concern is about net aggregate shifts and not individual level consistency and the problem is to determine whether survey effects significantly contribute to differences in the observed fertility experience. As noted, discrepancies in the results of successive surveys can occur because of sampling and non-sampling errors as well as real change in the phenomenon under observation. Following Swicegood et al. (1984), it is assumed for this analysis that sampling error is not significant in view of the considerable sample

sizes. The possibility of real change is controlled for by restricting the analysis to the same birth cohorts in the two surveys.

The analysis is restricted to women who are eligible to be included in the two surveys, that is women who were born between the years 1939 and 1964. Women born in 1939 were 40 years by the date of the 1979 survey and 49 by the time of the 1988 survey. Also, women born in 1964 were 15 and 24 respectively. For the second restriction, only those fertility events that occurred before 1979 are considered. Selected fertility events which were dated on or before 1978 were analysed for birth cohorts 1939-1964 that were covered in both data sets. In addition, for events that were analysed for specific ages, the analysis was further restricted to women who were old enough to have attained these ages by the time of the earlier survey. For example to consider the probability of a birth by age 30, the analysis is limited to women who were born before 1949 so that they are at least 30 by 1979. The importance of these restrictions is to obtain similar average exposure for comparable cohorts.

The following indicators of fertility experience were chosen as dependent variables: age at first marriage, age at first birth, and the first to the sixth birth intervals. The choice of independent variables is largely influenced by their reported effects in the literature on fertility determinants. Also, it was considered necessary to include in the analysis only those variables that are comparably measured in both surveys. Where coding for any of the selected variables differs, these have been recoded to ensure uniformity. Five independent variables are considered for various models: religion, ethnicity, years of education, residence, and survey.

4.7.3 Statistical test procedures

For statistical procedures for testing for significant shifts in mean levels the analysis of variance technique was applied while for the testing of study effects for covariates

dummy regression was used. Applications of the dummy regression to compare or test the equivalence of several sets of results or replication by treating the group or sample as a dummy have been reported in the literature (Gujarati, 1970). In particular the procedure can be used to determine whether all intercepts and slope coefficients are the same or whether only the intercepts or only the slopes or both differ in several regressions. Data requirements for the dummy regression are a dependent variable measured on at least the interval scale, one or more independent variables whose values are in the form of categories, or interval variables that have been transformed into a set of categories.

The intercept parameter in the regression model for the dummies represents the population mean of the dependent variable and the Beta coefficients denote differences between this mean and the means of the subpopulations represented by the cells. The dummy variable is introduced in both additive and multiplicative forms. The latter is denoted by a cross product term which denotes an interaction term. The coefficient for the additive dummy term is the differential intercept while that for multiplicative forms denotes the differential slopes. The additive and multiplicative dummies therefore make it possible to determine whether the two regressions differ in the intercept or slope or both. If the differential slope and intercept are significant it implies that coefficients for the first set of data are different from those of the second.

In the present application, a dummy variable was created to denote 'survey'. Also, all the independent variables were recoded as dummies. For each of these variables, a regression model involving the dependent variable, the dummy variable for survey and an interaction term between the two was fitted using SPSS. Tests for individual coefficients as well as groups of coefficients were obtained. Only the results for interaction terms of the survey variable and each of the independent variables are presented. The interaction coefficients indicate the extent to which the effects vary by survey.

4.8 Results

4.8.1 Shifts in mean levels

Table 4.1 gives values for mean age at first marriage and first birth as well as average interval lengths for the first to the sixth closed birth intervals by survey. The results suggest significant shifts in the average levels of, particularly, the earliest events.

Table 4.1 Showing comparison of selected fertility indicators by survey

	Mean age first marriage (years)	Mean age first birth (years)	B i r t h		I n t e r v a l s(mths)			
			1	2	3	4	5	6
GFS	17.45	18.93	19.29	34.68	34.32	34.20	31.95	32.82
GDHS	17.14	18.36	14.21	33.58	32.21	31.72	32.10	31.77
T-stat	3.49	5.80	6.54	1.82	3.21	3.28	0.01	1.04
Prob.	0.001	0.000	0.000	0.100	0.010	0.010	0.925	0.200
N	5873	5284	5481	3968	2913	2034	1399	882

For example, statistically significant differences are observed for the average age at first marriage ($p < .001$), first birth ($p < .00$) and the first birth interval ($p < .00$). Similarly, the third and the fourth birth intervals are also significantly different in the two surveys. However, the second, fifth and sixth intervals are not differently measured in the two surveys.

While the results do not follow any clear pattern, the evidence indicates statistically significant differences in the measurement of the earliest of the events examined here. This finding is consistent with what is expected for the recall of retrospective data. The more distant events are less likely to be recalled reliably. The problem of dating of first marriage in Africa because of its processual nature (see Meekers, 1992) further complicates the issue of the quality of the data on the age at first marriage and the first

birth interval. The observation by Meekers (1991) that premarital births are possibly underestimated in the GFS has been noted. About 6.9 percent of first birth intervals in the GFS and 8.2 percent in the GDHS are negative. For the GFS this corresponds to 19.3 percent for women aged 24 years or less, 17.7 percent for women aged between 25 and 29 and 63 percent for women aged 30 years and above. The corresponding figures for the GDHS are: 14.9 percent 22.5 percent and 62.5 percent. These data suggest that the occurrence of negative birth intervals is largely due to inaccurate recall of dates of the marriage and first birth events which is likely to be most common among the older cohorts. Differences in the measurement of these data are another possible source of the inconsistency that has been observed. The analysis therefore examined other segments of the first birth interval. First all negative birth intervals were excluded: with this restriction, the mean interval for the GFS was 23.3 months while that of the GDHS was 20.5 months, which showed a considerable narrowing compared with the averages including the negative birth intervals. This improved difference is, however, still significant ($p < .00$). Finally, the analysis was arbitrarily restricted to intervals which occurred 12 or more months after marriage. For the GFS data an average interval of 29.3 months is obtained and the GDHS data yielded an average of 28.5 months. The difference of 0.8 of a month is not statistically significant ($p < .37$).

The results for the higher intervals are not consistent. The aggregate shifts in the average levels of the third and fourth intervals are statistically significant while those of the second, fifth and sixth intervals are insignificant. This means that the latter are consistently measured in the two surveys.

4.8.2 Consistency in covariate effects

The next issue to be addressed is whether or not the effects of various covariates are consistent across the surveys. Differences in question structure, content and understanding can give rise to significant differences in effects obtained for comparable variables. It is also possible for change to occur in the effect of certain variables over time. This is likely to be the case with variables like education or residence status that can change over time. If analysis is restricted to comparable cohorts, such changes are in effect minimized. Table 4.2 gives results for tests for various interaction terms for the dependent variables, age at first marriage and age at first birth and the first to the sixth birth intervals and the survey variable.

The data in Table 4.2 indicate remarkable consistency in the measurement of the covariates. Only ethnicity, religion and years of education are marginally significant for age at first marriage. The effect of ethnicity, religion, education and residence are shown to be consistently measured for the age at first birth and the first to the sixth birth intervals. These results show further evidence that age at first marriage may not have been consistently measured in both surveys. It could be concluded that there is considerable consistency in the measurement of the fertility events that are considered in this survey.

Table 4.2 F-statistics for Study effects for predictor variable for the selected fertility indicators

	Age at first marriage (years)	Age at first birth (years)	B i r t h		I n t e r v a l (mths)			
			1	2	3	4	5	6
Covariate								
Ethnicity	6.37 ^a	2.48	3.07	1.58	1.34	0.62	0.49	2.09
Religion	8.54 ^a	2.60	2.96	0.72	0.10	0.65	0.59	0.95
Educ(yrs)	3.06 ^a	1.10	3.37	3.56	0.06	0.80	0.87	1.56
Residence	1.88	0.01	5.26	0.12	0.50	0.01	0.00	0.24

^a implies significance at .05

4.9 Conclusion

This analysis showed considerable consistency in the measurement of the variables considered. Of the higher-order birth intervals compared, only the third and fourth intervals are shown to be inconsistent. The actual differences observed are small in many cases and also, because of the size of the samples involved, the tests can be very sensitive in that small differences are shown as significant. However, the differences could be a reflection of real differences in the measurement of the variables in the two surveys. They could also be due to some unknown elements of real change which the constraints used could not eliminate entirely. The finding of significant study effects for the measurement of age at first marriage and first birth, and the first, third and fourth birth intervals, implies that care is needed in the pooling of data on these variables and that this finding must be borne in mind in attaching any importance to changes observed for these data in the two surveys. The results for age at marriage and the first birth interval are consistent with the often cited poor nature of marriage data in Africa. There is little evidence of differences in the measurement of the effects of the independent variables for the fertility indicators that are examined.

Arnold (1990) reported a similar good degree of agreement between the GDHS and GFS fertility estimates for overlapping periods. He noted that even though the GDHS estimates would be expected to be lower because the respondents in this survey would be reporting on events further away in the past, estimates for both surveys are quite consistent in most cases. Where there were discrepancies, estimates in the latter survey tended to be higher. To explain the observed inconsistency, Arnold gave three reasons: the reporting of births for the overlapping period was more complete in the GDHS; the GFS births that occurred close to the time of the survey were reported as having occurred earlier than they actually did; or older women in the GDHS surveys underestimated the age of the older children.

CHAPTER 5

A COMPARATIVE ANALYSIS OF AGE AT FIRST MARRIAGE AND FIRST BIRTH

5.1 Introduction

The age of a woman at her first marriage and childbirth has important consequences for the process of family formation; it also has implications for the woman's welfare and health and her child's survival. Marriage usually signifies entry into sexual activity and the risk of childbearing in many societies (Hirschman and Rindfuss, 1982 ; Hobcraft and Murphy, 1987), and early marriage is associated with early childbirth in societies with little or no contraception. The age at first birth is important for a young woman because the need to care for a baby limits her ability to take advantage of opportunities for a different life. The life prospects of a girl who has an ex-nuptial child at age 16 are 90 per cent determined (Campbell, 1968). Young ages at first birth are also associated with high completed fertility (Knodel, 1982), and with poor maternal and infant outcomes (Rossiter et al., 1985); though some researchers believe that the relatively high risks in teenage births are due to social conditions rather than the age of the mother (Makinson, 1985; Geronimus, 1987). Furthermore the inverse relationship between age of mother at first birth and risk does not appear to be universal: McDonald (1984) found no significant extra risks for teenage mothers in his examination of World Fertility Survey data.

The waiting time from marriage to first birth may be influenced by both social and biological factors: an important biological factor is chronological age, which affects the length and level of adolescent subfertility while social effects act essentially through coital frequency. The association between longer birth intervals and lower fertility can be explained in terms of biology and behaviour. The assumption relating to biology is

that less fertile women have low fecundability and therefore longer waiting periods between births: because of the limitations on the reproductive period such women end up with fewer children. On the other hand, the behavioural assumption is that women who control their fertility limit the number of births and lengthen their birth intervals.

5.2 Socio-economic and biological context of transition to parenthood

Every human society puts some form of pressure on its younger generation to start a family, to ensure the survival of the society. Rindfuss, Morgan and Swicegood (1988) note that such normative pressures can assume direct or subtle forms and may operate at both individual and societal levels. At the personal level, the pressure may take the form of spouses or potential spouses wishing to have a child or parents wanting to become grandparents. In Africa where the extended family system is the norm, relatives other than a couple's own parents may also express similar wishes.

More indirectly, as more members of a peer group become parents, other members are confronted with the need to do likewise (see Hernes, 1972; Rindfuss, Morgan and Swicegood 1988). There is also a tendency in many places to view the transition to adulthood as the transition to parenthood; thus to be treated like a mature adult a person is expected to be married and have children. In several Ghanaian communities, eligible men who remain unmarried may be considered irresponsible, miserly or perhaps infertile while the single women might be thought of as prostitutes. The younger generation are made to see marriage and subsequent childbirth as a social responsibility. Attitudes similar to the finding by Blake (1979) from American attitudinal data that childlessness is not a desired way of life, appear to underlie behaviour towards transition to parenthood in most Ghanaian communities too. Failure to have a family may attract sanctions such as nagging, pity, exclusion from some activities and mockery. For those employed in the modern sector of the economy, it may lead to the loss of tax reliefs and other benefits.

5.2.1 Economic considerations

The degree of pressure to start a family may however be tempered by economic considerations. For example, young people may want to wait until they can take care of children before they start a family. This may involve the need to complete an appropriate level of schooling, secure a well paid job and own a house. In Ghana, such economic considerations may be different for the rural and urban communities depending on varying levels of individual economic and educational aspirations. Rural dwellers may be less emphatic on these economic considerations because they are more likely to have lower levels of these aspirations.

These pressures also vary across periods and cohorts (Ryder, 1973; Rindfuss et al., 1988); again there is a large economic element as people begin to discern good or bad times and react accordingly. For example young unmarried men could counter their elders' arguments about starting a family by citing the hard economic times. On the other hand, such hard times could lead to shortening of marriage and first birth-intervals if individuals perceive that things will never become better.

Changes in the timing of marriage and first birth may occur as a result of wars, economic hardship, natural disasters and even scientific innovations. At the individual level, the process of physical maturation, fecundity, education, job, and family experiences are all temporal factors that may bear on the decision to start a family. Neugarten et al. (1965; 1985) argued that the lives of individual members of a society are guided by what that society regards as appropriate roles and behaviours, and that there are roughly agreed timetables about jobs and family formation. They note that individuals tend to compare their progress with what is considered appropriate for their group.

5.2.2 Biological constraints

A number of physiological constraints imposed on the social process determine who are capable of having children and when they can have them. The onset of the female reproductive years is signalled by the start of menstruation which generally occurs between ages 10 and 15. Menarche may be followed for some time by frequent instances of cycles in which there is no ovulation, or cycles which are highly irregular. The characteristics and length of this period of adolescent sterility vary for individual women but little is known about its nature and causes (Leridon, 1977).

Apart from adolescent sterility and subfecundity, there is still considerable variation in the ovulatory cycle. Leridon (1977) notes four types of this variation. First, the average length of the cycle varies from woman to woman, and second, the length varies from cycle to cycle. The third source of variation is that the day on which the ovulation occurs varies and finally all these factors vary with the age of the woman.

Another source of variability is the probability that a conception results in a live birth. According to Leridon (1977) about 40 per cent of all conceptions experience intra-uterine mortality in the first two weeks of gestation. Also, the length of the non-fertile period following a live birth varies from woman to woman and is strongly affected by lactation and breastfeeding.

Finally, the onset of sterility, whether voluntary or involuntary, is also a variable factor. Sheps and Menken (1973) showed that if a constant level of fecundability is assumed, the correlation between successive birth interval lengths is less than 0.5. This means that an analysis concerned with the timing of fertility which assumes no change in fecundability, will show lower levels of explained variance than an analysis for the total quantity of fertility (See Rindfuss et al., 1988).

5.3 The relationship between premarital births and marriage

There is considerable interest in the ways in which premarital birth in an unmarried young woman's life can affect the timing of her first marriage. Having a premarital child may cause a delay in entry into marriage because such a woman may become less attractive in the marriage market. On the other hand it may speed entry into marriage as a result of social compulsion or sheer convenience as for example, when a premarital pregnancy speeds up marriage to ensure legitimacy of the unborn baby. There are other possibilities: there may not be any causal relationship at all between first marriage and first birth, as may happen when marriage and first birth are planned to occur jointly (see Rindfuss et al., 1988). The relationship between having a premarital birth and age at first marriage is not examined in this analysis because of uncertainty about the nature of the data relating to these events. The problem of accurate dating of marriage in Africa has been discussed widely in the literature. Rindfuss et al. (1988) note that although there is usually some sort of ceremony which marks the start of marriage, there is no consistency over time or across groups about what these ceremonies mark. Marriage is socially defined and the definition varies across time and group. With regard to African marriage, it has been noted that it should not be seen as a single event but rather a process that unfolds over time (see van de Walle, 1968) and is therefore difficult to measure since it is difficult to determine when a union started (Meekers, 1991, 1992). Furthermore the relationship may be complicated by the fact that some of the negative first birth intervals that were recorded in the surveys may be due to errors in dating the first marriage or first birth or both.

5.4 The start of family formation in Ghana

Trussell and Reinis (1989) estimate that the mean age of first marriage in Ghana ranges from 18.8 for 35-39-year-olds to 19.2 for women aged between 40 and 44. The average age at first birth ranges from 20.4 for women aged 20-24 to 21.2 for women

aged 40 and above. Consistent with the conclusions of the studies noted in section 1.3.2 of Chapter 1, these figures also indicate very little variation in the start of reproductive life in Ghanaian women over time. Also the preliminary analysis of the GDHS data indicate some decline in early marriage. In this chapter, events relating to the start of reproductive life are compared for the GFS and the GDHS data. It has been seen in Chapter 4 that the measurement of these data is probably inconsistent in the two surveys and thus the results here may be influenced significantly by differences originating in the surveys. The data and methods of analysis are discussed in the next section.

5.5 Data and methods

5.5.1 Dependent variables

The aspects of the start of family formation discussed in this chapter are age at first marriage, age at first birth and the first birth interval. For the analysis of first birth interval, the dependent variable is the period from a woman's first marriage to her first childbirth. This was obtained by subtracting the date of marriage (cmc)¹ of the respondent from the date of her first birth (cmc). The dependent variable for first marriage is the age of the respondent when she was first married. The dates of these events are often imputed for many respondents in many African surveys. For example, about 64 per cent of the respondents in the GFS and 73 per cent in the GDHS could not give the exact month and year of the age at first marriage and first birth (see Table 5.1). These figures give an indication of the extent of imputation involved in the derivation of the century month code and hence the possible extent of errors associated with these data. For example, 6.9 per cent of first births in the GFS and 8.2 per cent in the GDHS are shown to be negative and are treated separately in the analysis. Further discussion of this topic is provided in section 5.5.4.

¹ Life table methods use information on dates of events in order to calculate lengths of exposure and age or duration at the time of the event. Many demographic surveys record dates in monthly intervals often using a century month code (cmc) scheme in which the month of January, 1900 is designated as '1' and the subsequent months are labelled accordingly.

5.5.2 Independent variables

Individual decision making regarding the transition to parenthood takes place within the constraints of temporal, biological and social factors. Structural factors often used to define group membership include race, religion, region of origin, ethnicity and rural or urban background. In the analysis of transition to parenthood, group membership is important if there are shared values affecting its timing. Educated parents might stress the need to defer marriage and birth till their children have attained specified levels of education and obtained good secure jobs. Group membership is also relevant if it influences intermediary variables; for example, if a religious organization strongly opposes sex outside marriage to the extent that members of that organization have on average a later age at first birth.

Background variables are also important if they either expand or constrain individual opportunities in early adult life. Lack of opportunities for higher education and good jobs away from the family home may lead young adults to early family formation, as is likely to be found in many rural areas in Ghana. On the other hand, young adults who have the opportunity for higher education may defer marriage until certain aspirations are realized.

The covariates used in this analysis are selected to reflect the woman's cultural and educational background as well as aggregate periodic influences. Several references were made in Chapter 2 to the influence of culture and education on human reproductive events. Proxies for cultural effects such as ethnicity, religion and type of place of residence are included in the analysis. Aggregate periodic influences on the timing of the transition to parenthood are examined through indicator variables which represent decision making in the specified period.

The assumption that ethnicity, for example, has an effect on transition time is based on the premise that structural conditions within the various groups are sufficiently different that the processes of transition to first marriage and first birth are quite different. A substantive question in the multivariate analysis framework is whether, having controlled for other factors, it matters if a mother belongs to, say, the Akan ethnic group or any other ethnic group.

A number of characteristics during adolescence would also be expected to influence the timing of the transition to parenthood. Rindfuss et al. (1988) note that the factors possibly include family characteristics such as number of siblings and whether the teenager is living with both parents. Also relevant is the orientation of the peer group. Rindfuss et al. (1988) suggest that the effect of family characteristics may be direct when they lead to preferences about the timing of parenthood and its appropriate intermediate variables, or indirect when the effect comes about through educational or career aspirations.

Education is often regarded as an important status-determining factor: thus the attainment of higher levels of formal education has modernizing effects on the individual's behaviour. Aspirations about education affect transition to parenthood since the demands on parents' time in caring for a child interfere with these aspirations. There are two ways in which this effect can occur. First, if substantial numbers stay long enough in school they become exposed to the simultaneous risks of obtaining more education and starting a family. Secondly, the occurrence of first births may lead to the termination of further schooling (see Rindfuss et al., 1988).

5.5.3 Some measurement problems

An important factor cited in Section 5.1. that can affect birth intervals is variability in the biological capacity to conceive and produce live births. There are no data on this variable for the analysis in this thesis, hence estimates of the effect of the covariates used in this analysis are confounded with the variability in the biological factor. It is also difficult to deal with the problem of unequal exposure caused by the temporary absence of husband or wife, such as absence for purposes of work within specific intervals. It is known, for example, that many young men and women migrate from the northern sector of Ghana to the south when the farming season in the north is over, and return to the north in time for the next farming season. While such movements can interrupt exposure to reproductive activity among age groups in which they occur, definitive statements can only be made about their effect when the issue is considered significant and is specifically researched.

5.5.4 Comparability of data

As discussed in Chapter 4, comparability of data from the two surveys in this analysis is important because conclusions about the roles of some variables in the different settings depend on whether the variables and concepts bear the same or similar meanings in different surveys. The variables included in this analysis are standard ones in most demographic enquiry. The results in Chapter 4 show some evidence of inconsistency in the measurement of the dependent variables: age at first marriage, age at first birth and the first birth interval. This is not surprising in view of the problems of measurement that are usually associated with the measurement of these variables. The difficulty of obtaining accurate data on marriage in Africa could also be reflected in the distribution of the first birth interval whose estimation is based on date of marriage by definition. In addition, first births being the earliest of birth events are less likely to be accurately recalled, especially among older women. As noted in Chapter 4,

the implication of this finding is that inter-survey differences that are observed for these variables may not be emphasized, and similarities will be of more interest. The analysis in Chapter 4 shows that the effects of background variables are consistently measured in both surveys, which means that observed changes in the effects of these variables from one survey to the other are not likely to be due to differences in the conduct of the two surveys.

The general lack of motivation to remember the precise dates for various demographic events (Singh, 1987; Owusu, 1988) often leads to the need to impute data and different imputation procedures can affect conclusions in comparative analysis. Meekers (1991) observed that fine temporal variables like the first birth interval are sensitive to imputation, because the time between first marriage and first birth is usually short and thus the potential variation due to imputation can make up a large part of the first birth interval. Furthermore, the first birth interval is obtained as the difference in time between the date of first marriage and of first birth and is therefore subject to any biases in the imputations of the timing of both of these events.

According to Meekers (1991), if both marriage and first birth are reported to have occurred in the same year but the exact months of occurrence were not given, imputation procedures lead to one or another placement of the event. For example, the midpoint method locates both events in the middle of the year: this implies a simultaneous occurrence of both first marriage and first birth. However, the random imputation method could place either event first and the other second in time. Given that the ages at first marriage and first birth tend to occur close together, the use of different imputation procedures affects the observed proportion of premarital births.

Table 5.1 Distribution of form of responses for age at first marriage and first birth by survey

	Month and year	Other	Total
GFS	1635	2895	4530
	(36.0%)	(64.0%)	(100%)
GDHS	915	2448	3363
	(27.0%)	(73.0%)	(100%)

Table 5.1 shows cross-tabulations of the form of responses for the dates of first marriage and first birth; this gives some indication of the quality of the reporting of the first birth interval data (see Meekers, 1991). The magnitude of the proportion of respondents who can give the exact date for both the first marriage and first birth shows the extent of possible imputation bias in the first birth interval. In Ghana, 36 per cent of women who have married and have had a first birth in the GFS and 27 per cent in the GDHS were able to provide exact information for both first marriage and first birth. Meekers (1991) suggested that the GFS data, in comparison to other West African data, underestimated premarital births because the imputation procedure used disallowed the imputation of months that resulted in premarital births. It is obvious that if the decision rules used for imputation in the GFS differ from those of the GDHS, some of the differences observed for premarital births could be due to variations in imputation policy.

5.6 Method of Analysis

The statistical procedures used in the analysis in this chapter include life table techniques and proportional hazard models. The life table technique was used to analyse the first birth interval while the proportional hazards model was to determine

significant effects for age at first birth, that is, time that had elapsed after a respondent's own birth when she had a first child. In the analysis of the time to the occurrence of an event, the concept of time is defined in terms of a reference event which gives its origin. If exposure ends when the second event occurs, life table methods or hazard models (introduced in Chapter 1) are the natural methods for analysis (see Hobcraft and Murphy, 1987). Exposure is measured from the point of entry to risk of the process under study. The censoring variables which end exposure need to be identified, and a necessary requirement is that the failure time process is independent of the censoring variable. Life table techniques are used to deal with the difficulty of obtaining unbiased estimates for the social determinants of the tempo of fertility from cross-sectional data (see Whelpton et al., 1966; Ryder and Westoff, 1971).

The birth intervals to be analysed are a combination of open and closed intervals. The first birth interval is considered to have been initiated by first marriage and terminated by first birth or the survey. Thus, of all respondents who were married, those who did not have a first birth before the survey have an open first birth interval while those who did have a first birth by the survey date are deemed to have closed their first birth interval. The former group of women are said to be censored by the survey. The usual assumption is that these respondents will eventually have a birth but did not do so by the time of the survey. The analysis of a mixture of intervals poses problems unless the schedule according to which the intervals are closed is known. The life-table technique allows an estimate of the shape of this schedule to be made without the need to make an assumption about its functional form.

Life-table techniques also assume that there is a risk of the occurrence of the event of interest at each duration or age which is the same for all individuals in the interval. Cox's Proportional Hazard model permits this risk to be estimated as a function of individual characteristics (Cox, 1972). This model is used to obtain covariate effects of the risk of first birth. The determinants of the lengths of these intervals are a matter of

considerable interest. Also of interest are the similarities and differences in effects across these factors and across the two data sets.

5.7 Results and Analysis

5.7.1 Age at first marriage

Table 5.2 shows the average age at first marriage for women aged 25 years and above who were married for the first time at age 25 years or below. The average age of marriage for the women under 24 years of age who are excluded is between 17 and 18 and are similar for the two surveys. Those of them who had secondary or higher education married on average at about 19 or 20 years of age (see Table 5.9, Appendix B). The exclusion of the younger women is to minimize the downward bias that is likely to arise in the estimation of the average age of first marriage as a result of truncation in their experience by the survey (see Meekers, 1992).

The data show a fairly steady age at first marriage in terms of the trends ($t = 1.17$; $p = 0.2$). For the subgroup for which the data are analysed, the mean age of first marriage is about 17.6 years. In both surveys, the mean age at first marriage increases as years of education and degree of urbanness increase. Thus, for education, women who had 11 or more years of education marry for the first time at the average age of 20.4 in the GFS and 20.1 in the GDHS, compared to 17.3 years for the uneducated women in both surveys. This result shows modest increases in the expected direction, that is, expectation that increasing exposure to education and Western values will lead to increase in the female age at first union (see Caldwell, 1982; Goode, 1963). While the age at first marriage did not change between two surveys, significant changes are

observed for such subgroups as women who had between one and ten years of education, the Mole-Dagbani and the traditionalists. In much of sub-Saharan Africa, going through formal education and living in urban areas are some of the means by which people get exposed to Western culture. Another noticeable evidence of probable change in the mean age of marriage may be seen by comparing the mean ages for the period 1969 to 1973 in the GFS with the non-overlapping period, 1983 to 1987 in the GDHS.

Table 5.2 Mean Age at First Marriage by Selected Covariates by Survey

Variable			S	U	R	V	E	Y	
	GFS	VAR	N		GDHS	VAR	N		T-STAT
Total	17.7	10.96	3353		17.6	8.42	2309		1.17
Ethnicity									
Akan	17.7	9.55	1716		17.5	7.98	1377		1.86
Ga-Adangbe	18.1	9.59	244		18.0	10.49	214		0.34
Ewe	18.2	9.93	408		18.0	9.02	387		0.92
Mole-Dagbani	17.0	7.87	521		17.7	7.99	331		-3.34
Religion									
Christian Cath	17.8	9.61	529		17.7	8.58	421		0.51
Christian Other	17.9	9.63	1442		17.7	8.17	1325		1.76
Moslem	17.5	8.60	388		17.0	9.92	287		2.12 ^a
Traditional	17.1	8.16	675		17.6	7.77	252		-2.86 ^b
Education									
None	17.3	8.83	2284		17.3	8.35	1305		
1-10	18.3	8.95	956		17.7	8.19	1165		4.71 ^c
11+	20.4	9.15	113		20.1	8.23	154		0.44
Residence type									
Rural	17.5	9.10	2281		17.5	8.55	1296		
Urban	18.1	9.47	1072		17.9	8.64	828		1.43
Age									
25-29	17.9	9.05	968		17.9	9.05	819		
30+	17.6	9.39	2385		17.5	8.34	1805		1.07
Period*									
69-73GFS	18.9	6.18	659		18.6	5.24	571		2.19 ^a
74-78GFS	22.2	2.91	173		21.8	2.66	199		2.31 ^a

* equivalent periods for the GDHS are 78-82 and 83-87

^a implies significance at .05 ^b implies significance at .01 ^c implies significance at .001

The mean age for the former is about 19 years compared with about 22 years: a difference of about three years. Finally, the younger birth cohorts in either survey have slightly higher mean ages at first marriage than the older cohorts within each survey but have the same average ages across surveys. However, the indication that the mean age at first marriage might be rising is a weak one in view of the stability in the overall mean age at first marriage in the two time points observed, that is 17.7 years in the GFS and 17.6 years in the GDHS. Furthermore, other recent research has failed to find any

strong evidence that the average age of first marriage is increasing in sub-Saharan Africa (see Locoh, 1988; Lesthaeghe, Kaufmann and Meekers, 1989).

5.7.2 Age at first birth

From the data in Table 5.3 the median age at first birth generally appeared to vary little from one subgroup to another. With the exception of women with 11 or more years of education, the median age for all other subgroups considered ranges between 19.4 and 20.4 years in the GFS and 19.2 and 20.4 years in the GDHS. The differences are smaller when the median age is considered for the same subgroup over time, that is, in 1979 and 1988; the difference being less than one year in all cases. For women with 11 or more years of education, the mean age at first birth is about 25 years in the GFS and 23 in the GDHS. The observed difference of about two years is probably due to the fact that women are achieving higher levels of education at lower ages over time.

A comparison of the median age for age groups across surveys indicates no change for women aged 30 years and over, but a decline of about five months for women aged between 25 and 29 years of age. It is to be noted that this difference could also be due to differences in the imputation of months in the two surveys.

Table 5.3 Median Age at First birth (years) by Selected Covariates by Survey

Variable	S	U	R	V	E	Y
	GFS		N		GDHS	N
Ethnicity						
Akan	19.7		3314		19.6	2379
Ga-Adangbe	20.2		460		20.0	397
Ewe	20.0		745		20.2	718
Mole-Dagbani	20.1		804		19.8	429
Religion						
Christian (Cath)	19.6		1145		19.7	765
Christian Other	20.0		2847		19.9	2381
Moslem	19.8		660		19.5	445
Education						
None	19.5		3152		19.2	1783
1-10 years	19.9		2694		19.7	2394
11+ years	24.9		279		23.3	311
Residence type						
Rural	19.6		4046		19.4	2965
Urban	20.4		2079		20.4	1523
Age						
25-29	19.6		2591		20.0	1716
30+	19.9		1011		20.0	867
Period*						
69-73GFS	19.5		1010		19.5	711
74-78GFS	19.4		1153		19.9	821

* equivalent periods for the GDHS are 78-82 and 83-87

In view of the fact that possible errors in the recall of this data are likely to be more numerous for the older cohorts than the younger ones, it is perhaps necessary to focus here on the latter, that is, women aged 25 -29 years at the time of the survey. The data for this group indicate a moderate increase in age at first birth; a similar level of increase is noted for the period variable when only first births that occurred in the six years before either survey are considered. For this variable there appears to be no change for births that occurred 11 to 6 years before the survey but an increase of about six months for those that occurred six years before the survey. Some lengthening in age

at first birth appears to have occurred in the recent periods before the survey and also for the younger cohorts across surveys. Statistical tests for mean age at first birth show significant differences for women with no education, women aged 30 and above and also for births in the five year period preceding each survey (Table 5.10 in Appendix B).

5.7.3 Life table analysis of the first birth interval

This section deals with the probability that a woman has a first birth in the next period of time given that she has not yet had a first birth by a given age. Several aspects of the process of first birth following first marriage, for example, the quantity (quantum) and its speed (tempo) are considered. The quantum indicates the proportion of women having a first birth following first marriage in a reasonably long time. When the period considered is five years, the quantum is referred to as quintum. The conditional mean which also contains some information about the distribution of the birth interval, shows the mean time for women to move from marriage to the first birth (Rodriguez and Hobcraft, 1980). Differentials for age cohort and period effects are also obtained.

5.7.4 Age, cohort and period effects

The length of the first birth interval in relation to age, birth cohort and period effects is examined next. Age here refers to the age of the woman at the start of the interval (i.e. age at first marriage). The age categories used here are : under 16, 16-17, 18-20 and over 20 which roughly correspond to the quartile distributions of age at the start of the interval. Cohorts here denote age of the woman at the time of the survey which has been grouped as: 15-24, 25-29 and 30 and above. Also, period here denotes the 10-12 year period preceding each survey classified into two calendar periods: 1977-1981 and 1982 - 1986 in the GDHS and 1968 - 1972 and 1973 - 1977 in the GFS survey. Negative intervals are excluded in the data in Table 5.4.

Table 5.4 shows the unstandardized values for the quartiles, trimean and spread of the distribution of the first birth interval by survey. The unstandardised quartiles give the duration by which 25, 50 and 75 per cent of all women have had a subsequent birth. Twenty five per cent of women who married for the first time proceeded to have a first birth about two months earlier in the GDHS survey; however, this difference tends to diminish by the time 50 per cent of the first-time married have a first birth. The median and the trimean are about 16 and 17 months for both the GFS and GDHS. The data for ages 15-49 show that the largest inter-survey difference in the quartile distribution of the first birth interval is less than two months. Age, cohort and period effects are considered in further detail below.

Table 5.4 Unstandardised quartiles of the distribution of the first birth interval (mths) by survey

variable	survey	N	T25	T50	T75	Trimean	Spread
15-49	GFS	2142	10.6	16.2	24.9	17.0	14.3
	GDHS	1564	8.9	15.8	26.6	16.8	17.7
cohort 15-24	GFS	1063	10.6	16.2	26.5	17.4	15.9
	GDHS	708	9.9	17.0	28.9	18.2	19.0
25-29	GFS	784	10.4	16.4	24.9	17.3	15.5
	GDHS	635	8.6	15.4	25.7	16.3	17.1
30+	GFS	295	8.3	15.2	25.0	15.9	16.7
	GDHS	221	6.1	13.4	24.4	14.3	18.1
period 68-72	GFS	1141	10.4	16.2	26.1	17.2	15.7
	GDHS	654	9.1	15.9	26.6	16.9	17.5
73-77	GFS	1001	10.2	16.1	25.9	17.1	15.7
	GDHS	739	9.0	15.9	26.4	16.8	17.4
Age <16	GFS	325	12.1	19.0	33.8	21.0	21.7
	GDHS	169	12.2	20.0	37.5	22.4	25.3
16-17	GFS	577	10.3	15.6	25.0	16.6	14.7
	GDHS	389	10.3	17.6	28.4	18.5	18.1
18-20	GFS	779	10.0	15.5	23.5	16.1	13.5
	GDHS	627	8.9	14.9	24.7	15.9	15.8
>20	GFS	461	9.6	16.4	28.0	17.6	18.4
	GDHS	379	4.9	13.7	24.6	14.2	19.7

5.7.4.1 Age effects

Following Hobcraft and Rodriguez (1980), the quintum and trimean values for the first birth interval for age, cohort and period categories are supplemented by the proportions of women having ex-nuptial births denoted by B9. The summary measures given in Tables 5.5 to Tables 5.7 are based on standardised life-table calculations. Table 5.5 shows that age at the start of the interval appears to have some slight effect on the timing of first birth. Premarital births (B9) occur to between 10 and 20 per cent of women in the GFS while in the GDHS the proportion having such births ranges from about 16 per cent for women who marry under age 16 to about 35 per cent for those who marry above 20 years of age. Within each survey, the probability of premarital births shows an increasing trend with age as expected. The quintum of fertility is more than 90 per cent for all ages in either survey. This means that the proportion of women who proceed to have a first child within five years of marriage exceeds 0.9 irrespective of the age at which they first marry.

Table 5.5 Summary measures of the life-table analysis of the first birth interval by age at start of interval by survey

			A	G	E	
	Survey	Q1	Q1-Q2	Q2-Q3	Q3	
	summary measure					
GFS	Ages	16	16-17	18-20	>20	
	B9	.130	.180	.202	.228	
	Quintum	.923	.964	.932	.905	
	Trimean	18.8	15.9	15.0	15.4	
GDHS	Ages	16	16-17	18-20	>20	
	B9	.160	.201	.252	.346	
	Quintum	.915	.945	.953	.930	
	Trimean	20.1	17.4	14.9	9.6	

Among women who marry under age 16 in the GFS about ninety-two per cent (quintum = .92) of those who proceed to have their first birth within five years do so by 19 months (trimean = 18.8) while for women who marry for the first time after age 20, about ninety-one per cent proceed to have a first birth by 15 months on average. The finding is generally similar for the GDHS. The average waiting time for over ninety per cent of the women who marry for the first time under 16 and who proceed to have a first birth within five years is 20 months while for those who marry after age 20, ninety-three per cent have their first child by duration 10 months on average. The main inter-survey difference is for women who marry above age 20: the women in the GDHS appear to have their first birth about five months on average earlier than their GFS counterparts. This is possible in view of increasing modernisation and hence availability of medical intervention for those who have infertility problems. The difference may also be due to varying rates of occurrence of premarital births and conceptions. In the GFS, nearly 13 per cent of those reported to have married under age 16 had pre-marital births or conceptions, compared to about 23 per cent of those who married at or above age 20. Corresponding values for the GDHS are 16 per cent and 35 per cent respectively. If these figures reflect the true extent of pre-marital conceptions and births, then the use of date of first marriage as an indicator of the start of exposure can lead to biased estimates of the effect of age at first marriage on the first birth interval (see Rodriguez and Hobcraft, 1980). The alternative of excluding all negative first birth intervals and intervals less than eight months is not adopted here because of the interest in comparing the incidence of pre-marital births and conceptions in the two data sets.

5.7.4.2 Cohort effects

Table 5.6 shows life table summary measures for the comparison of cohort effects on the length of the first birth interval for each survey. For the GFS data, a lower

incidence of pre-marital births is again observed at lower ages rising from approximately 17 per cent to 27 per cent.

Table 5.6 Summary measures of the life table analysis of the first birth interval by age cohort and by survey

Survey	Summary measure	Age Cohorts		
		15-24	25-29	30-49
GFS	B9	.168	.191	.271
	Quintum	.948	.930	.905
	Trimean	16.2	16.0	14.2
GDHS	B9	.218	.260	.340
	Quintum	.944	.938	.957
	Trimean	16.9	15.1	12.0

The first birth intervals also appear to be longer for the younger cohorts, having dropped from about 16.2 to 14.2 months in the GFS and from about 17 to 12 months in the GDHS. But these observed trends could be due to selectivity. Rodriguez and Hobcraft (1980) noted that this result may be obtained if the younger cohorts are selected for a relatively early age at marriage since early-marrying women are less likely to have pre-marital conceptions and therefore show longer intervals to the first birth. They also showed that when age at marriage, is controlled for, the observed differences disappear if they are indeed spurious. This analysis is not extended further because of the uncertainty about the nature of marriage data as previously discussed. The trimeans show much similarity in the time taken to have the first birth in both surveys: the difference being less than two months. The women aged 15-24 in the GDHS have a trimean 0.7 of a month longer than their GFS equivalent but women aged between 25 and 29 have intervals approximately one month shorter. Finally, it appears that cohorts aged 30 years or more are having their first birth slightly earlier in the

GDHS. But focussing on the younger cohorts, it can be concluded that the median durations for the first birth interval are about the same for both surveys.

5.7.4.3 Period effect

For the most recent period in the GFS, the quantum of fertility appears to have increased only slightly with 94 per cent of women having their first birth within five years compared with 93 per cent in the previous five years before the survey. In the GDHS this proportion decreased from 95 per cent to 93 per cent in the most recent five years before the survey. It is observed from Table 5.5 that the trimean did not differ by more than one month either within or between surveys. The only inter-survey change is 0.7 of a month in the five years immediately preceding each survey.

Table 5.7 Summary measures of the life-table analysis of the first birth interval by calender period and by survey.

Survey	Summary measure	Calendar	Period
		1968-1972	1973-1977
GFS	B9	.197	.185
	Quantum	.925	.943
	Trimean	15.7	16.1
GDHS		1977-1981	1982-1986
	B9	.249	.246
	Quantum	.951	.928
	Trimean	15.7	15.4

Premarital conceptions and births declined only slightly both within and between the surveys. The measure of the incidence for both periods is about 20 per cent in the GFS and 25 per cent in the GDHS; the quantum fluctuates between 93 and 95 per cent in both surveys. Overall, the distribution of the first birth interval is not different in the two surveys. The Lee-Desu statistic for the comparison of survival time from first marriage to first birth for the two surveys is 3.3 with 1 d.f. ($p = .07$).

5.8 Multivariate analysis

5.8.1 Socio-cultural determinants of age at first birth

The discrete time proportional hazard model (Cox, 1972) is used in this section to estimate the effects of selected covariates on the age at first birth. All independent variables have been coded into categories. The independent variables used are ethnicity, education, religion, current residence, age cohorts, period. Education was divided into three categories: no education, up to middle school and secondary and higher. Current age was also divided into three categories 15-24, 25-29 and 30+. For period, two groups of five-year time periods immediately preceding each survey were considered.

The exponentials in Table 5.8 indicate the risk of having a first birth for the corresponding category compared with the risk of the reference group net of the effect of other factors in the model. The relative risk of a reference group is by definition 1.00. If the relative risk is lower than one, then the risk function is lower at every duration of the baseline hazard function and higher if it is greater than one. It is assumed that there is variation in the risk of having a first birth across individuals and that the risk does not vary within specified groupings of age.

5.8.2 Multivariate analysis of the age at first birth

The relative risks obtained in Table 5.8 indicate an increasing probability of first birth as the years of education fall in both data sets. In the GFS data, women who had up to 10 years of education ($RR = 0.84$) are about 16 per cent less likely to have first births at an early age than those who had never been to school ($RR = 1$) while women who had 11 or more years of education ($RR = 0.43$) are about 57 per cent less likely. In the

GDHS, the differences in the risks of early first birth are only significant for women having more than 10 years of education compared to uneducated women, the former being about 44 per cent less likely than the latter to have early first births.

Table 5.8 Exponentials of Discrete Time Proportional Hazard Co-efficients for

Age at First Birth by Survey				
Variable	S	U	R	V E Y
	GFS			GDHS
	RR	Z-stat		RR Z-stat
Education(yrs)				
None	1.00			1.00
1-10	0.84	(-4.38 ^c)		0.91 (-1.94)
11+	0.43	(-8.91 ^c)		0.56 (-6.42 ^c)
Residence type				
Rural	-	-		1.00
Urban	-	-		0.78 (-5.21 ^c)
Current Age				
<24	1.00			1.00
25-29	3.42	(23.3 ^c)		3.17 (17.89 ^c)
30+	2.99	(23.7 ^c)		3.83 (24.05 ^c)

c. implies significance at .001

The differential for 'place of residence' is statistically significant only in the GDHS. As expected, urban women (RR = 0.87) are less likely to have first births at an early age than rural women (RR=1); in the GDHS they are about 22 per cent less likely to do so. Among the probable reasons for this pattern in Ghana are that aspirations for a better life will certainly be higher in the cities than the rural areas. To achieve this requires considerable formal education followed by the search for a good job, and these could lead to the postponement of the start of family formation. Other factors affecting early childbirth could be unfavourable economic conditions usually associated with

urbanization, for example, availability of suitable and affordable accommodation. Also, the relative ease with which urban women can have access to contraceptive devices can contribute to the urban effect.

It can also be seen that the education effect is smaller in the GDHS but the place of residence effect is much stronger. Thus, what used to be seen as an education effect appears to have transferred into the rural-urban difference. There are various possible reasons for this: one is change in the differentiating capacity of education as it becomes more universal or even as its value is reduced with economic stagnation; another is possible rural-urban drift of educated people.

Age of women at the time of the survey is the most important covariate in the final models for both surveys. The older women tended to have their first births at earlier ages than the younger ones. For example, women 30 years or more are about 3.0 or 3.8 times more likely to have first births at an early age than those who were 24 years or less in the GFS and GDHS respectively.

5.9 Conclusion

This chapter has examined several aspects of the transition to parenthood: the mean age at first marriage and first birth, and the transition from first marriage to first birth. Proportions of women who had a first birth within five years of first marriage and estimates of the average birth interval for women who gave birth within five years of first marriage have been obtained. Proportions of premarital births appear to increase with age at the start of the interval in both surveys. This is reasonable since the earlier the age at which a woman marries, the less the chance of having a premarital birth. The level of premarital births also appears to be higher for the GDHS. However, as noted above, there are a number of reasons why much significance may not be attached to these differences, particularly between the surveys, for example, problems associated

with the recall of first marriage and first birth will be reflected in the values observed, thus giving erroneous impressions about the actual levels of this event.

The analysis has also been extended to a multivariate framework by allowing the risk of first first birth to depend on individual characteristics of women. The results in this analysis suggest a generally stable transition to parenthood in Ghana: significant differentials are found only for place of residence, and education. Even though place of residence and education have been shown to be highly correlated (see page 56), their interaction effect for age at first birth is only marginally significant ($t = 2.24$, $p = 0.05$) for the GFS data. It was therefore decided to analyse the simpler additive model for both data sets.

The results, which indicate significant differential effects for place of residence and education, are expected since further education leads women to alternative opportunities which make early childbirth less desirable and which are more available in the urban areas. It is possible that significant changes in the timing of first birth will occur when more women go to school and remain at school for a considerable time; and also when there is widespread development leading to the introduction in rural areas of modern facilities usually associated only with the urban areas.

CHAPTER 6

A COMPARATIVE ANALYSIS OF INTER BIRTH INTERVALS

6.1 Introduction

Birth spacing is an important determinant of the rate of population growth and is strongly related to maternal and infant health. This chapter contains the analysis of birth intervals. Birth interval order is designated as the order of the birth that closes that interval: under this system, the third birth interval defines the time interval between the second and the third birth. The study of intervals between successive live births facilitates knowledge about the patterns by which individuals space their children, the variations in these patterns and the factors that affect these patterns and distributions.

The role of birth-interval analysis in the study of reproduction is well documented. Changes and differentials in natality may first appear in patterns of child-spacing before they are observed in other types of fertility data (Goldberg, 1965). Birth intervals may also serve as sensitive indicators of the adoption of family planning (Ryder, 1965), while Henry (1958) has argued that data on birth intervals offer richer, more detailed materials for analysis than do data on numbers of births. For example, the analysis of birth interval data can provide information on the progression from one parity to the next as well as the timing of this transition (Rodriguez and Hobcraft, 1980).

There are three main objectives for the analysis in this chapter. The first is to compare aspects of the distributions of various intervals in the two surveys. Another issue is to compare how the intervals have been changing over time. Finally, the chapter examines the socio-demographic differentials in the spacing of the second to the sixth birth intervals. The analysis will also determine whether or not these covariate effects

differ by survey. The rest of the chapter describes the background to childspacing in Sub-Saharan Africa with emphasis on Ghana; it also deals with some problems related to comparative analysis, and discusses problems concerning birth interval analysis. Issues relating to data and their management are discussed, and the methods of analysis and the results are presented.

6.2 Child spacing in Ghana

The relationship between birth intervals and fertility has been noted in Chapter 1. Ultimately the rationale for the analysis of birth intervals is to gain valuable insight into aspects of fertility change. This section therefore reviews some ideas about fertility and child spacing in Ghana in the wider context of this reproductive behaviour in sub-Saharan Africa.

It has been noted that except for a few recent exceptions, fertility levels have remained generally stable or rising in the presence of rapidly declining mortality in sub-Saharan Africa. Previous research in Ghana has pointed to the great desire to bear many children in the traditional society (see Fortes, 1978) and to the fact that reproductive behaviour is generally characterized by universal marriage for women, childbearing soon after marriage and continued childbearing throughout the reproductive life span of the women (Caldwell and Caldwell, 1977; Lesthaeghe et al., 1981; Ofosu, 1992). Furthermore, there appears to be no concept of a limited number of children that is socially acceptable after which a woman may voluntarily stop childbearing.

The main methods of spacing births in traditional society in sub-Saharan Africa are postpartum abstinence and prolonged breastfeeding. Other methods of less importance include coitus interruptus and low coital frequency (see Mabogunje, 1981). In many of these traditional societies, women are not expected to become pregnant until after an acceptable interval of time since the previous birth. Some reasons usually given to

explain the postpartum abstinence are health of the infant, morality and decency (Caldwell and Caldwell, 1981), health of infant and mother (Kumekpor, 1975) and guarantees for women's effective participation in social and economic activity (Mabogunje, 1981).

There is evidence in parts of tropical Africa of change in birth spacing patterns due to modernization. For example, there is ample evidence of the shortening of breastfeeding and also diminished significance of norms regarding postpartum abstinence with or without the adoption of modern contraception (Mabogunje, 1981). Mabogunje noted that the issues that are emerging from these changes include a new perception of women's sexuality in marital relations, changes in the child-parent relationship, and possible excess fertility and unwanted children. He noted the growing attitude among modern women to sex in marriage as not only a means for procreation but also a means of sustaining their marriage, with the result that there is an increase in their exposure to the risk of pregnancy and thus a greater need for artificial contraception. Mabogunje (1981) also noted an increase in the reversal of the direction and magnitude of intergenerational flow of wealth and services between children and their parents. As a result, parents are beginning to re-evaluate the desired number of children, less in terms of economic assets and more in terms of the psychological satisfaction that they will give.

While these assertions may be true for Ghana as well, there has certainly not been the desired effect in the form of significantly decreasing fertility. Ghana's population policy of 1970 targeted a reduction in population growth rate to less than 2 per cent by the end of this century. But the average population growth rate fell only slightly from about 3.4 in 1981 to 3.1 in 1990, and in 1991 the total fertility rate was about 6.2 (Global Coalition, 1992). Also, a large number of the population is relatively young. The large proportion of children in the populations of developing countries means that even if educational expenditure levels were the same, expenditure per child would be much less than in low fertility countries. For example, in 1965, Ghana with a school-

age population of 37 per cent spent \$40 per child of a Gross National Product (GNP) per capita of \$300. In contrast, the United Kingdom with a school - age population of 22 per cent spent \$500 out of a per capita GNP of \$1800 (National Academy of Sciences, 1971).⁵⁰ One implication of such relatively low expenditures in developing countries is lower quality education, which in turn affects the country's development process. Gaisie (1981) noted that the socio-political structures in traditional Ghanaian society motivate and support high fertility by ensuring that the burden of caring for large families does not fall solely on the parents; he suggested this as a probable reason for the relatively high level of fertility observed in Ghanaian censuses and surveys since 1970. He noted evidence of the shrinking period of postpartum non-susceptibility giving rise to fertility increase in the urban areas of Ghana. He also noted that while educated white-collar working women appear to be successful in using contraception to counteract this effect of the shortening non-susceptible period, the rural women are not. This conforms to findings by Pool (1970) that the few signs of potential fertility decline were present only among the elite professional administrative and executive classes and that chances of a substantial decline seem to be low. Van de Walle (1992), suggested that for fertility decline to take place, people must have a general idea about what family size is ideal and where they stand in respect of the norm: only when this realization occurs will people take steps to limit their families. Obviously, this realization is more likely to occur among the elite.

6.3 Some factors affecting length of birth intervals

Since this chapter deals with the spacing of births, it is instructive to examine factors that affect birth intervals and the associated problems. Birth-interval lengths may be seen as consisting of three components: the duration of pregnancy, the period of postpartum non-susceptibility during which a woman does not ovulate, and the time to conception during which a woman is menstruating, and is exposed to the risk of pregnancy and actually conceives. The biologically determined period of gestation is

the least variable, has an average value of about nine months with a small standard error (Jain, 1969), and is uniform across populations. Thus the last two components become the most important in considering the length of the birth interval and hence fertility. The incidence of spontaneous abortions varies from one population to another and very early spontaneous abortions often go undetected. Spontaneous abortion is disregarded in this analysis because of the lack of appropriate data: incidents of it are included in the period of exposure to risk.

Factors that affect birth-interval lengths include physiological problems that affect the chances of becoming pregnant and the ability to sustain the pregnancy to a live birth. Factors that affect the period of postpartum non-susceptibility include age, health and nutritional status of the mother. Following a live birth, amenorrhoea lasts for about two months on average in a non-breastfeeding woman (Perez et al. 1971; Chen et al. 1974). Breastfeeding can extend this non-susceptible period considerably depending on its frequency and intensity. Thus an important explanatory variable of birth intervals is the duration of breastfeeding and of non-susceptibility as a result of lactational amenorrhoea. After the return of menstruation, a woman is usually ovulating and is susceptible to pregnancy; but this does not always immediately occur, because of intervening inhibiting factors such as contraception, frequency and timing of intercourse, various degrees of temporal separation between the couple, and degree of fecundity. There is thus a waiting time to conception which can last for several months. Depending on the practice of contraception, the waiting time to conception can vary widely between individuals and also between populations.

There may also be a temporal variation. The instantaneous risk of conceiving, as well as the duration of non-susceptibility associated with pregnancy (gestation plus postpartum non-susceptible period), varies with time. The mother's ill-health or the death of the child may interrupt lactation. Besides, the period of gestation also varies as with spontaneous abortions when pregnancy duration shortens; and stillbirths occurring between live births further distort intervals. With regard to the variation in

the spontaneous risk of fecundability, it is believed that women do not become completely sterile suddenly, without a preceding decline in fecundability assumed (see Wolfers, 1967). This may however not be true when disease agents, for example gonorrhoea cause the blocking of the woman's fallopian tubes. Here sterility may be sudden and absolute. Natural fecundability of a couple indicates that the instantaneous risk of conceiving which is only possible at the time of ovulation, does not vary much between populations and does not make a substantial contribution to fertility parameters (Bongaarts, 1978). If separations and illnesses are uniformly distributed over time, they modify the probability of conception but do not affect its assumed invariance. Another possible source of variation in birth-interval lengths is error in reporting dates; this has been discussed in Chapter 4. The effect of postpartum factors is examined in Chapter 7.

6.4 Some problems of birth-interval analysis

A number of effects and interactions complicate the interpretation of birth-interval data. For example because women reproduce for only a finite period of time, those who have relatively short intervals can have a relatively large number of births. This implies that if birth intervals of a homogeneous group of women with constant parameters were examined by birth order, irrespective of completed parity, higher-order intervals would tend to be shorter and less variable than low-order intervals. This truncation effect acts contrary to the tendency for intervals to lengthen with increasing rank order, as older women tend to become less fecund than younger women.

The truncation effect leads to selectivity as the women who proceed to higher orders at early ages are unlikely to be representative of all women who ultimately attain these orders. Rodrigues and Hobcraft (1980) showed the importance of such selection effects and how they might be eliminated considerably by the introduction of demographic controls. They suggested that the data be further divided by characteristics such as age

at previous birth, length of previous interval and duration of motherhood which are related to the pace of family formation. Rindfuss, Palmore and Bumpass (1982) suggested in addition the restriction of the analysis to recent years before the survey.

Another important problem is that birth intervals involving censored cases become artificially long if there are a large number of censored cases which contribute long durations to the interval because they will never be closed. Part of this artificial elongation of the interval can be avoided by restricting closed intervals to cases that are closed within some specified period of reasonable duration. Rodriguez and Hobcraft (1980) standardized birth-interval estimates based on the proportion of women who actually have a birth within five years of a previous birth.

6.5 Data and data management

The birth-interval data examined in this chapter are based on standard demographic questions which elicit the maternity history covering babies which showed any sign of life at birth irrespective of later survival status. In both surveys, this took the form of recording the child's name, its sex, month and year of birth, survival status and if dead, at what age it died. Similarly, questions on the respondent's background are quite straightforward. Data on age of mother are collected in a very similar manner. Each survey collected data on both age at time of survey (in completed years) and the exact month and year of birth. However, the interpretations of these questions where translations are required, and the depth of probing, may differ with the interviewer.

6.5.1 Comparison of questions on covariates

The analysis involving covariates seeks to determine the effect, if any, of each individual covariate on the length of birth intervals net of the effect of other covariates, and whether the effect is the same for the two surveys and for selected time periods. The comparability of the data for the covariates in the two surveys facilitates this analysis. An essential step is to examine the questions that elicit data for the covariates.

The covariates examined in the analyses are ethnicity, religion, residence and education. A comparison of the questions regarding these variables across surveys shows that the questions are either exactly the same or nearly the same, as in the case of religion, education and ethnicity; or that the concepts involved are basically straightforward but with different question wording. The question on ethnicity in the GFS is 'What is your ethnic origin?'; for the GDHS, the question is 'What is your ethnic group?'. While such minor changes in wording can hardly lead to different responses, this cannot be said with equal certainty about the differences in wording regarding childhood residence. The question on this variable requires respondents to make decisions about whether their current and childhood residence may be classified as a village or a town: the distinction between these may not always be clear-cut in Ghana. It is not easy to determine the extent to which a misclassification can result between the two surveys. This variable is not used in this analysis.

6.5.2 Dependent and independent variables

6.5.2.1. The dependent variable

The dependent variables in this chapter are birth intervals of various orders. The i th birth interval is obtained in months by subtracting the date of birth (cmc) of the $(i-1)$ th

child from that of the i th child. In the analysis in this chapter, the interval lengths are restricted to those seven months and above.

6.5.2.2 Choice of birth intervals.

The choice of intervals for analysis depends on the type of analysis under consideration. For example, one important objective in this analysis is to compare aspects of the distribution of birth intervals obtained in the two surveys. For this purpose closed birth intervals of specified order for mothers of comparable cohorts in the two cohorts are compared. This analysis examines the second to the sixth intervals. Another objective is to compare the average length of intervals over time for the two surveys. Intervals of all orders in either data file are included in this analysis. For the multivariate analysis in the final section only the second to the sixth intervals are considered. The analysis of the first few births would miss fertility decline if the decline was characterized by early stopping behaviour among those with five or more children. However, there is evidence that much of the fertility decline in Africa is not characterized by this early stopping behaviour and that the decline appears to be fairly well spread across birth intervals.

Another important consideration in the analysis of birth intervals is the time restriction to impose on the data in order to reduce the risks of memory lapse. Intervals further away from the survey date are often less representative. Several time restrictions are considered depending on the nature of the particular analysis. For example, the time series analysis involved the examination of all intervals reported for all periods as well as for specified time segments. For estimates based on all intervals the risk of memory error is expected to be more pronounced. In the hazard model analysis in the last section, only intervals starting one to ten years before the survey were included.

6.5.2.3 *Independent variables*

The background variables used in these analyses include mother's education, ethnicity, religion and residence status, age and period of initiation of the interval. The age used here is the age of the mother at the time of the birth which initiates the interval. Rodriguez et al. (1983) found that mother's education among other variables affects birth-interval length. Rindfuss et al. (1983) found significant differences for ethnicity, and urban residence. They also found that education had relatively little effect except at the higher birth orders. Education is expected to have a negative impact on fertility, through mechanisms such as child costs, greater knowledge of and access to contraception, and alternative values (see Bumpass, Rindfuss and Palmore, 1986); and urban dwellers have easier access to new ideas, and technological settings that tend to change the costs and benefits of children. They are also likely to have greater access to modern health facilities and family planning services. In respect of education, it is suggested for this analysis that since female education has generally been on the increase in Ghana, there will be a corresponding decline in fertility. In terms of birth intervals, it is reasonable to expect that intervals for the relatively young cohorts will be longer on average if sufficient members of the cohorts are enrolled and retained for considerable lengths of time in the formal educational system. Formal female education, urban residence and non-traditional religion are assumed to influence traditional behaviour which is generally likely to characterize a person who lives in the rural area, is uneducated and practises traditional religion.

Difficulties associated with the use of residence of origin as explanatory variables for the analysis of fertility differentials have been discussed (see Bumpass et al., 1986). For example a large number of women in Ghanaian urban areas come from a rural setting: the duration of their stay in urban areas could range from their childhood days to the year preceding the interview. Furthermore some women classified as being of rural residence may have had varying duration of urban life before finally returning to re-settle in the rural areas. The data sets at hand cannot distinguish these categories,

neither can the extent and influence of these problems be determined. To the extent that they exist, however, these effects will be confounded with the actual effects expected in connection with the residence variable.

A number of studies have reported fertility differentials for Ghana, important among which were place of residence, education and ethnicity (see Caldwell, 1968, 1971; Gaisie and de Graft-Johnson, 1976). While the educational and residential differentials are probably related to the socio-economic changes during the century, ethnic differentials probably reflect differences in traditional practices in respect of breastfeeding, postpartum sexual abstinence and temporary separations of husbands for economic reasons (see Caldwell, 1968, 1971).

In this study, 'years of education' is used instead of data on education already classified into the categories of primary, middle, and secondary or higher education; this is to ensure uniform classification of this variable across surveys. The categorization of years of education is however made to coincide with primary, middle and secondary or higher classifications.

6.6 Methodology

6.6.1 Life table methods

Since the data to be analysed come from cross-sectional surveys, many women had not completed their childbearing before the survey date. Observations on women still engaged in reproduction are considered to be censored by the survey and data for such women constitute incomplete reproductive histories. As noted in Chapter 1, life-table methods make it possible to consider both complete and incomplete birth interval data. Further details of the procedure are provided in this section. Summary measures based

on quartiles are used to measure the timing of fertility while proportions at each parity who eventually move to the next higher parity is related to the quantity of fertility.

The procedures used in the analysis in this section are based on the probabilities that women, at risk of births of a given order at the beginning of interval i , have such births. From the series of conditional probabilities, the standard life table measures are derived. For example, women who have an i th-birth enter the $(i+1)$ th interval. A woman is considered a censored case if she reaches the end of the period without having an $(i+1)$ th birth. Duration is measured in months since the start of the birth interval. For example, a second birth interval is defined as time in months from the date of the first birth to the date of the second birth for those women who had a second birth. For women who did not have a second birth before the interview, the second birth interval is defined as the time that elapsed between the first birth and the interview. The risk of a second birth is assumed to be the same for the subintervals for individuals with the same values of the covariates.

Life table methods estimate the probability of not having the $(i+1)$ th birth (analogous to survival) at specified intervals. The number of months at which 25, 50 and 75 per cent of the eligible women are expected to have the $(i+1)$ th birth is estimated.

6.7 Multivariate Analysis

Life-table techniques enable the inclusion of all intervals, closed and open, in the analysis. This ensures that the bias towards short intervals which results from the analysis of only closed intervals is avoided. However the use of life-table methods to study covariates of interval length, requires the creation of categories within the covariates of interest and the computation of separate life tables for any cell in a covariate matrix. If the analysis involves many covariates, the cell sizes quickly become too small for the calculation of life tables. The common procedure to avoid

this problem is to use hazard models. The discrete time version of the Cox (1972) regression model already described in earlier chapters is used to examine the net effect of variables in the multivariate analysis.

The effect of a covariate on the hazard may change over time even though the covariate is the same. Trussell et al. (1985) gave the examples, use of pill and breastfeeding, as covariates which can be considered as time-varying with the same effect and time-varying with effect varying over time respectively; they estimated a model which encompassed the assumptions of fixed covariates, fixed covariates with time-varying effects and time-varying covariates with time-dependent effects.

The covariates in the analysis describe the social and economic characteristics of the woman. These variables are assumed unchanged over the course of the interval and have the same (proportionate) effect on the hazard at all durations. In addition to assuming a constant hazard within subperiods which is shifted proportionately by the covariates, the estimation procedure also assumes that all heterogeneity is measured by the covariates. Fortran was used to prepare the files from which estimates of the covariate coefficients and their standard errors are obtained using the statistical package, GLIM.

6.8 Analysis and results

6.8.1 Comparison of mean length of intervals

This section tests for significant differences in mean intervals for closed birth intervals for the same cohorts of women in the two surveys. Interviewing for the GFS occurred between February, 1979 and March, 1980 and that for the GDHS happened between February and June 1980. The interval between the median interviewing times in both surveys, which is about nine years, is taken as the difference in time between the surveys.

The section compares the mean lengths of interval for the same birth cohorts in the GFS and GDHS surveys. The first comparison involves testing for significant differences between intervals for women aged 15 to 40 years in the GFS and those aged 24 to 49 in the GDHS. The comparison is for five year age groupings except the last group which for convenience was for a six-year age group.

6.8.2 Comparisons for comparable cohorts

Tables 6.1.1 to 6.1.5 give the estimated mean intervals in months, their standard deviations and t - statistic for differences in means by survey for comparable age cohort for the second to the sixth birth intervals. The data indicate significant differences in average length of the second and fifth birth intervals. The actual differences of 1.4 months for the second and 3.2 months for the fifth interval, however, do not appear to be substantial. The difference in average length for the third and fourth and sixth intervals which are between 0.4 and one month are not statistically significant.

For a more detailed analysis approximate five-years subgroups are compared. A maximum difference of about seven months for the second birth interval is observed for the 15-19 age cohort (24-28 in the GDHS) while the minimum difference of about one month is obtained for the 30-34 age cohort (39-43 in the GDHS). Average second birth intervals for age cohorts 15-19 (24-28 in GDHS), 20-24 (29-33) and 25-29 (34-38 in GDHS) are significantly different between the surveys. The differences declined with age being largest for the younger age groups and with the exception of the age cohort 35-40 (44-48 in GDHS), it is observed that the intervals are longer in the later survey.

Table 6.1.1 Mean second birth intervals by comparable age cohort by survey.

Age Cohorts	Survey	Mean	Std dev	N	T-stat
15-19	GFS	28.5	10.2	35	
24-28	GDHS	35.7	16.9	667	-2.496 ^b
20-24	GFS	32.2	12.8	499	
29-33	GDHS	36.7	19.0	601	-4.509 ^c
25-29	GFS	35.7	17.9	790	
34-38	GDHS	38.0	21.9	531	-2.120 ^a
30-34	GFS	35.9	20.0	716	
39-43	GDHS	37.0	22.0	362	-0.824
35-40	GFS	36.7	21.3	903	
44-48	GDHS	34.8	20.5	386	1.483
Total	GFS	35.4	18.7	2943	
	GDHS	36.5	19.9	2547	-2.110 ^a

Table 6.1.2 Mean third birth intervals by comparable age cohort by survey.

Age Cohorts	Survey	Mean	Std dev	N	T-stat
20-24	GFS	29.5	11.4	175	
24-28	GDHS	35.3	17.0	519	-4.205 ^c
25-29	GFS	33.3	14.2	524	
34-38	GDHS	35.1	16.7	494	-1.856
30-34	GFS	36.1	17.1	627	
39-43	GDHS	35.0	18.1	343	0.938
35-40	GFS	36.3	20.7	838	
44-48	GDHS	35.3	24.7	364	0.725
Total	GFS	34.9	17.7	2165	
	GDHS	34.8	18.2	2146	0.183

Table 6.1.3 Mean fourth birth intervals by comparable age cohort by survey.

Age Cohorts	Survey	Mean	Std dev	N	T-stat
20-24	GFS	27.6	10.3	46	
24-28	GDHS	35.3	15.9	395	-3.205 ^c
25-29	GFS	32.3	13.5	263	
29-33	GDHS	35.9	16.5	435	-2.985 ^c
30-34	GFS	34.7	15.7	478	
34-38	GDHS	36.0	20.3	323	-1.020
35-40	GFS	36.1	19.0	750	
44-48	GDHS	33.8	18.3	351	1.894
Total	GFS	34.8	17.0	1537	
	GDHS	34.8	17.3	1695	0.00

Table 6.1.4 Mean fifth birth interval by same age cohort by survey

Age Cohorts	Survey	Mean	std dev	N	T-stat
25-29	GFS	29.2	11.1	118	
34-38	GDHS	35.9	18.2	363	-3.776 ^c
30-34	GFS	31.6	14.2	300	
39-43	GDHS	35.9	18.2	303	-3.233 ^c
35-40	GFS	33.8	16.0	612	
44-48	GDHS	35.3	21.6	318	-1.198
Total	GFS	32.6	15.0	1038	
	GDHS	34.7	18.1	1307	-3.15 ^b

Table 6.1.5 Mean sixth birth interval by comparable age cohorts by survey.

Age Cohorts	Survey	Mean	Std dev	N	T-stat
25-29	GFS	27.8	13.8	40	
34-38	GDHS	35.8	15.6	258	-3.062 ^c
30-34	GFS	32.7	16.6	181	
39-43	GDHS	35.0	19.8	256	-1.277
35-40	GFS	34.6	16.9	463	
44-48	GDHS	36.1	19.2	302	-1.137
Total	GFS	33.7	16.7	684	
	GDHS	34.7	17.7	955	-1.155

a implies significance at .05, *b* implies significance at .01 *c* implies significance at .001

The differences in average interval length similarly declined with age for the third to sixth intervals and are significant for the relatively young cohorts for which sufficient data are available. Thus intervals for ages 20-24 in GFS (and 29-33 in the GDHS) are significantly different for the third birth interval; while differences for age cohorts 20-29 (29-38 in GDHS) are significantly different for the fourth interval. From Tables 6.1.4-6.1.5, the difference for ages between 25 and 34 in the GFS (34-43 in the GDHS) is significant for the fifth interval while for the sixth interval, the difference for age cohort 25-29 (34 - 38 in GDHS) is statistically significant. The next section examines yearly average intervals to determine whether they have been changing significantly over time.

6.9 Time series analysis

To compare the variation in average lengths of closed intervals over time, a time series analysis is carried out. All birth intervals from the second to the fourteenth are strung together individually for the two data sets together with the year in which the

individual interval was closed. Analysis of variance techniques was used to determine if there were significant variations in average interval length by the year of closure by survey and by selected time periods.

Figure 6.2.1 shows the graphs of average interval lengths by year of closing the interval for the GFS and the GDHS. The diagrams show evidence of an underlying linear trend. As expected, the earlier years show evidence of greater levels of fluctuation than the later years probably because events in the later years are likely to be recalled more correctly. It can also be seen that the graphs fluctuate most between 1957 and 1961 probably because the GDHS respondents were recalling events from a more distant past and also probably because of the relatively smaller sample sizes for these earlier years. In the GFS, the average interval length appears to be fairly steady in the period between 1964 and 1977 when it began to increase. The GDHS data also show a small but fairly steady rise from about 1960. Also, intervals occurring near the survey date appear to be lengthening. The graphs suggest some underlying trend towards longer average intervals in both samples. The average birth-interval length appears to vary between 17 months and 37 months for the GFS and 25 and 42 months for the GDHS. The next question of interest is whether this trend is statistically significant.

Table 6.2.1 shows F statistics for the analysis of variance of interval length by period of closing the interval for various segments of the data sets available. The only period for which yearly averages do not appear to be significantly different is between 1946 and 1953; data for this period are available only in the GFS. From Table 6.2.2 the F-statistics for linearity tests for all the periods examined are significant. Next to be examined are intervals that were closed 5, 10 and 20 years before each survey. It is important to compare data for various periods because it has been seen in Chapter 4 that the length of the period over which events are recalled influences the accuracy of the data. The somewhat more pronounced fluctuations observed in the earlier periods of the graphs in Figure 6.2.1 probably show evidence for this.

Fig 6.2.1 Time series graph of mean birth intervals for the GFS and GDHS

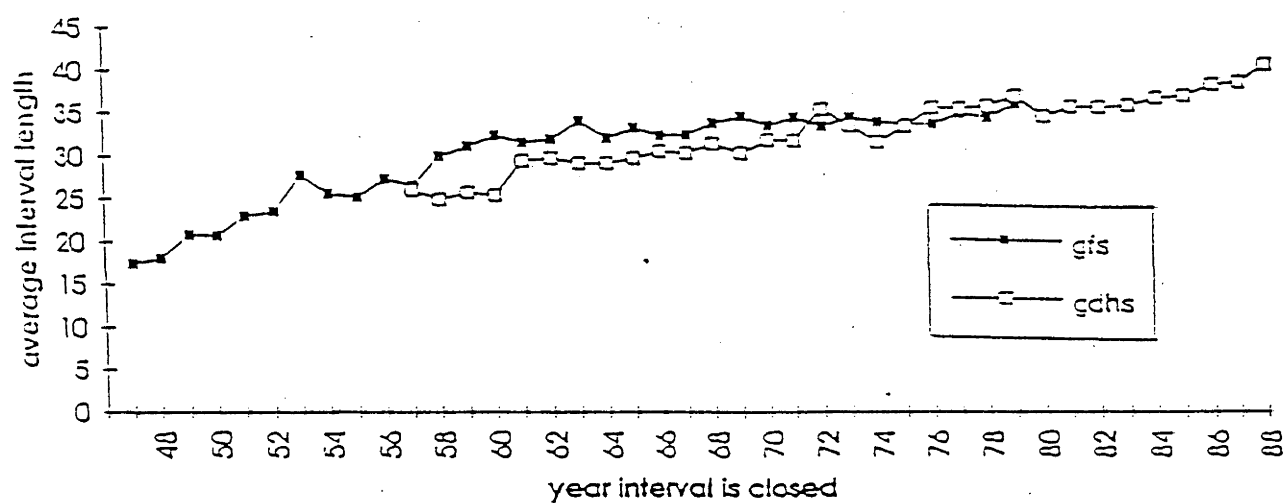


Table 6.2.1 F-statistics for differences for yearly change in average interval length for all intervals by survey.

survey	F-statistics	p-val
GFS	7.97	0.00
GDHS	8.83	0.00

Table 6.2.2 F- statistics for the significance of linearity for data in Table 6.2.1

survey	F-statistics	p-val
GFS	227.7	0.00
GDHS	257.4	0.00

6.9.1 Five years before either survey

The average interval for all birth orders for successive five-year periods before the GFS appears to have declined slightly from 36.3 in 1974 to about 35.9 in 1977 after which it appears to have increased. The average intervals five years before the GDHS rise gradually from a little above 35 months in 1983 to just above 39 months in 1987, a change of about four months; the change for this period in the GFS was about two months, which unlike that in the GDHS is not statistically significant.

6.9.2 Ten years preceding survey

For the period of ten years preceding the GFS survey the average interval length increased from about 34.5 months to a little above 36 months between 1969 and 1971. It appears to have been generally steady between 1971 and 1977, when it increased as noted above. Again the apparent linear increase for the GFS is not statistically significant. For the GDHS, average yearly interval length ten years before the survey increased slightly from just under 36 months in 1978 to just above 37 months in 1979, whence it declined to just above 34 months in 1983; it rose steadily thereafter to above 39 months in 1987. Unlike the increasing trend in the GFS, the increases in the latter survey are statistically significant.

6.9.3 Twenty years before survey

Average intervals for the period 20 years before the GFS survey fluctuates between 31 to 34 months between 1959 and 1963, and is fairly constant till 1977, after which it appears to be rising. The yearly changes in average birth interval length for the 20 years preceding the survey appear to be significant. The mean interval length for the successive 20 years before the GDHS rose steadily from just above 30 months in 1968 to under 39 months in 1987, a difference of about nine months. If birth intervals increased significantly as observed, it is expected that the increase be reflected in fertility decline but this does not appear to be the case. This situation may arise if, for example, age at starting childbearing decreased and childbearing continues throughout the reproductive period. In this case, it is possible for women to have longer birth intervals but maintain the same level of fertility. However, for Ghana, the start of family formation has been observed to be fairly constant over time. The observed trend may also result if the intervals that are closed in the earlier years occurred to the women when they were generally younger since they would be relatively more fecund

and thus have shorter birth intervals. It is also possible that much of the observed trend is just a reflection of errors in the birth interval data.

6.10 Life table analysis

The survival distributions for the second birth interval in the GFS and GDHS are marginally significantly different. The value for the Lee-Desu statistics associated with the distributions is 4.05 ($P = .04$). Table 6.3.1 gives selected life-table measures for the second to the fourth birth intervals. The B_x measures indicate the cumulative proportion of women who proceed to have a subsequent event by single months of duration since a previous event. From Table 6.3.1 it can be seen that of the women who had a second birth within five years of the first, 14 per cent proceeded to the second birth within 18 months in the GFS data and 13 per cent did so in the GDHS data (i.e. $B_{18} = 0.14$ in the GFS and 0.13 in the GDHS). The proportions of these women proceeding to second births within 24 and 30 months in the GDHS are again slightly lower in the GDHS: these are 29 per cent and 46 per cent respectively compared with 31 per cent and 49 per cent in the GFS. The quintums recorded for the GFS and GDHS are the same, that is, 87 per cent in either case. However, the average time taken for half of the second birth interval to be closed in the GDHS is 32.4 months compared to 31 months in the GFS with a spread of about 16 months in either case. The risk of closing the second birth interval appears to be slightly lower in the GDHS for births occurring within 24 and 30 months: elsewhere, it appears to be the same for both surveys.

The proportions of women having their third and fourth births within five years of the second and third births respectively appear to be slightly higher or the same as in the GFS. For example, from Table 6.3.1, while 14 per cent and 13 per cent proceeded to have their third and fourth births after 18 months in the GDHS, about 11 per cent did so in the GFS. The average time taken to close the third and fourth intervals is about

the same or slightly longer in the GDHS. The trimean is about 32 months for both intervals in GFS while in the GDHS it is between 32 and 33 months.

Table 6.3.1 Selected life table measures for birth intervals two to four by survey

Measure	Survey	Birth Intervals		
		2	3	4
B18	GFS	0.14	0.11	0.11
	GDHS	0.13	0.14	0.13
B24	GFS	0.31	0.29	0.29
	GDHS	0.29	0.31	0.30
B30	GFS	0.49	0.47	0.46
	GDHS	0.46	0.47	0.47
B60	GFS	0.87	0.86	0.85
	GDHS	0.87	0.88	0.87
Trimean	GFS	31.11	31.82	32.06
	GDHS	32.42	32.01	32.61
Spread	GFS	15.84	15.24	15.83
	GDHS	16.28	16.09	16.05
Cases	GFS	4563	3641	2840
	GDHS	3416	2758	2196

From the data in Table 6.3.4 the statistic D is equal to 2.33 ($P = .13$) for the third birth interval distribution and 2.42 ($P = .12$) for the fourth interval distribution. Therefore it may be concluded that the third and fourth birth interval distributions are not significantly different in the two surveys.

The distributions of the second to the fourth birth intervals for comparable cohorts are considered next. It can be seen from Table 6.3.2 that average time taken to close the second to fourth intervals for subgroups of the comparable cohorts are generally similar though the patterns are less clear. The average times taken to close these intervals appear to be generally longer in the GFS: for example, the trimeans for the second interval appear to be consistently slightly longer for cohorts in the GFS than for comparable cohorts in the GDHS. The same applies to the third and fourth intervals except for the earliest cohort. For these cohorts, the trimeans are about the same or longer in the GDHS, that is, the trimeans are 31.6 and 33 for the third and fourth

intervals respectively in GFS while in the GDHS, they are 32 and 34 months respectively. The findings for the third and fourth intervals are inconsistent with those for second birth interval. The graphs in Figures 6.3.2 and 6.3.3 show that the chances of proceeding to the third and fourth births are either the same or slightly higher in the GDHS, a reversal of the trend observed for the second interval. However since these differences are not significant, they can be attributed to sampling fluctuations.

Table 6.3.2 Summary life table statistics for birth intervals two to four for age cohorts by survey

			C	O	H	O	R	T	S
Survey	Birth	Summary	15-40	20-24	25-29	30-34	35-40		
GFS	interval	Statistics							
	2	Q50	30.12	35.86	31.57	30.26	30.20		
		Trimean	31.11	34.82	32.11	30.82	30.70		
		Spread	15.84	15.52	15.11	15.84	16.12		
	3	Q50	31.51	31.18	32.26	32.25	30.24		
		Trimean	31.82	31.55	32.53	32.80	30.62		
		Spread	15.24	14.88	15.41	16.78	13.60		
	4	Q50	31.69	31.51	32.85	32.85	30.97		
		Trimean	32.06	32.96	33.28	32.86	31.45		
		Spread	15.83	19.68	16.21	14.74	16.53		
GDHS	Birth	Summary	15-40	20-24	25-29	30-34	35-40		
	interval	statistics							
	2	Q50	32.15	31.92	32.48	30.40	28.80		
		Trimean	32.42	32.50	31.62	30.77	29.60		
		Spread	16.28	16.34	18.90	15.65	15.13		
	3	Q50	31.78	31.84	32.02	30.46	30.24		
		Trimean	32.01	32.12	31.97	30.91	30.20		
		Spread	16.09	17.62	15.81	16.66	13.60		
	4	Q50	32.04	33.22	33.04	30.76	28.97		
		Trimean	32.06	33.53	32.84	31.15	29.68		
		Spread	15.05	16.47	15.85	16.73	15.92		

Table 6.3.3 The quantum and the trimean by cohort and by survey

Birth order	Summary Measure	Survey	Cohorts			
			20-24	25-29	30-34	35-40
2	Quintum	GFS	.8152	.8713	.8704	.8881
		GDHS	.8837	.8575	.8856	.9043
	Trimean	GFS	34.82	32.11	30.82	30.70
		GDHS	32.50	31.62	30.77	29.60
3	Quintum	GFS	.8182	.8367	.8817	.8566
		GDHS	.8663	.8884	.8971	.8784
	Trimean	GFS	31.55	32.53	32.80	30.62
		GDHS	32.12	31.97	30.91	30.20
4	Quintum	GFS	.9327	.8319	.8443	.8483
		GDHS	.8535	.8588	.8890	.9061
	Trimean	GFS	32.96	33.28	32.86	31.45
		GDHS	33.53	32.84	31.15	29.68

Fig 6.3.1 Graph of the cumulative hazard functions for the second birth interval

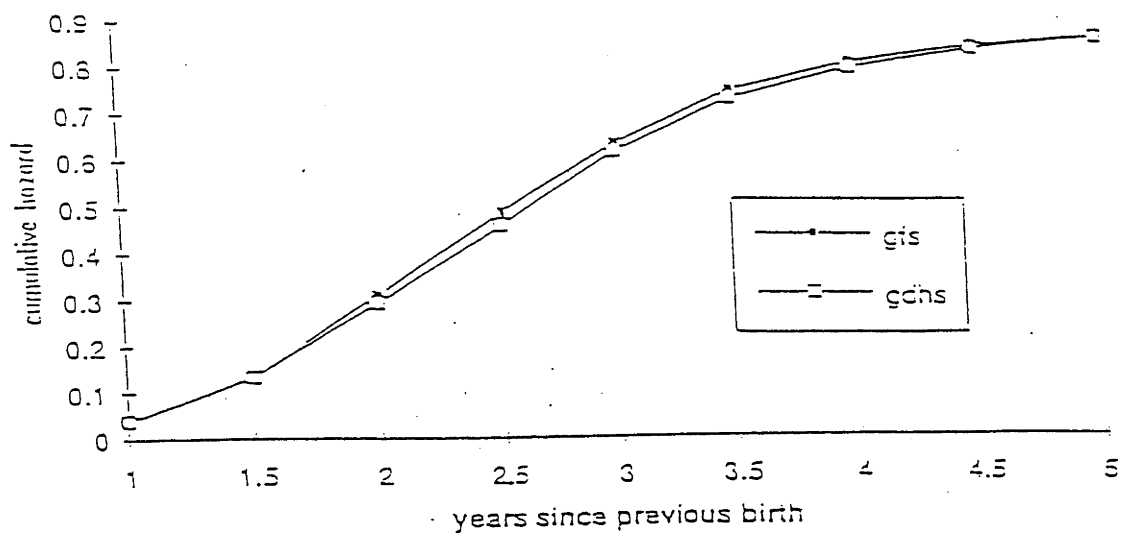


Fig 6.3.2 Graph of the cumulative hazard functions for the third birth interval

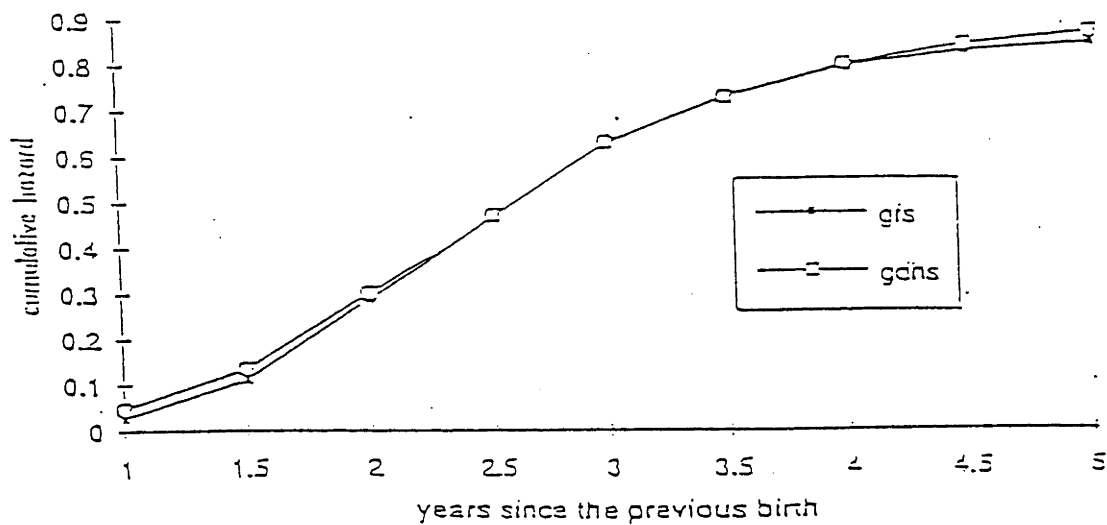
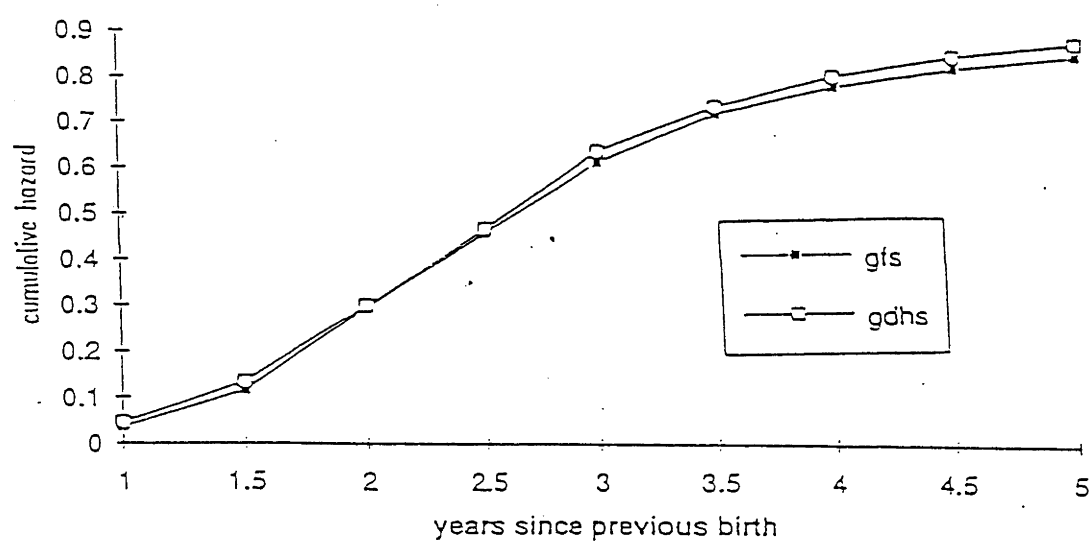


Fig 6.3.3 Graph of the cumulative hazard functions for the fourth birth interval



As noted in an earlier section, trimean values which are close to the median indicate symmetry and stability in the distribution of the timing of the next birth. In terms of the speed of the progression, a symmetrical distribution of timing of subsequent births between the 25th and 75th percentiles implies that it takes as much time for 25 per cent of women who had birth i to have the $(i + 1)$ th birth between the median age and the 75th percentile. Furthermore, small values of the semi-interquartile range (spread) show evidence of the concentration of the pace of closing the respective intervals. If, however, the difference between Q_{25} and Q_{50} is greater than that between Q_{50} and Q_{75} , the trimean will tend to be smaller than the median. This will imply that it takes an additional 25 per cent of women to have the $(i+1)$ th birth between the median and the third quartile of the distribution. If the difference between the median and the third quartile is higher, the rate of proceeding to the $(i+1)$ th birth after the median is slower. From Table 6.3.2, it can be seen that trimeans in both surveys are either approximately equal to or only slightly greater than the medians for all three birth intervals under consideration. It appears therefore that in either data set, there is a constant rate of closing the intervals after the median (which ranges between 30 and 33 approximately in either data set) and before it. This almost consistent pattern of the relationship between the median and the trimean for the cohort aged 15-40 years (24-49 in GDHS) is somewhat replicated in a similar analysis for subgroups.

The median time for closing the second to the fourth interval for all cohorts and for either survey ranges from about 28.8 to 35.9 months while the trimean ranges from 29.6 to 34.8. This appears to indicate fairly symmetrical distribution and hence fairly constant pace of closing these intervals. There is also a general tendency for both the median and trimeans to decrease with age. This suggests that younger cohorts may be starting to delay births longer than the older cohorts, albeit only slightly.

Table 6.3.4 Showing values of the D statistics for the distributions of the second to the fourth birth intervals for age cohorts.

BI	Whole		15-19*		20-24		25-29		30-34		35-40	
	D	Prob	D	Prob	D	Prob	D	Prob	D	Prob	D	Prob
2	4.05	.044	1.84	.175	8.87	.003	.002	.965	.455	.500	2.07	.150
3	2.328	.127	.685	.408	1.36	.243	5.467	.019	5.038	.025	1.476	.225
4	2.419	.120	-		.442	.506	.813	.367	8.000	.005	11.01	.001

* there are insufficient cases for the 4th interval for this age group.

6.11 Multivariate analysis

The analysis in this section is based on intervals that were begun in the 10 years ending two years before the survey: 1968 - 1978 in GFS and 1977-1987 in GDHS. The resultant set of intervals is intended to minimize selection bias. In addition, the series provided is long enough to allow examination of trends and the sample size large enough to permit stable estimates of coefficients (see Bumpass et al., 1986). The analysis covers the second to the sixth birth intervals. The first birth interval was examined in Chapter 5. Intervals for births of very high orders are excluded because they are highly biased towards intervals that were begun close to the time of the survey.

The independent variables considered show significant effects for different birth intervals. The results for the GFS show that all the five intervals initiated in the six years before the survey are less likely to be closed shortly than those that have been initiated 7 - 11 years before the survey. The data also show that while ethnicity appears to be significantly related to the pace of closing the second and the fourth birth intervals, religion is significantly associated with only the sixth. Also, place of residence and age at initiation of the interval are marginally significant for the fifth

birth interval while years of education is associated with the fourth. The period effect is quite similar for the GDHS too, except for the second birth interval for which the differential is not statistically significant. Another finding is the reduced impact of the period effect for all the intervals relative to that found in the GFS. As with the GFS data, different covariates are marginally related to different birth intervals. For example, ethnicity is associated with the second, fourth and fifth intervals; years of education for the second and fourth intervals; while age is associated with the sixth interval.

Table 6.4.3 gives estimates of relative risks for the second to the sixth intervals pooled together within each survey. The data indicate that there is no difference in the risk of having the second to the sixth births for religious and place of residence groups in both surveys. In the GFS, the risk of closing the second to the sixth birth net of the effect of education and period, is significantly lower for the Ewe and the Mole-Dagbani than for the Akan group. For example, the Ewes have about 16 per cent while the Mole-Dagbani have about 22 per cent lower risk than the Akans. However, in the GDHS, only the Mole-Dagbani are significantly different from the Akans with about 28 per cent lower risk.

Table 6.4.3 Estimated regression co-efficient from discrete time Cox proportional hazard model:

	S u r v e y s			
	RR	GFS Z-stat	RR	GDHS Z-stat
Covariates				
Ethnicity				
Akan	1		1	
Ga-Adangbe	1.017	-0.257	.997	-0.038
Ewe	0.838	-3.222	.936	-1.167
Mole-Dagbani	0.778	-5.025	.724	-4.687
Education				
None	1		1	
1-10 years	0.884	-3.074	.934	-1.493
11+ years	0.920	-.820	.736	-3.096
Period				
1st 5 years	1		1	
2nd 5 years	0.483	19.50	.743	-7.26

The effect of education on child-spacing is as expected in the GDHS. The relative risk of having a birth shortly after the previous one is inversely related to the years of the woman's education but the difference in the risk is only significant for women with higher education. The GFS appears to show a curvilinear relationship with women having no education and those having higher education being more likely to have subsequent births soon after a previous birth compared to women having up to ten years of education. A similar finding about the effect of education for fertility was reported by Shah and Singh (1985) and was noted in Chapter 1.

Education is generally negatively associated with fertility. Cochrane et al. (1980) mentioned three mechanisms by which higher educational achievement may result in lower fertility. They noted that higher education is mostly associated with later age at marriage which in turn leads to lower fertility. Also, more educated women tend to be more efficient users of modern contraception, and finally education acts to change the focus of women with respect to desired family size through changes in value systems. This negative association appears to be true in the Ghanaian situation for the more recent data in this analysis. This suggests that more female education, if encouraged, can become a promising path to lower fertility in Ghana.

The period variable seems to be the most important one, influencing child-spacing net of the effect of ethnicity and education in the 11 years preceding either survey although its impact appeared to have lessened considerably in the GDHS. For example intervals initiated in the six years before the GFS have about 52 per cent lower risk of being closed early compared to those started 7 - 11 years before the survey. The intervals in the six years before the GDHS have only 26 per cent lower risk of being closed shortly after their inception.

6.12 Conclusion

This chapter presented various analyses of the birth interval data in the GFS and GDHS data. One main objective was to compare the distributions of the lengths of the intervals obtained in the two surveys. The analysis also sought to determine whether the average birth interval length has been increasing over time and whether selected background variables influence the time taken to close specific intervals. One finding is that the average length of intervals actually closed by year of closure appears to be increasing with time. While this may represent a genuine trend, it could also be an artefact of the data.

The distributions of the time to closing the second to the sixth birth intervals are generally similar in both surveys. The risk of closing these intervals is either the same or slightly lower in the GDHS. The evidence in Table 6.1 shows that the differences in the length of birth intervals for the younger age groups are only marginally different between the two surveys. Finally, there is some evidence of differentials for period, ethnic and education categories. These findings suggest that there is some increase in child spacing in Ghana although it does not appear to be a substantial change.

CHAPTER 7

OTHER FACTORS AFFECTING LENGTH OF BIRTH INTERVALS

7.1 Introduction

It is known that the waiting time to the next conception can be extended by sexual abstinence, by contraception, and by breastfeeding. It is also fairly well known that some form of relationship exists between fertility and infant mortality. Consider for example the so-called postpartum variables. The effect of the practice of breastfeeding and sexual abstinence as the cause of variations in the levels of fertility in non-industrial societies; and prolonged breastfeeding has been shown to be associated with the reduction of fertility by delaying postpartum ovulation and menstruation (Potter et al., 1965; Perez et al., 1971, 1972). After the resumption of menstruation, breastfeeding continues to have a small inhibitory effect on the return of normal ovulation. Presumably, the longer breastfeeding lasts after menstruation resumes, the more anovulatory cycles occur, and the longer the waiting time to conception. Even when ovulation precedes menstruation the chance of conception during lactational amenorrhoea is small. When the waiting time to conception is observed from the end of amenorrhoea however, and abstinence is equal to or longer than amenorrhoea, then abstinence can act to reinforce or extend non-susceptibility. It can be seen that breastfeeding and abstinence are crucial to both amenorrhoea and the waiting time to conception.

With regard to contraception, recent studies have stressed the importance of understanding the choice of contraceptive method and the factors that affect such choice (see Tsui et al., 1981). The importance of the demand and supply of modern contraception as the key components of any programs for changing fertility has been noted (see Freedman and Berelson, 1976). However, effective use of modern contraception is affected by several socio-cultural factors including the norms about marriage, age and women's status in the family. The norms may be prescribed by

religion or the society and they may favour large family size or may regard the birth of at least one boy as highly desirable. For effective supply of modern contraception, a comprehensive infrastructural network of health and family planning services is one of the essential requirements.

Another issue of interest in this analysis is the survival status of a previous birth and its effect on the time to the next birth. The association between infant and child mortality and fertility behaviour has long been a subject of interest among demographers. Some aspects of the association between infant and child death and subsequent reproductive behaviour that have attracted attention in the literature are: the nature of the biological mechanisms involved in the relationship; the effect of actually experienced child loss and that of perceived infant and child mortality. Some of these are discussed further in Section 7.2.3.

This chapter deals with factors other than socio-economic ones that influence the length of a birth interval. Particularly, the analysis will consider the postpartum variables, contraception and the survival status of the penultimate child and its effect on the length of the succeeding birth interval. The main objective is to compare the effect of the selected variables within and across the GFS and GDHS surveys. The analysis is done controlling for the demographic variables, age and parity.

This chapter continues with a review of selected findings relating to the postpartum variables, infant and child mortality and subsequent fertility behaviour; there is discussion of the data, its problems and management and methods of data analysis.

7.2 Some previous related research

Fertility levels in any society are directly related to the biological and behavioral factors called the 'proximate determinants'. These determinants, namely proportions married, contraception, induced abortion, lactation and postpartum abstinence, are deemed to be important for the analysis of fertility changes in a population since the effect of other factors tends to be less variable (Bongaarts, 1978).

7.2.1 Breastfeeding

Breastfeeding is known to have positive effects on fertility and infant and child health. In the absence of breastfeeding, postpartum amenorrhoea commonly lasts about two months (Potter et al., 1965; Salber, Feinleib and MacMahon, 1966; Bonte and van Balen, 1969; Perez et al., 1971). However, in the presence of prolonged and extensive breastfeeding, postpartum amenorrhoea can last for between one and two years (Chen et al., 1974; Singarimbun and Manning, 1976). Page, Lesthaeghe and Shah (1982) noted that breastfeeding can increase the average interbirth interval by about 18 months. The nature of the fertility-reducing effect of breastfeeding does not appear to be known exactly. The explanation has been that high levels of prolactin are produced during breastfeeding to aid lactation, which in turn inhibits the cyclical production of hormonal substances that cause delay in the normal return to ovarian function; but this explanation appears to be in doubt as it is now known that the raised levels of the prolactin hormone which result from suckling do not directly suppress the release of gonadotrophins and luteinizing hormones which are needed for menstruation and ovulation (see Guz and Hobcraft, 1991).

Guz and Hobcraft (1991) showed that breastfeeding influences fertility through the lengthening of the period of postpartum amenorrhoea and also through its influence on the time from the resumption of menstruation to conception. They noted that the

differential impact of breastfeeding on fertility can be attributed to frequency, intensity and timing of breastfeeding, frequency of intercourse and the nutrition of the mother. They have also found strong and persistent reductions in the probability of conception for lactating women who have resumed menstruation and sexual activity.

Breast milk is usually sufficient for all the child's nutritional requirements, both in quantity and composition, for the first few months of life. Even when supplementary food becomes necessary from say four to six months, breast milk can still meet a substantial part of the child's nutritional requirements. One main advantage of breastmilk is that it is uncontaminated and therefore reduces the possibility of the child getting infections from agents that cause gastro-intestinal problems among infants. Finally an important health-related advantage of breastfeeding is the transfer of immunity from infection from the mother to the child, thereby providing the child with defensive reinforcements against infection. This health and hence survival of the infant may in some cases remove the need for extra children (see Jelliffe and Jelliffe, 1978).

Traditionally, women in Ghana tend to breastfeed for extended periods of time. Long periods of breastfeeding are used to ensure the survival of as many offspring as possible in West African countries (see Caldwell and Caldwell, 1977 ; Gaisie, 1984). Gaisie (1984) found significant breastfeeding differentials for ethnic, residential and educational subgroups. For example, children were reported to be breastfed on average for 26 months among the Mole-Dagbani and 21 among the Ewe, while among the Asante, Akwapim and other ethnic groups, the age at weaning is about 18 months. Gaisie also found that breastfeeding in rural areas was about six months longer than in the large urban areas and three months longer than in other urban areas; that children born to women with no formal education were breastfed on average between 16 and 18 months; and that children born to women with secondary or higher education were weaned within 12 months on average.

Guz and Hobcraft (1991) found that for Ghana, the average three-monthly conception rate for six to 24 months of exposure is 6 per cent for women still breastfeeding, 13 per cent for those who never breastfed and 18 per cent for women who have weaned their children. Ratios of the conception rate for those who are breastfeeding to those who have weaned indicated the fertility difference between the two groups. The study found about 66 per cent reduction in probability of conception for the still breastfeeding and 28 per cent for the never-breastfed group.

Guz and Hobcraft (1991) also found that in Ghana, the conception rate over the first 18 months of sexually active menstruating exposure for those still breastfeeding is about 10 per cent and for those who have weaned, the rate is about 18 per cent. Thus, the risk of conception over the first 18 months for women who are still breastfeeding is about 56 per cent less than that of women who weaned their children. Finally, Trussell et al. (1992) reported that the average breastfeeding duration increased by between two and three months in Ghana from the GFS to the GDHS.

7.2.2 Postpartum sexual abstinence

The practice of postpartum sexual abstinence for extended durations has been noted for certain traditional communities in West Africa, for example the Yoruba (Caldwell and Caldwell, 1977), the Ewes (Kumekpor, 1975) and in rural Senegal (Cantrelle and Leridon, 1971). Bleek (1976) has noted however that postpartum abstinence may not exceed six months in certain rural areas of Ghana. The reason for prolonged postpartum sexual abstinence is to maintain good health of the mother and the child, thus maximizing the number of living children (see Lorimer, 1954; Caldwell and Caldwell, 1977). Coulibaly and Pool (1973) observed that abstinence was becoming more prolonged in rural areas than in the urban areas of Ghana and Burkina Faso.

While some researchers are of the view that since postpartum abstinence does not depend on parity, it may not be regarded as a method of fertility regulation (see Saucier, 1972), others have also noted the possible role of abstinence in keeping fertility below what it would otherwise have been. Caldwell and Caldwell (1977) suggested for example that prolonged postpartum abstinence may have led to a 25 per cent reduction in fertility among the Yoruba of Nigeria.

7.2.3 Infant and child mortality and subsequent fertility

Notestein (1945) noted that decline in mortality would reduce the social need for many births, though only after a lag period, because there was not likely to be rapid change in the social norms which previously guided reproductive behaviour to offset the effect of high infant and child mortality. It is observed that infant and child mortality may affect fertility through the biological mechanisms that operate through the shortening of breastfeeding, leading to a quicker return to ovarian function as a result of a child's death, and also through an individual couple's response to perceived mortality in their community or to experience of past child death. Furthermore, the society's means for coping with high probability of child death may lead to social institutions that ensure the maintenance of high reproductive goals.

It is also argued that the decline in infant and child deaths in societies which practise little contraception and long breastfeeding will lead to an increase in the net reproduction rate although the extent of the increase will be mitigated by the extent of breastfeeding as the biological effect of prolonged breastfeeding on the duration of postpartum amenorrhoea becomes pronounced. If infant and child deaths fall, relatively fewer lactation periods will become interrupted and this results in changes in the relationship between breastfeeding and amenorrhoea. The couples' response to perceived child loss is termed the insurance effect while their response to an actual child loss is known as the replacement effect. The insurance argument states that the reproductive goal of couples is to have surviving children mainly as an insurance in

their old age, which is essentially a rational goal in societies in which there are no formal institutions to take care of the aged. The replacement theory on the other hand presumes that couples have reproductive goals and are able to control fertility once these goals have been achieved (Knodel and van de Walle, 1967; Heer and Smith, 1967; Preston, 1978). The birth of a younger child could also cause the death of the older one if the older one is prematurely weaned as a result of the new pregnancy, and the older child may die before the younger one is born (Harrington, 1971).

Iskandar and Jones (1977) examined the effect of infant and child mortality on subsequent birth intervals and found evidence of the tendency to compensate for childhood mortality through shorter birth intervals following the experience of child death at lower parities. Santow and Bracher (1984) also found for Javanese data that the probability of having another child increased when the reference child had died

While these studies provide some indication of how social and biological factors may combine to influence fertility, the nature of the association between infant and child mortality and fertility does not appear to be a straightforward one. Heer (1983) noted that besides showing strong evidence of the existence of a relationship between infant and child mortality and subsequent fertility, research in the last 20 years has not definitely established a direction of the causal link between the two phenomena.

7.3 Data problems and management

The analyses in this chapter are based on three types of data: reported durations of breastfeeding, amenorrhoea and sexual abstinence in the open birth interval; data on the ever-use and current use of modern contraception; and data on the survival status of the penultimate child and the length of the subsequent birth interval. The data on the post-partum variables are available for only the last two births and the problems associated with this are discussed. Also discussed are the problems associated with the form of measurement of breastfeeding data.

The data on breastfeeding in both GDHS and GFS can be analysed as retrospective breastfeeding durations or current status data. The aspect of breastfeeding that is of interest in this chapter is the duration or length of breastfeeding and possible correlates. Various aspects of the distribution of breastfeeding durations are compared for the GFS and GDHS. The duration data for breastfeeding in both the GFS and GDHS are measured in months. Retrospectively reported breastfeeding data consist of the duration of breastfeeding for those children who have been weaned, and the current duration of breastfeeding for those children who are currently still being breastfed, and an indicator of current breastfeeding status (weaned or not) at the interview date. In terms of survival analysis, the observation for such children is considered to be censored in that all that is known is that they have been breastfed up to the point of the last observation and whatever happened thereafter is not known. Assuming that breastfeeding for the censored cases started soon after birth, the censored duration of breastfeeding is taken to be equal to the age of the child at the survey date. Lesthaeghe and Page (1980) have shown that such data usually show heapings on durations of 6, 12 and 18 months.

Heaping in reported postpartum durations can indicate genuine reporting of appropriate cultural norms with regard to these practices (see Bracher and Santow, 1981, 1982; Trussell et al., 1992). However, such heaping can also be due to misreporting. For example, Haaga (1988) found that the same characteristics predicted heaping in the reported durations of breastfeeding and amenorrhoea. The incidence of a generally similar pattern of heaping found in the data for amenorrhoea may not be real because amenorrhoea is not under the voluntary control of the respondent (see Trussell et al., 1992). The extent to which such observed heapings constitute genuine cultural practices for a particular data set is often difficult to determine. And it cannot be determined to what extent heaping which is not a reflection of normative behaviour, distorts the shape of the distribution.

It is also difficult to detect systematic tendencies to overstate or understate breastfeeding durations unless the errors are gross. Whereas overstatement of breastfeeding durations may lead to visible inconsistencies (breastfeeding durations in excess of the current age of the child or its age at death), its understatement would not result in any visible inconsistency and therefore remains unnoticed.

7.3.1 Reported durations of breastfeeding, amenorrhoea and abstinence

Although as noted postpartum abstinence and breastfeeding durations may be culturally based, and therefore the heaping in the postpartum variables may indicate normative durations rather than actual ones, care is needed in the analysis and interpretation of data in which considerable heaping is evident. On the basis of comparative analysis involving current status and reported durations data, Guz and Hobcraft (1991) concluded that mean reported durations are unbiased in spite of the presence of heaping in the data, and noted that there is usually not much detail contained in fertility data about these errors to enable appropriate adjustments to be made. However, the choice of samples and the application of statistical techniques appropriate for grouped data are expected to reduce the impact of these errors in the analysis.

Figures 7.3.1 to 7.3.6 show graphs of the distribution of breastfeeding, amenorrhoea and sexual abstinence in the open and last closed birth intervals. There is clear evidence of preference for even numbers for all three postpartum variables under consideration in this chapter. The breastfeeding data show evidence of heaping on durations of 12, 18 and 24 months in both surveys. There is also a remarkable similarity between the patterns of heaping in the reported breastfeeding durations for the open and the last closed intervals in the individual surveys as well as across the surveys. The patterns of preferences in the amenorrhoea and the sexual abstinence durations also appear similar for both the open and closed intervals and for both data sets. The most popular durations beyond 11 months appear to coincide with those for the breastfeeding data, although to a lesser extent. Figure 7.3.5 shows one exception to

the general preference for even numbers, as the duration of three months is reported by between 6 and 9 per cent of the respondents in either survey.

Similar patterns of irregularities in data on the postpartum variables have been reported in some previous research (Lesthaeghe and Page, 1980; Gaisie, 1981). Gaisie (1981) suggested that in addition to possible effects of rounding error, expectations about general notions concerning developmental processes such as children learning to crawl between six and nine months and walking between 12 and 18 months might have led to the tendency to use these durations as landmarks to determine durations of breastfeeding and postpartum sexual abstinence. Gaisie (1981) also noted that the fact that data on postpartum amenorrhoea also follow the same pattern as breastfeeding and sexual abstinence indicates the effect of rounding error over and above that of normative reporting.

Fig 7.3.1 Per cent distribution of reported durations of breastfeeding in the last closed interval for the GFS and GDHS data

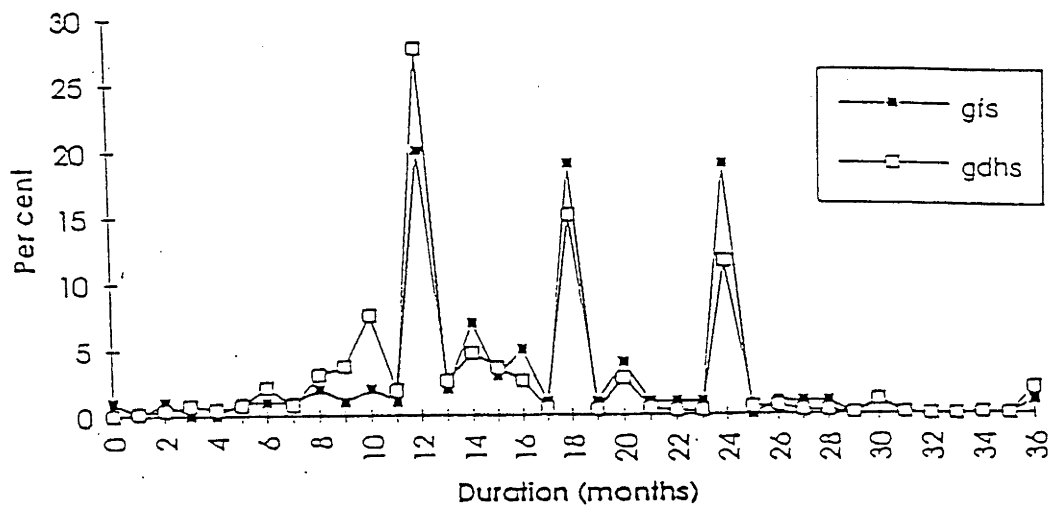


Fig 7.3.2 Per cent distribution of reported durations of postpartum amenorrhoea in the last closed interval for the GFS and GDHS data

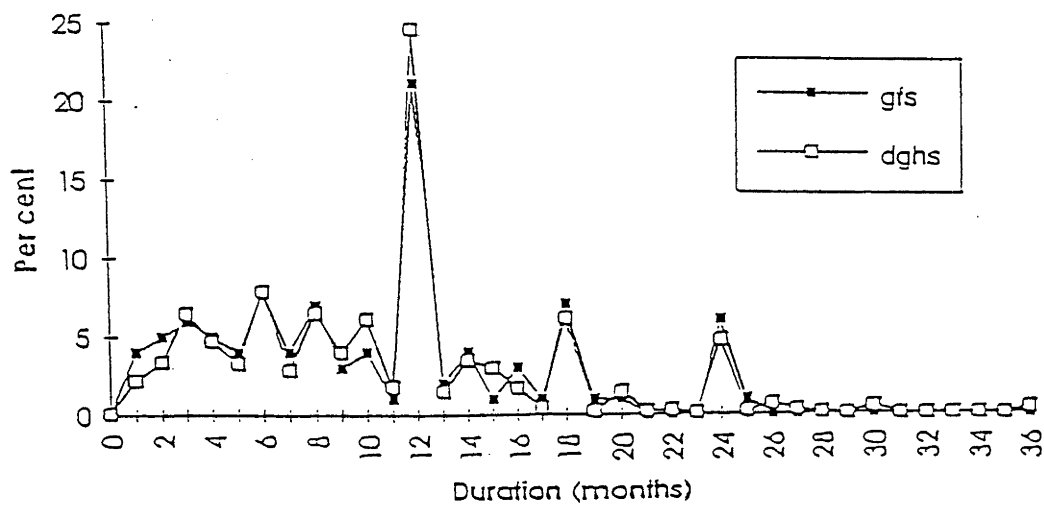


Fig 7.3.3 Per cent distribution of reported durations of postpartum sexual abstinence in the last closed interval for the GFS and GDHS data

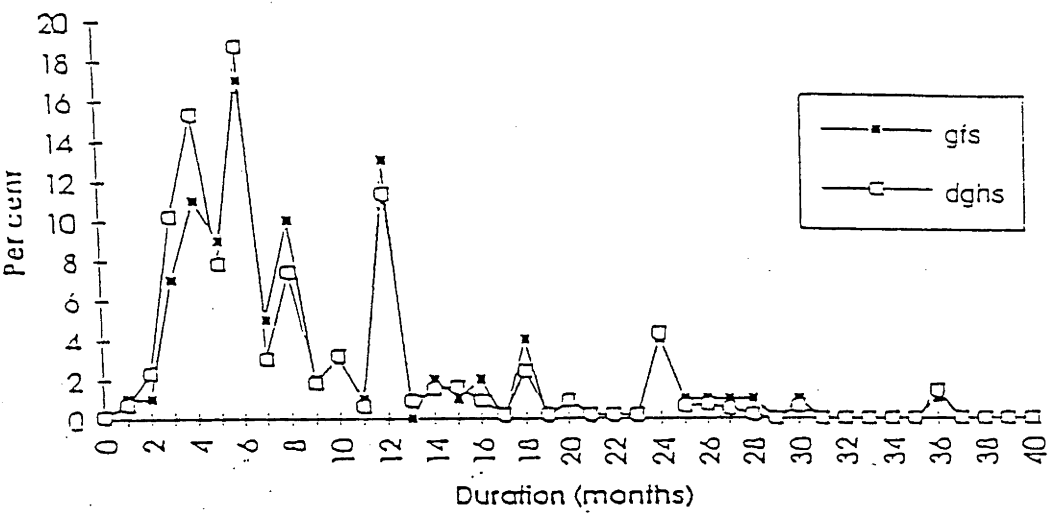


Fig 7.3.4 Per cent distribution of reported durations of breastfeeding in the open interval for the GFS and GDHS data

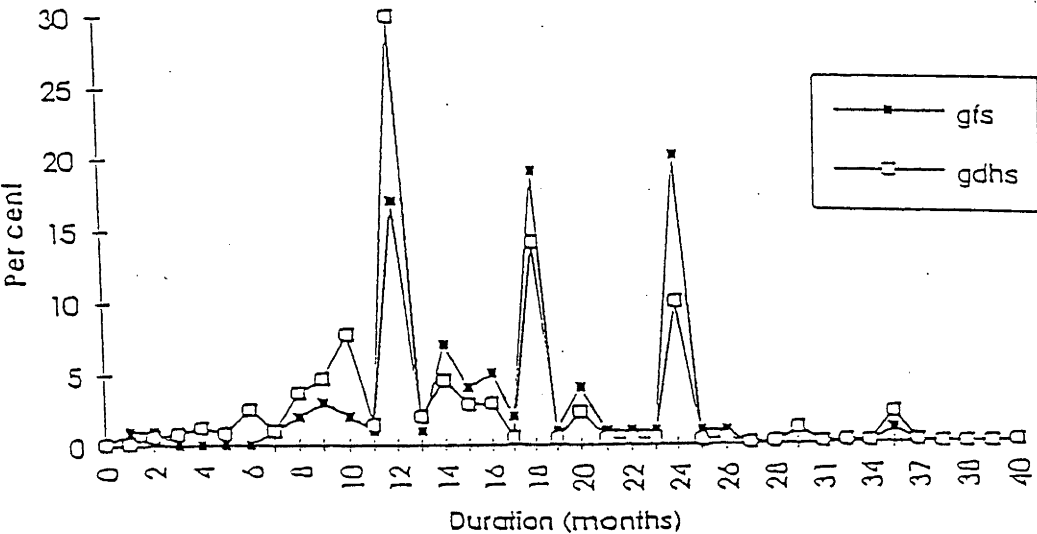


Fig 7.3.5 Per cent distribution of reported durations of postpartum amnorrhoea in the open birth interval for the GFS and GDHS data

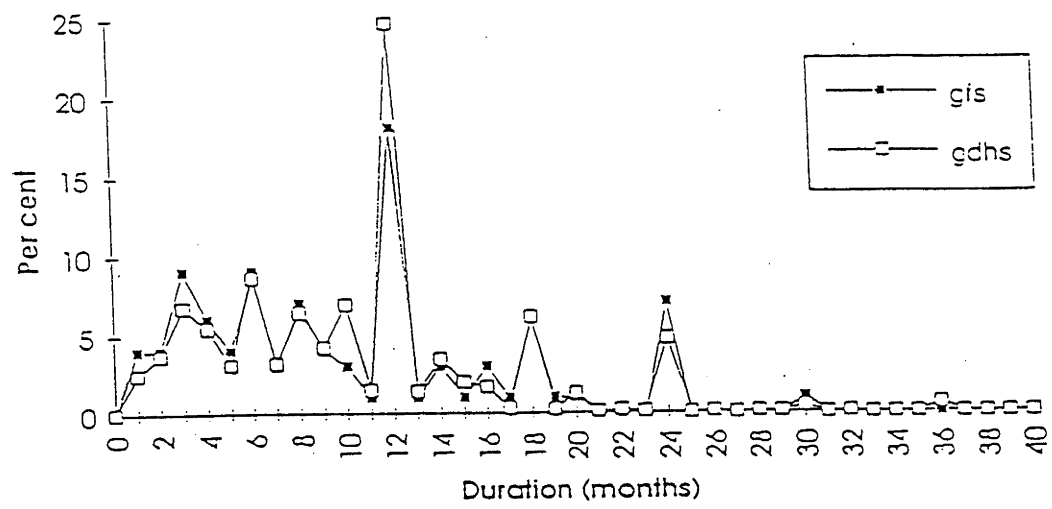
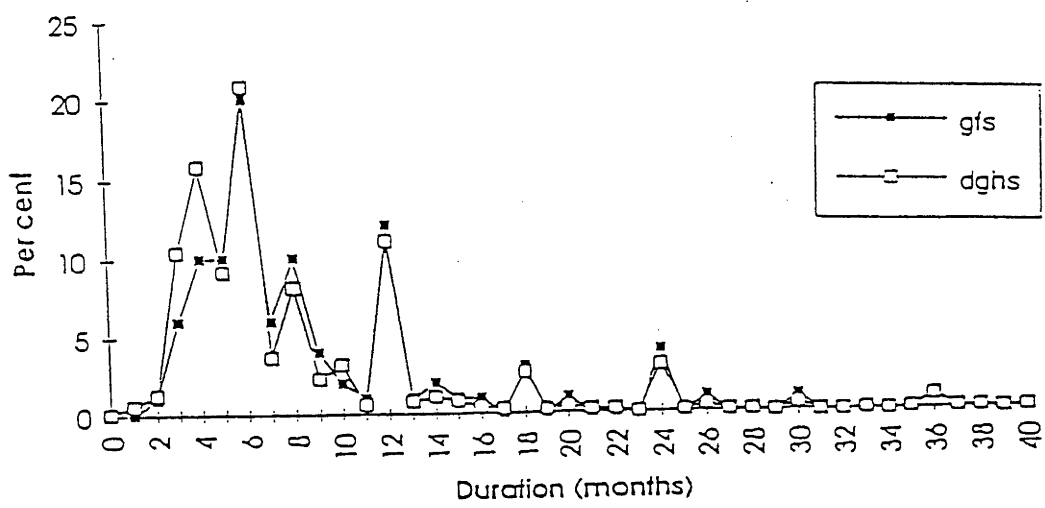


Fig 7.3.6 Per cent distribution of reported durations of postpartum abstinence in the open birth interval for the GFS and the GDHS data



7.3.2 Current-status breastfeeding data

Current-status breastfeeding data on the other hand refer to the breastfeeding status (still breastfeeding or weaned) at the interview date. These data, combined with the duration of time elapsed since the birth, yield independent estimates on the distribution function for the length of breastfeeding. Lesthaeghe and Page (1980) showed that current-status data are unbiased since women can report their current breastfeeding status accurately. Bracher and Santow (1981) have noted that such data are subject to other biases besides those in reporting of dates of birth.

Since current breastfeeding status data are used in conjunction with age data, they are liable to errors that may occur in the recorded dates of birth. The result of heaping in the reported dates of birth would be to distort the shape of the distribution of the length of breastfeeding as well as the analysis of proportions still breastfeeding. These data may also be inaccurate, when women who are still breastfeeding wrongly report the number of months they intend to breastfeed instead of indicating that they are still breastfeeding. This could lead to a downward bias in the apparent proportions still breastfeeding. The choice between current-status data and retrospectively reported data is a question of the trade-off between bias and precision. Furthermore, the use of current-status data involves loss of information since for uncensored observations only an upper limit for the length of breastfeeding is used in the analysis rather than the reported exact length of breastfeeding. It is also known to have larger sampling variability than reported duration of equal size (Vanderhoeft, 1982; Diamond, McDonald and Shah, 1986). Trussell et al. (1992) showed that the choice of data base affects the conclusions drawn about breastfeeding. It would have been ideal to include both types of data in the current analysis but practical considerations preclude this and only the reported-durations data are used with analysis procedures that mitigate any defects in the data.

7.3.3 Selection effects

Selection effects occur as a result of obtaining data on only the two most recent live births (Page et al., 1982). Because such data refer to a relatively short segment of each woman's experience and also to a segment that is different for all women, the analysis excludes a substantial part of the experience of the younger women as well as most of the older women's experiences. Furthermore, among women who are actively bearing children, women with short birth intervals will be reporting on births that occurred more recently than their counterparts who have long birth intervals. A procedure for dealing with the different historical influences is to restrict analysis to births occurring within a fixed period of time (Page et al., 1982); but this excludes mainly the older women who stopped childbearing a long while ago and reduces the sample size; a partial solution is to adjust results for effects of age at reference event and parity.

7.3.4 Measurement of postpartum variables

Questions on postpartum variables in the GFS were restricted in the core questionnaire to the woman's two most recent live births, but to the two most recent confinements that resulted in a live birth in the modified version (FOTCAF), both of which were used in the Ghana survey. In the core questionnaire, breastfeeding data for a woman who has had one live birth could have either been a reported duration when the child was weaned before the survey date or current-status information if the child is still being breastfed by the survey date. Where a woman has had two or more live births, both of the last two babies would have been weaned or else the last one is still being breastfed. Here, the duration of breastfeeding of the last but one child and that of the last child are obtained if both are weaned. If the last child is still breastfeeding, then only the information that it is being breastfed is provided.

This definition also applies to the women with the data in the FOTCAF modules who were not reported to be pregnant at the time of the survey. For those women who have had at least one live birth and were pregnant at the time of the interview, the standard definition of the current open interval (from the time of the birth of the last child to the time of the survey) was redefined to be from the time of birth of the last child to the expected date of delivery and labelled as the last closed interval. Such women therefore have no open interval defined for them. Also, for women with two or more children who were pregnant at the time of the survey, only the last closed interval was defined: the time of the birth of the last child to the expected date of delivery.

The WFS definition in these cases was converted to the standard definition by excluding data for postpartum variables for wasted pregnancies. Also, for currently pregnant women, data originally attributed to the closed interval were transferred to the open interval. Furthermore, data for women whose last pregnancy was wasted reverted to the open birth interval while data on women whose penultimate pregnancy was wasted were treated as missing; and finally, if both the last two pregnancies were wasted then the woman was regarded as being childless.

7.3.5 Other problems associated with breastfeeding data

Trussell et al. (1992) discussed the effect of the differences in the mode of collecting breastfeeding data for the last birth and the treatment of inconsistent cases in the GFS and the DHS surveys. For example, in the WFS, if the child was ever breastfed, the number of months for which it was breastfed was obtained and the interviewer noted the duration or indicated whether the child was still being breastfed. For the DHS, if the last child was ever breastfed, the interviewer then asked whether the child was still being breastfed and if the answer was negative, the interviewer obtained the number of months that it was breastfed. Trussell et al. (1992) pointed out the problem of handling discrepant cases, that is, cases for which the number of months the child was

reported to be breastfed exceeded the age of the child. While the discrepant cases in the GDHS were coded as inconsistent in the DHS, they were not similarly identified in the WFS. The procedure adopted in this analysis was to determine the inconsistent cases and exclude them from the analysis.

There are difficulties associated with the evaluation of the effect of breastfeeding on fertility, in that while breastfeeding practices affect the time for a woman to experience the next pregnancy, the occurrence of this pregnancy can in turn influence breastfeeding. This is the case when a woman stops breastfeeding only when she realizes that she is pregnant. These two effects are confounded since no information is available about whether the stoppage of breastfeeding was due to pregnancy (see Page et al., 1982). Furthermore, it is difficult to determine an uncontaminated form of the relationship between breastfeeding and fertility because each of these variables is in turn affected by other variables. Guz and Hobcraft (1991) noted that resumption of menstruation after a birth may be confused with postpartum bleeding and that pregnancies that do not yield livebirths may not be recognized, but concluded that in spite of these problems the closeness of the relationship between breastfeeding and fertility can be demonstrated among several populations where the relationship is strong.

7.3.6 Sample and variable selection

A number of explanatory variables for the analysis of breastfeeding and sexual abstinence differentials have been considered on the basis of their likelihood of influencing the decision to wean or resume sexual activity, their demonstrated effect in previous research and the comparability of their measurement in the GFS and GDHS. Six explanatory variables were initially chosen for examination in the study: place of residence, education, religion, ethnicity, parity and age. The religion variable did not have any significant effects on either breastfeeding or abstinence in the preliminary

bivariate analyses (results not shown) but showed marginal significance for breastfeeding in the WFS data. Age and parity are included as demographic controls.

The analysis involving the postpartum variables is based on data for all births that occurred in the five years preceding each of the surveys. The GDHS data are available only for this period and a comparable period was selected for the GFS. This window of observation is expected to reduce errors arising from recall for intervals that were started a long time before the surveys and also to reduce selection biases for very recent intervals. For this choice of window, Trussell et al. (1992) noted that estimates of breastfeeding in the WFS will be biased upwards if the age-at-weaning data were accurately reported and this bias either might not show or might be exaggerated if there are systematic errors in the data.

Finally, the data on breastfeeding were of two types: duration of full breastfeeding and total duration of full plus supplemented duration of breastfeeding. The duration of total breastfeeding is used in this analysis because unsupplemented breastfeeding is usually too short for enough to be learnt about its distribution. Data on the use of contraception during the open and closed birth intervals were obtained from the core questionnaire but similar data were not available for the GDHS. The analyses involving contraception and the effect of survival status of the penultimate child and birth interval have no time restrictions and are not related to specific intervals.

7.3.7 Choice of explanatory variables

Women may stop breastfeeding soon after a birth because of medical or physical problems; however, others will breastfeed for some extended duration based on several socio-economic factors. Some of the factors that have been found to affect differences in breastfeeding include place of residence, education, ethnicity, income and place of work (Jain and Bongaarts, 1981; Gaisie, 1981; Bracher and Santow, 1982; Huffman,

1984). Urban residence is thought to be negatively related to breastfeeding because mothers in urban areas see bottlefeeding as a sign of modernity and sophistication, because it is convenient for mothers employed outside the home and finally because young mothers in these areas have fewer role models to copy. Education is usually found to be negatively related to breastfeeding in developing countries. Other variables that are relevant in the study of breastfeeding include the mother's age, parity and contraceptive use. Age and parity have been found to be related to longer breastfeeding durations (Smith and Ferry, 1984) while the use of modern contraception tends to be associated with shorter durations and less probability of breastfeeding (Akin et al., 1986). Age may be used to control for cohort, fecundity or other normative aspects of reproduction. The control for cohort effects is relevant if breastfeeding is declining over time in the society. Also, older women are likely to breastfeed longer since they are less likely to conceive. Parity is important because women with more births are those who are more likely to be highly fecund or attached to more traditional values and behaviour (Trussell et al., 1992). If breastfeeding is being used for family limitation purposes, then its duration is expected to be longer at higher parities.

The relationship between breastfeeding and women's work status is not consistent. For example there is no conclusive evidence that mothers who work outside the home are unable to feed their babies (see Smith and Ferry, 1984). Some studies have observed the expected negative impact of work place since marriage (Mott, 1984) but others did not (Jain and Bongaarts, 1981). Trussell et al. (1992) noted that the estimated effects of employment status cannot show the extent to which work and lactation are not compatible because the timing of the woman's work cannot be determined from the data used in such studies. The income and work status variables are not used in this analysis.

7.4 Data analysis and methods

Several statistical techniques have been applied in the analysis contained in this chapter. These include correlation analysis, analysis of variance, life-table analysis, logistic regression and discrete time proportional hazards model. This section discusses the implementation of the discrete time proportional hazards model as applied to breastfeeding and sexual abstinence in the open birth interval. A similar discussion of the logistics regression model is provided in section 7.5.5.

7.4.1 *Cox's proportional hazards model*

The dependent variables here are measured as the duration of time from birth of a child till termination of its breastfeeding, assuming breastfeeding started soon after the birth; and also the duration from time of birth of a child till the mother resumed sexual activity. The measurement of both variables is incomplete in that there is censoring of the experience of the women who did not wean or resume sexual activity (following the birth of their penultimate children) before the interview but who eventually did so. Such experiences are said to be right censored because all that is known about them is that the event of interest did not occur by the survey date. Life table methods and multivariate hazard analysis are used to avoid biases resulting from such censoring.

Decisions about duration of time have been analysed within the framework of either discrete or continuous - time hazard models (see Lancaster, 1990). Discrete time models are preferred if the distribution is marked by heaping at certain points in time such as 6 or 12. Peterson (1991) noted that this type of time aggregation can lead to biased results. For the discrete time model implementation here the duration of breastfeeding is expressed in the dichotomous form showing whether a child is still breastfeeding or weaned in each of several grouped intervals. A similar treatment is applied to the sexual abstinence variable.

The discrete-time Cox's proportional-hazards model is used to determine the effects of the selected explanatory variables upon the probability of weaning occurring to the individual in the next instant of time. The subperiods used are as follows: 0-4, 5-7, 8-10, 11-13, 14-16, 20-28, 29-40, 41-60. The grouping intervals chosen are such that the endpoints straddle the durations for which heaping has been observed. Also considered is the fact that there are few observations at the longer durations. All covariates are treated as indicator variables that are specific to the subperiods.

7.4.2 Assumptions

The set of background variables included in the model is assumed to be fixed. This implies that they did not change¹ at any time over the course of the interval after the mother is at risk of weaning or resuming sexual intercourse. They are also assumed to have the same (proportionate) effect on the hazard at all durations. In addition the estimation procedure also assumes that all heterogeneity is measured by the explanatory variables included in the model and that all intervals are mutually independent, that is, individuals with the same value of all covariates in a subperiod have exactly the same risk.

The assumption that the effect of a covariate is constant over the range of failure times may be tested by plotting the function, $\log_e(-\log_e S_o(t))$ against the time variable, t for each group of covariate categories. If the proportionality assumption holds, the resulting curves show constant differences (parallelism). It has however been argued that the proportional hazards model is robust and that even if this assumption is violated, a satisfactory approximation is obtained (Allison, 1984 cited in Roden, 1989). The graphs in Fig 7.4 Appendix 2 show approximate parallel curves for most of the covariates and the proportionality assumption is taken to be valid for the applications in this chapter.

¹ It is possible that a respondent's years of formal education change while she is at risk of weaning or resuming sexual intercourse after a birth especially given the generally extended durations of breastfeeding and sexual abstinence practised in Ghana. For example, young schooling mothers can move from say the tenth to the eleventh year of schooling. In practice however, such cases will be few since they will involve women who are simultaneously nursing and schooling.

7.4.3 Model selection

The problem here is to determine how adequately the model accounts for the variation that is observed in the data. Poor fit can be attributed to violations in the assumptions, such as the presence of non-linearities or interactions, or it might be due to non-random error. The forward stepwise model selection is used to determine which models to include in the final model. In the procedure used here, the null model is fitted initially, followed by all main effects one at a time. Next, the most significant explanatory variable is fitted together with the overall mean, followed in turn by all the remaining explanatory variables as before. To determine whether an extra added variable is significant, the decrease in the chi-square value from the model without this variable and to the model with the variable is compared with the corresponding change in the degrees of freedom. If the drop is large, compared with the degrees of freedom, then the current model is accepted over the former. After exhausting the main effects, first-order interactions are similarly tested. Three or more factor interactions were not considered in the model selection procedure because they considerably increase the number of parameters to be fitted and hence the cost of model fitting, and render model interpretation more difficult.

The null hypothesis that is tested at each turn in the given model, and the probability computed from the chi-square value and the degrees of freedom, measures the probability that the data were generated from the given model. Because the given model is based on several simplifying assumptions so that the model can be estimated, it may not fully reflect the complex process underlying the data. A null hypothesis may therefore be rejected because of the simplifying assumptions. Finally, because the samples are large, the more conservative significance level of 0.01 was used to include or exclude a variable in the sample.

7.5 Results and discussion

7.5.1 Durations of breastfeeding, amenorrhoea and postpartum sexual abstinence in the open and last closed intervals

Medians of the distributions of breastfeeding, amenorrhoea and sexual abstinence in open and last closed birth interval by ethnicity are shown in Table 7.5.1. The median durations are obtained in months since the birth of the child. Life-table techniques are used to obtain the median values for the open interval while for the closed intervals the median durations were obtained by ordering the observations. The analyses are limited to cases in which the child survived till weaning.

Table 7.5.1 Medians of the distribution of breastfeeding, amenorrhoea and sexual abstinence in the open and closed intervals by ethnic group and by survey

Survey/groups	Breastfeeding		Amenorrhoea		Abstinence	
	open	closed	open	closed	open	closed
GFS	17.3	13.0	12.7	12.0	8.1	6.0
Akan	14.4	12.0	12.4	10.0	6.7	6.0
Ga-Adangbe	13.9	12.0	11.4	10.0	7.1	6.0
Ewe	18.9	14.0	13.4	12.0	10.9	9.0
Mole-Dagbani	26.1	23.0	14.3	12.0	25.7	17.0
GDHS	20.7	18.0	13.5	12.0	11.1	7.0
Akan	19.8	16.0	12.9	9.0	8.0	6.0
Ga-Adangbe	19.6	15.0	12.9	12.0	11.6	7.0
Ewe	20.5	18.0	13.3	10.0	13.3	10.0
Mole-Dagbani	26.2	24.0	18.4	12.0	28.1	15.5

It can be seen that median durations of breastfeeding in the open birth interval have increased except among the Mole-Dagbani where it has been consistently high for both surveys. For example, the duration in the open interval for the overall data sets

increased by about 20 per cent from 17.3 months in the GFS to 20.7 months in the GDHS. For the last closed interval, the increase is about 38.5 per cent. Also the median breastfeeding in the open interval increased by about 36 per cent for the Akans but the increase for the Mole -Dagbani is less than one per cent. The data also show that the durations by which half of the women in both surveys resumed menstruation are generally similar, while those for sexual abstinence appear to have increased slightly in the later survey. Also notable is the consistency of the relatively high average durations of postpartum abstinence among the Mole-Dagbani. Gaisie (1981) suggested that differentials in postpartum variables are probably a major cause of regional differentials in fertility in Ghana, and that a better explanation for the link between socio-economic variables and fertility may be obtained by considering postpartum variables.

The median breastfeeding duration observed for the combined breastfeeding in the open and closed intervals for the GFS is 14.2 months and that for the GDHS is 18.1 months yielding an average increase of about three months. Trussell et al. (1992) reported similar results for the overall data in the Ghana surveys. Estimates of proportions ending at specific intervals are generally higher for the GDHS data, a probable indication that any fertility decline shown between the two surveys is at best minimal.

7.5.2 Correlations among postpartum variables parity and age at event

The relationship between breastfeeding, amenorrhoea and fertility has been discussed in the literature (see Perez et al., 1971, 1972; Brown, Harrison and Smith, 1985; Santow, 1987). The delay in the return of ovulation which is caused by protracted breastfeeding may be shown by the correlation between the length of time a child is breastfed and the duration of amenorrhoea (see Perez et al., 1971, 1972). This section explores the nature of relationships existing between breastfeeding, abstinence, and

selected background and demographic variables, for example, age of mother at confinement and parity, using simple correlation analysis. The data for the last live birth are analysed separately. Trends in breastfeeding and abstinence durations using the grouped-data proportional-hazards model are explored in section 7.5.4.

The Pearson correlation coefficient is used to summarize the strength of the linear relationship between pairs of the postpartum variables, age of the mother at confinement and parity, and also to test the null hypothesis that there is no linear relationship between selected pairs of the variables in the population sampled. When the null hypothesis is rejected, it implies that the value of the population correlation coefficient is unlikely to be zero. If a sufficient number of coefficients are tested at the 5 per cent level of significance for example, 5 per cent of the coefficients will be seen to be statistically significant when in fact they are not.

Table 7.5.2 Estimates of coefficients of correlation between durations of breastfeeding (bfg) amenorrhoea (amnr) abstinence (abst) and parity and age of mother at birth for the last closed interval by ethnicity by survey.

Survey	Bfg & amnr	bfg & abst	bfg & age	bfg & par	abst & age	abst & par	abst & amnr
GFS	.34 ^b	.56 ^b	.05	.03	.02	.03	.38 ^b
Akan	.24 ^b	.10 ^a	.05	.10 ^a	-.03	-.03	.13 ^b
G.Ad	.33 ^b	.12	.11	.12	-.05	-.05	.32 ^b
Ewe	.28 ^b	.35 ^b	.04	.03	.00	.00	.40 ^b
M-Dag	.38 ^b	.69 ^b	.15 ^b	.10 ^a	.09 ^a	.02	.52 ^b
GDHS	.43 ^b	.39 ^b	-.03	-.03	-.01	-.04	.44 ^b
Akan	.35 ^b	.11 ^a	-.07	.01	-.10	-.09 ^a	.21 ^b
G.Ad	.33 ^b	.19 ^a	.06	-.04	-.02	-.04	.16
Ewe	.38 ^b	.37 ^b	-.04	.01	.06	-.02	.49 ^b
M-Dag	.61 ^b	.66 ^b	-.10	-.12	-.05	.02	.74 ^b

a implies significance at .05, *b* implies significance at .01.

The data in Table 7.5.2 indicate statistically significant association among the postpartum variables and weak association between these variables on the one hand and age and parity on the other. In both surveys, higher correlation coefficients for breastfeeding and abstinence are observed for the Mole-Dagbani ethnic group (about 0.7) followed by the Ewes (about 0.4). Among both the Akans and the Ga-Adangbes, the corresponding coefficients are between 10 per cent and 20 per cent. It is also worth noting there are cultural differences among these ethnic groups which could have contributed to the observed differences, for example, the system of inheritance. While the Akans have the matrilineal system of inheritance, the Ga-Adangbe like the Mole-Dagbani and the Ewes inherit patrilineally. The fact that the Ga-Adangbe live in and around the national capital means that they could have been more exposed to modernizing influences that could impinge on their traditional practices. This issue is explained further in Chapter 8.

The absence of important associations between breastfeeding and abstinence on one hand and parity on the other possibly implies that prolonged breastfeeding and abstinence are not practised as a form of birth control because of the number of children a woman already has though as noted in section 7.2.2, they probably help to keep fertility lower than it would otherwise have been. Also, the lack of correlation between the postpartum variables and age implies a weak effect or no effect of age on these processes and points to the lack of significant change in reproductive activity during the natural span of the women's reproductive careers.

7.5.3 Further examination of the relationship between postpartum variables and fertility

Breastfeeding which occurs after the resumption of menstruation cannot affect the duration of amenorrhoea and the practice whereby some women breastfeed until they recognize pregnancy may bias estimates of the relationship between breastfeeding and

amenorrhoeal durations (Santow and Singh, 1984; Habicht et al., 1985; Guz and Hobcraft, 1991). Guz and Hobcraft (1991) observed that since the interval between one birth and the next conception is a function of the extent of amenorrhoea, the degree to which the durations of breastfeeding and amenorrhoea are correlated will be overestimated if women tend to breastfeed till the next pregnancy is recognized. They also noted that the problem of a causal relationship between breastfeeding and amenorrhoea is made more complex by the fact that less fecund women are likely to breastfeed longer; they suggested that unbiased estimates of the impact of breastfeeding on fertility can be obtained by deriving the rates of conception and resumption of menstruation for different breastfeeding states.

Table 7.5.3 Medians of the distribution of amenorrhoea and abstinence in the open interval by breastfeeding status

Variable	Survey	Breastfeeding status		
		still bfg	never	weaned
Amenorrhoea	GFS	14.5	3.4	12.5
	GDHS	13.1	4.7	19.1
Abstinence	GFS	9.0	4.7	7.8
	GDHS	11.9	5.9	9.0

The data in Table 7.5.3 give life-table median durations of postpartum amenorrhoea and sexual abstinence for various breastfeeding states in the open interval. The inclusion of abstinence indicates whether or how far the data reflect the tendency of women to refrain from sexual activity while lactating. The results show that women who never breastfed their last children had shorter durations of amenorrhoea and sexual abstinence followed by women who had weaned and those who were still breastfeeding in that order; these findings are consistent in the two surveys. The average durations

till resumption of menstruation recorded here are somewhat higher than the two months that have been reported for developed countries (see Salber et al., 1966). Guz and Hobcraft (1991) also reported a median duration from the GFS data of five-and-a-half months for women who did not breastfeed; they suggested that in the developing countries where it is the norm to breastfeed, the few women who do not do so may have been selected for physiological factors that are likely to cause delays in the resumption of menstruation, and these factors may have been particularly marked for countries like Ghana for which such relatively long average durations were observed.

Table 7.5.4 Breastfeeding duration and the length of the last closed birth interval

Subgroup	Survey	Q50	Trimean	Cumulative proportions		
				D24	D36	D48
No bfg	GFS	22.8	22.0	.72	.92	.97
	GDHS	26.5	26.7	.52	.89	.99
1-11	GFS	27.4	27.5	.48	.84	.96
	GDHS	25.5	25.3	.55	.88	.97
12-17	GFS	30.3	30.5	.35	.80	.96
	GDHS	28.6	28.5	.43	.87	.97
18-23	GFS	33.3	33.0	.23	.73	.96
	GDHS	30.5	30.3	.33	.87	.97
24+	GFS	35.4	35.0	.20	.66	.92
	GDHS	35.1	35.3	.14	.68	.95

From Table 7.5.4 it can be seen that the median durations for the last closed interval among women who did not breastfeed the penultimate child ranged from about 23 months in the GFS to 27 months in the GDHS. As expected in both surveys the median breastfeeding duration generally increased. The exception to this trend is that the median duration for women who breastfed for less than one year in the GDHS appears to be the same as that of those who did not breastfeed. Also, except for women who

did not breastfeed, the median durations are shorter in the GDHS. For example for women who breastfed for one year and above, the average durations range from 30.3 months to 35.4 months in the GFS and from 28.6 months to 35.1 months in the GDHS (see Table 7.5.4). The data also show cumulative proportions of women who closed their last closed birth interval by specified durations for the various breastfeeding durations; there is a general indication of the expected decreasing proportions closing the interval as breastfeeding duration increased. For example, in the GFS, 72 per cent had their penultimate child after 24 months, 92 per cent after 36 months and 97 per cent after 48 months among women who did not breastfeed. Corresponding values for women who breastfed for 24 months and more are: 20 per cent after 24 months, 66 per cent after 36 months and 92 per cent 48 months. The pattern is the same in the GDHS.

Table 7.5.5 Average duration of the last closed birth interval for varying lengths of amenorrhoea.

Subgroup	survey	Median	Trimean	Cum. proportions		
				D24	D36	D48
0-5	GFS	26.8	26.8	.51	.83	.97
	GDHS	26.7	26.8	.51	.86	.98
6-11	GFS	28.7	28.5	.43	.83	.95
	GDHS	27.7	27.5	.47	.88	.98
12-17	GFS	30.7	30.5	.33	.78	.97
	GDHS	31.0	31.3	.31	.80	.97
18+	GFS	36.8	36.5	.10	.60	.90
	GDHS	35.7	35.5	.02	.66	.94

For the present analysis, Tables 7.5.5 and 7.5.6 demonstrate a positive relationship between fertility on one hand, and amenorrhoea and abstinence on the other. Average durations of the last closed interval increase with the durations of postpartum amenorrhoea and sexual abstinence, while proportions resuming menstruation or sexual

activity are shown to be inversely related to duration of amenorrhoea and abstinence respectively.

Table 7.5.6 Median duration of the last closed birth interval for varying lengths of abstinence

Subgroup	survey	Median	Trimean	Cum. proportions		
				D24	D36	D48
0-5	GFS	28.2	28.3	.45	.84	.97
	GDHS	27.5	27.3	.48	.88	.97
6-11	GFS	30.5	30.5	.35	.78	.95
	GDHS	29.0	29.0	.43	.87	.97
12-17	GFS	30.0	30.4	.37	.78	.94
	GDHS	30.7	30.4	.30	.79	.97
18+	GFS	38.0	37.5	.10	.55	.90
	GDHS	38.2	38.5	.03	.54	.91

Another notable feature of the results in Tables 7.5.5 and 7.5.6 is the apparent similarity of the estimated durations of the average intervals for the same groups in the different surveys. For example, the maximum average difference observed for the abstinence data is one-and-a-half months while that for amenorrhoea is one month.

7.5.4 Proportional hazard analysis

7.5.4.1 Breastfeeding and postpartum sexual abstinence differentials and trends

Tables 7.5.7 and 7.5.8 give relative risks of weaning and resumption of sexual activity for the last birth. It can be seen that the risk of early weaning is about 86 per cent higher for urban women in the GFS and 70 per cent higher in the GDHS compared with rural women (RR = 1). The risk of early weaning is about 35 per cent less among the Ewes and 64 per cent lower among the Mole-Dagbani than among the Akans (RR = 1) in the GFS survey. However, in the GDHS only the breastfeeding duration among

the Mole-Dagbani appears to remain significantly different from that of the Akans. The trends for education differentials are similar for both surveys; the risk of early weaning increasing with education. Women with 11 or more years of formal education are about two and a half times as likely to wean early compared with women without formal education (RR = 1) in the GFS. In the GDHS the risk for the highly educated women is about 74 per cent higher than that for uneducated women.

Table 7.5.7 Exponentials of proportional hazards co-efficients (RR) of the breastfeeding duration in the open birth interval

Variable	GFS		GDHS	
	RR	Z-stat	RR	Z-stat
Residence				
rural	1.00		1.00	
urban	1.86	(8.87) ^c	1.69	(6.84) ^c
Ethnicity				
Akan	1.00		1.00	
Ga-adangbe	0.99	(0.10)	1.12	(.95)
Ewe	0.65	(4.27) ^c	0.96	(.39)
Mole-dagbani	0.36	(8.14) ^c	0.57	(4.5) ^c
Religion				
Catholics	1.00		-	-
other chris.	0.98	(0.30)	-	-
Moslems	0.76	(1.95)	-	-
Traditional rel	0.60	(4.06) ^c	-	-
Age				
Age<24	1.00		1.00	
Age 25-29	1.19	(1.80)	0.98	(.23)
Age 30-34	1.17	(1.34)	0.97	(.22)
Age 35+	1.34	(2.35) ^a	0.70	(2.5) ^a
Parity				
1-3	1.00		1.00	
3+	0.79	(2.43) ^a	1.05	(.48)
Education(yrs)				
none	1.00		1.00	
1-10	1.25	(2.89) ^b	1.39	(3.97) ^c
11+	2.48	(5.44) ^c	1.74	(3.62) ^c
Likelihood Ratio statistic = 1546 ^c (GFS)		1700 ^c (GDHS)		
Degrees of freedom = 16 (GFS)		16 (GDHS)		

Table 7.5.8 Exponentials of proportional hazards co-efficients (RR) of the sexual abstinence duration in the open birth interval

Variable	GFS		GDHS	
	RR	Z-stat	RR	Z-stat
Residence				
rural	1.00		-	-
urban	1.20	(3.18) ^b	-	-
Ethnicity				
Akan	1.00		1.00	
Ga-adangbe	0.85	(1.74)	0.79	(2.49) ^b
Ewe	0.45	(10.2) ^c	0.64	(5.65) ^c
Mole-dagbani	0.14	(21.1) ^c	0.29	(10.65) ^c
Age				
<24	1.00			
25-29	1.14	(1.64)	-	-
30-34	1.05	(0.52)	-	-
35 +	1.02	(0.14)	-	-
Parity				
1-3	1.00		1.00	
3+	0.99	(0.18)	1.30	(3.19)
Education (yrs)				
none	-		1.00	
1-10	-	-	1.28	(3.76) ^c
11+	-	-	1.50	(3.34) ^c
Likelihood ratio statistic =	967.5 ^c (GFS)		553.6 ^c (GDHS)	
Degrees of freedom =	16 (GFS)		16 (GFS)	

a implies significance at .05, *b* implies significance at .01, *c* implies significance at .001

The patterns of ethnic differentials in abstinence are also similar in both surveys. The Mole-Dagbani and the Ewes have 86 per cent and 55 per cent lower risk of early resumption of sexual activity after a birth compared the Akan in the GFS while in the GDHS, they have 71 per cent and 36 per cent lower risk of doing so. The Ga-Adangbe are only marginally different from the Akans in the GDHS. Significant residence and

age differentials appear to be non-existent in the GDHS while religious differentials do not exist for either survey. Finally, the risk of early resumption of sexual activity after a birth increased with years of formal education in the more recent survey. The likelihood ratio statistics for the models in Tables 7.5.7 and 7.5.8 show that the independent variables significantly increase explanation over the global null model.

7.5.5 The use of modern contraception

In 1969 Ghana adopted a national population policy aimed at deliberate fertility limitation. The Family Planning Program which was to serve as the vehicle for population policy has had several problems including government apathy, administrative inadequacies and lack of effective logistic support (see Owusu and Batse, 1991 ; Kumekpor and Batse, 1991). Reasons adduced for the lack of political interest in the fertility-reducing aspects of the policy include suspicions about the ultimate aim of foreign-assisted family planning and the fact such a step will divert government's attention from real issues of development. Furthermore, there was also the feeling that fertility control is un-African and should therefore not be encouraged (see Caldwell and Caldwell, 1988; U N , 1992; Ofosu, 1992).

In spite of wide knowledge of contraception in Ghana, the adoption of modern contraception remains relatively low. The purpose of the analysis in this section is to determine which of a set of background variables are important for distinguishing current users and ever users of modern contraception in Ghana. This is important because as indicated above, a basic requirement of effective use of modern contraception is the demand for it. It is important to determine which factors underlie this demand in any particular setting; it is also important to determine any possible temporal shifts in the effect of these factors by examining the data for the two time periods.

The dependent variables for current use and ever use originally involve three distinct choices, 'no use', 'only traditional' and 'modern', but these have been recoded to reflect interest in the use of modern contraception only. The reason for the interest in the modern contraception is its relative effectiveness for fertility control and also because its adoption for this purpose is perhaps the most promising path to conscious fertility reduction. The dependent variables 'ever use' and 'current use' of modern contraception are bivariate and hence a logistic regression is applied. The results for current use are presented first as odds ratios and also as probabilities.

7.5.5.1 Basic formulation of the logistic model

The problem may be formulated in terms of logistic regression as follows: let *cuse* denote the dependent variable, current use of modern contraception and $X_1, \dots, X_k$ denote k background variables; *cuse* = 1 if the respondent is currently using modern contraception and *cuse* = 0 if she is not. Then the conditional probability of the current use of modern contraception, that is, the probability of modern contraception given the background variables, can be expressed as:

$$P(cuse = 1: X_1, X_2, \dots, X_k)$$

and the dependence relationship between current use of modern contraception and the explanatory variables may be expressed as a multiple regression model for the logit of P as:

$$\log[P/(1-P)] = b_0 + b_1X_1 + b_2X_2 + \dots + b_kX_k.$$

The desired model parameters b_0 and $b_1 \dots b_k$ are estimated here using the SPSS.

7.5.5.2 Model selection

Let M_1 denote model one and M_2 model two. Also let df_1 and df_2 denote the degrees of freedom associated with models one and two respectively. For each model a log likelihood ratio statistic is calculated. If M_1 and M_2 are nested or if M_1 is a subset of M_2 , then the likelihood ratio statistic for M_1 is greater than for M_2 and similarly, the degrees of freedom associated with M_1 , df_1 , is greater than that associated with M_2 , df_2 . The difference between the deviance for model M_1 and that for M_2 is distributed as a chi-square statistic with degrees of freedom corresponding to df_1 minus df_2 . The stepwise forward option in SPSS was used for model selection.

7.5.5.3 Interpretation of estimates of model parameters

For the effects of explanatory variables to be uniquely defined, one level of each set of categories has to be constrained to zero when the explanatory variables are redefined as indicator variables. This is regarded as the reference category and the estimates for other categories are interpreted relative to it. In SPSS the last category is set to zero but it is also possible to set any other category to zero.

When the estimated effects of independent variables in a logistic regression model are exponentiated, one obtains what are commonly known as odds ratios. Suppose we want to examine the effect of years of education on the dependent variable, current use of modern contraception. Suppose also that the education variable has been categorized as 'no education' (Ed1), '1-10' years of education (Ed2), and '11 and over' years of education (Ed3) coded as indicator variables in a model. If the 'no education' category is regarded as the reference and an odds ratio of 0.52 is obtained for Ed2, this will imply that net of the effect of all the other independent variables in the model, the odds of current use of modern contraception for women who had between one and ten years of education are about half as much as that of women who did not go to school; or that

the odds of current use of modern contraception for women with no education are about twice as high as that for women with one to ten years' education. Also, if for example an odds ratio of 2.05 is associated with women with 11 or more years of schooling this will mean their odds of current use of modern contraception are about twice as high as that for the uneducated women who constitute the baseline.

7.5.5.4 Current use of modern contraception

Contraception in Ghana may be practised for preventing pregnancy in premarital sex, for birth spacing and also for preventing further births. In the case of birth spacing, couples wishing to have sexual relations before the time of weaning their babies may resort to contraception to prevent pregnancy. Table 7.5.9 indicates that age, education and whether or not the woman lives in the rural or urban areas of Ghana are important determinants of the current use of modern contraception in both the GFS and the GDHS. While the woman's religion appeared to be an important factor in the GFS, this effect seems to have disappeared in the later survey. In this data set the Christians have odds of current use 60 to 90 per cent higher than the traditionalists. The effect of education and residence follow expected patterns. For example, women with higher education are more likely to be currently using modern contraception. However, in the GDHS these women appear to be significantly different only from those who did not go to school. Also, the odds of current use of modern contraception for rural women are about 30 per cent lower than those for urban women in both the GFS and the GDHS. Urban women and highly educated women are therefore more likely to use modern contraception since these women are likely to have many more aspirations apart from rearing children. The effect of age is less clear as women aged between 15 and 29 are shown to be less likely than those aged between 40 and 49 to be currently using modern contraception. This point is not pursued any further because age is included in these models merely as a demographic control. The goodness of fit chi-

square values for both models in Table 7.5.9. are significant. This implies that the specified model adequately fits the data.

Table 7.5.9 Logistic regression model estimates for the effects of selected background variables on the current use of modern contraception.

Variable	Survey	odds ratio	Chi-sq	df
Age				
15-29	GFS	.58	9.8	1
	GDHS	.31	32.9	1
30-39	GFS	1.00	0.00	1
	GDHS	0.72	2.6	1
40-49	GFS	1	-	-
	GDHS	1	-	-
Educ				
None	GFS	0.16	71.9	1
	GDHS	0.35	13.4	1
1-10	GFS	0.33	30.6	1
	GDHS	0.74	1.6	1
11+	GFS	1	-	-
	GDHS	1	-	-
Residence				
Rural	GFS	0.68	10.6	1
	GDHS	0.71	4.9	1
Urban	GFS	1	-	-
	GDHS	1	-	-
Religion				
Cath.	GFS	1.65	5.0	1
	GDHS	1.83	2.2	1
Other chris.	GFS	1.87	9.6	1
	GDHS	1.55	1.3	1
Moslem	GFS	0.83	0.4	1
	GDHS	1.59	1.1	1
Trad. religion	GFS	1	-	-
	GDHS	1	-	-
X ² =	3389 (GFS)	3884.9 (GDHS)		
Degrees of freedom =	3411 (GFS)	3936 (GDHS)		
p =	00 (GFS)	00 (GDHS)		

Table 7.5.10 shows probabilities of current use of modern contraception for selected covariate patterns by survey. The analysis confirms the low level of contraceptive use in Ghana. It can be seen that with the exception of uneducated urban women aged between 25 and 34 years in the GFS, the probabilities for all other covariate patterns do not appear to be significant. Furthermore, the probabilities obtained in the GDHS are consistently lower than those obtained in the GFS. This seems to indicate that even any possible enthusiasm that followed the introduction of family planning was dissipated between the GFS and the GDHS. Similar conclusions were made by recent assessments of the family planning program in Ghana (see Owusu and Batse, 1991; Kumekpor and Batse, 1991).

Table 7.5.10 Probabilities of current use of modern contraception for selected covariate patterns by survey.

Covariate pattern	Survey	estimated probability
No education, rural, aged up to 24 years	GFS	0.05
	GDHS	0.02
No education, rural, aged 25-34	GFS	0.09
	GDHS	0.03
No education, urban, aged upto 24 years	GFS	0.40
	GDHS	0.06
No education, urban, aged 25-34	GFS	0.53
	GDHS	0.13
Secondary+, urban, aged up to 24	GFS	0.06
	GDHS	0.02
Secondary+, urban, aged 25-34	GFS	0.09
	GDHS	0.05
Secondary+, rural, aged up to 24	GFS	0.20
	GDHS	0.04
Secondary+, rural, aged 25-34	GFS	0.20
	GDHS	0.04

Another interesting feature of Table 7.5.10 is the low probabilities obtained for combinations involving women with secondary or higher education. Possible reasons for this result include underenumeration of this category of women, most of whom would have been located in educational institutions during at least part of the fieldwork for the surveys. Another reason could be under-reporting for this group. Since most of these were unmarried, disclosing contraceptive use would have been an admission of sexual activity outside marriage. According to Laing (1982), respondents may under-report contraceptive use as a result of shyness and embarrassment, especially when the concept of family planning is seen as conflicting with traditional norms and values, or if the practice is not favourably regarded in the family or community. Also, in the survey of all women, the unmarried in particular may deny the use of contraception because the reverse will imply an admission of sexual activity or even promiscuity. Another aspect of the problem is over-reporting contraceptive use among previous users who are embarrassed about discontinuation. Laing (1982) also noted that in societies in which there is strong socio-political pressure to adopt family planning, there will be a similar tendency to over-report. In Ghana, the socio-cultural environment makes it likely that respondents will under-report contraceptive use and this is probably reflected in the low usage that has been observed.

7.5.5.5 Ever use of modern contraception

As with current use, the odds of ever using modern contraception are about 40 per cent lower for women below age 30 than for those aged between 40 and 49 (see Table 7.5.11). Also, women between 30 and 39 are significantly different from the older women in the GDHS but not in the GFS. Ever use among educational groups generally follows expected trends. The odds for uneducated women are about 84 per cent lower in the GFS and 60 per cent lower in the GDHS compared to the educated women. Again women with up to 10 years of schooling are not significantly different from

those with 11 years or more of schooling in the GDHS and it is only in the GFS that the observed differences between ever use for the rural and urban women appear to be significant.

Table 7.5.11 Logistic regression model estimates for the effects of selected background variables on the everuse of modern contraception.

Variable	Survey	odds ratio	Chi-sq	df
Age				
15-29	GFS	.56	43.3	1
	GDHS	.57	90.8	1
30-39	GFS	1.02	0.03	1
	GDHS	1.27	15.10	1
40-49	GFS	1	-	-
	GDHS	1	-	-
Educ				
None	GFS	0.16	151.4	1
	GDHS	0.40	133.9	1
1-10	GFS	0.40	45.2	1
	GDHS	1.05	0.79	1
11+	GFS	1	-	-
	GDHS	1	-	-
Residence				
Rural	GFS	1.10	2.4	1
	GDHS	0.83	18.7	1
Urban	GFS	1	-	-
	GDHS	1	-	-
Religion				
Cath.	GFS	1.49	14.9	1
	GDHS	1.29	14.9	1
Other xtian	GFS	1.40	13.5	1
	GDHS	1.37	16.6	1
Moslem	GFS	0.98	0.03	1
	GDHS	0.93	0.32	1
Trad. relig.	GFS	1	-	-
	GDHS	1	-	-

7.5.6 Infant and child mortality and fertility

Some researchers believe that one of the explanations for the continuing high levels of fertility in parts of the developing world is the association of high fertility with infant and child mortality. While there is some evidence of this association, establishing a causative link between them remains elusive, probably because of the reverse causation between them: that is, high infant and child mortality affects fertility levels, and high levels of fertility contribute to high levels of child mortality. An adequate understanding of this relationship may help to determine whether efforts to reduce fertility must be coupled with those that address infant and child survival.

This section discusses whether in Ghana, women who lost the children who initiate particular birth intervals before the interval was closed, tended to have shorter birth intervals than their counterparts who did not; how much is the reduction; and how these compare for the two surveys. The differences in mean intervals were examined by parity since birth intervals and child survival tend to be influenced by parity. The analysis was also done for the last closed birth interval, for which there are data on contraceptive use. The analysis for this interval was further restricted to women who breastfed and those who did not use any contraception in the interval. The results are, however, not expected to be very different from those for the second to the sixth birth intervals since breastfeeding is widespread in Ghana while modern contraception is relatively rare. The analysis of variance procedure was used to test if there are significant differences in average birth intervals depending on whether the child who initiated that interval survived. Table 7.5.12 shows the mean intervals by survival status, the absolute difference and a relative measure of change which gives the percentage change in birth interval in the two intervals.

Table 7.5.12 Average length(months) of the second to the sixth birth intervals by survival status of the child initiating the interval.

Birth Interval	Survey	Average length of interval							
		Surv.	N	Dead	N	Diff.	F-stat	Prob	% difference
2	GFS	36.5	3030	30.5	453	6.0	36.6	0.00	16.4
	GDHS	37.3	2235	30.1	412	7.2	47.2	0.00	19.3
3	GFS	35.9	2440	32.0	314	3.9	11.6	0.01	10.9
	GDHS	35.1	1794	31.9	335	3.9	8.5	0.04	11.1
4	GFS	35.7	1849	33.1	246	2.6	3.9	0.05	7.3
	GDHS	35.4	1417	28.3	245	7.1	33.5	0.00	20.1
5	GFS	33.6	1372	30.0	193	3.6	6.7	0.01	10.7
	GDHS	35.9	1073	25.9	206	10.0	51.0	0.00	27.9
6	GFS	35.3	1021	30.2	117	5.1	7.7	0.01	14.4
	GDHS	35.4	806	28.0	130	7.4	19.0	0.00	20.9

The absolute differences observed in Table 7.5.12 tend to depend on the magnitude of the birth-interval which in turn depends on the birth order. The percentage change in which the differences in the birth interval length are standardized for magnitude yields a measure of relative change in the length of the birth interval due to the death of the child who initiated the interval. The observed *P*-values indicate that the reductions between 11 and 16 per cent due to the death of the child who initiated the second, third, fifth and sixth intervals are significant. The 7 per cent reduction associated with the fourth interval is only marginally significant. The results present strong evidence of a biological effect that leads to the curtailment of a birth interval when the child who initiates the interval does not survive. This effect appears to be particularly strong following the death of the first child for families having only two children at the time. This is probably due to the fact that the younger couples are generally more fecund or that in a pronatalist society like Ghana, the pressure on young couples to have children

who will support them, is more intense at the lower parities. It is harder to speculate about why the reduction appears to intensify after the fourth interval, before which it became consistently smaller for the GFS data, except to suggest that the pattern is probably due to error. Also, it is possible that because women simply continue to bear children as long as they are biologically capable the societal pressures which were operating at the lower parities are not mitigated at the higher parities. On the other hand, the reductions in average interval length due to the death of the child who initiates the interval appear in the GDHS data to be significant for all intervals, which is likely to be the case for societies in which natural or near-natural fertility regimes largely prevail.

Table 7.5.13 Average length of the last closed interval (mths) by survival status of the penultimate child by survey

Survey	status	mean	std dev	F-stat	sig
GFS	dead	31.3	16.3	50.9	0.00
	survived	37.5	15.7		
GDHS	dead	31.8	16.9	44.8	0.00
	survived	38.2	15.5		

The data for the last closed interval indicate that women who lost the children who initiated this interval tended to close this interval earlier than those who did not and that the average duration at which they did so is significantly different from the average of their counterparts whose children survived, that is, 31.3 months in the GFS and 31.8 months in the GDHS as against 37.5 months in the GFS and 38.2 months in the GDHS. This result is similar for the two surveys. It has been observed that the duration of the interval between successive births in non-contracepting populations is related to the survival of the birth at the start of the interval, and that the death of a child causes

breastfeeding to be cut short, which in turn leads to quicker return to reproductive function. If this is true for Ghana, it can be suggested that if modern contraception becomes widely and effectively used in Ghana, women who lose a child can maintain the same length of interval between births as their counterparts whose children survived.

7.6 Conclusion

The findings in this chapter suggest a modest increase in the average duration of breastfeeding between the GFS and GDHS surveys. They also suggest ethnic, educational and residential differentials for breastfeeding and the use of modern contraception. The fact that the various ethnic groups in Ghana have different cultural approaches to at least certain aspects of reproductive behaviour is well known. It is reasonable to assume that modernizing factors like education, religion and urbanization should exert influence in the change of these traditional approaches, but the lack of marked interactions between ethnicity and the modernizing variables suggests that these traditional approaches still largely persist and that the effect of these factors is not pervasive. The evidence that ethnic and religious differentials may be narrowing constitutes a trend in the right direction, given the tendency for breastfeeding duration to increase. Also, the evidence of a possible biological effect of the death of a child, which leads to the shortening of the succeeding interval, is consistent with the low level of contraception use in Ghana. It also suggests that institutional efforts to sell modern contraceptive use in Ghana for purposes of fertility reduction may have to be coupled with efforts to improve the survival status of infants.

CHAPTER 8

CONCLUSION

An important issue in human reproductive research is the nature of change in its component factors. In addition to other uses, adequate knowledge about this is essential for the planning, implementation and assessment of any intervention programs. Human reproduction is a complex socio-biological and cultural phenomenon and often many researches like the current one can only deal with segments of the phenomenon. The inconclusiveness of the explanations of fertility change in Chapter 2 probably reflects some of this complexity. However, this discussion provided useful insight into the problem of measuring and explaining human reproduction. It has been noted that different combinations of factors determine different paths to fertility decline so that for a particular setting analysts have to determine which factors are important and how they affect human reproduction. This has been an important consideration in the present study.

This study compared several aspects of reproductive change in Ghana based on the data from two nationally representative surveys: the Ghana Fertility Survey and the Ghana Demographic and Health Survey which were taken in 1979 and 1988 respectively. The GFS and the GDHS are the most recent surveys with comprehensive data on various aspects of human reproduction including data on retrospective birth histories available for Ghana. In particular, data on transition to parenthood, birth-spacing, durations of breastfeeding, postpartum amenorrhoea and sexual abstinence were analysed. All these factors influence fertility. For example, as noted in Chapter 1, birth intervals affect the birth rate: since the reproductive life span of a women is fixed, longer birth intervals imply fewer children and shorter ones will result in more children. Repeat surveys have considerable advantages for monitoring changes over time. The analysis also included checks of the consistency of selected aspects of the data: this involved the comparison

of data on events which would have been reported in both surveys by the same cohorts. The two surveys make it possible to investigate trends in various aspects of the reproductive phenomena.

The study examined the consistency of the measurement of the first to the sixth birth intervals as well as age at first marriage and first birth in the two surveys, and compared changes in these variables for various subgroups of respondents. The intra-survey and inter-survey differences and the direction of change are highlighted where these appear to be important. Factors other than socio-economic that influence birth spacing are also examined; for example, durations of breastfeeding and postpartum sexual abstinence and their relationship with birth spacing are analysed. The study also compared modern contraceptive use and its determinants for the two surveys. The focus on modern contraception is because of its relative effectiveness for birth control and also because its acceptance and effective use probably hold the best prospects for fertility control in Africa. Finally, the analysis examined the effect of the survival of a child on the time to the birth of the next child. This makes it possible to determine the nature of the association between infant mortality and birth spacing in Ghana.

Life table techniques were used to obtain measures of the quantity and the speed of fertility. Furthermore, hazard models were applied to determine the effect of selected background variables on the age at first birth, birth-spacing, breastfeeding and postpartum sexual abstinence. The background variables used are religion, ethnicity, years of education and place of residence. For birth-interval data, age of the mother at the time of the birth that initiates that interval, as well as the period of the initiating event, is also included. Finally, age of the mother and her parity are included in some models primarily as demographic controls. Since there were data at two points in time, it was possible to cautiously discuss trends for the quantity and speed of fertility as well as for effects of the background variables. The analysis also sought to determine how birth intervals were changing over time by obtaining the mean length of all the birth intervals for all ages by year of closing the interval for both surveys.

The application of hazard models in the study permitted the examination of subgroup differences and possible interaction between subgroups. Since age data in fertility surveys are usually obtained in completed years and are therefore not exact, and also in view of the occurrence of considerable 'ties' in age data in large scale fertility surveys, it is more appropriate to use the discrete time version of the proportional hazards model, since these problems render inappropriate the use of likelihood functions derived for continuous failure time data. It should be noted however that both the discrete and continuous-time proportional-hazard models produce asymptotically the same results.

It is comparatively easy to gauge consistency in several reports on the same phenomenon if the data are collected from the same individuals in the various time intervals using exactly the same data collection procedures. In many cases, however, multiple surveys based on the same population (sometimes in the same geographic space) may cover different times and different sample members, and also employ different data collection and analysis procedures. If interest is in a changing phenomenon, differences resulting from the methods of data collection and analysis called 'study effects' tend to be confounded with real changes that would be observed in the phenomenon. In this study, a strategy similar to one proposed by Swicegood, Morgan and Rindfuss (1984) is used to determine whether such 'study effects' are statistically significant for selected variables. This involved comparing data for cohorts of women who are eligible to be in both surveys and for events which would have occurred before the first survey. This analysis shows that the age at first marriage and first birth and the first birth interval do not appear to be comparable in the two surveys; this is also the case with the third and the fourth birth intervals. There is however consistency in the measurement of the second, fifth and sixth birth intervals. The finding that first marriage and the first birth interval are not consistently measured probably show evidence of the problems previously discussed about the nature of marriage data in Africa. The findings about the age at first birth may be expected because the first birth is in the more distant past and is likely to be less well remembered.

However, it is not easy to similarly speculate about the finding for the third and fourth birth intervals which should be relatively more recent for a large number of the respondents. Consistency has also been demonstrated in the measurement of the effect of most independent variables in the two surveys.

The quality of survey data involving recall of events from memory often presented problems for analysis, particularly of change. For data on fertility, the extent of decline or increase can be distorted by possible age misreporting and displacement of children's dates of birth: these can be exacerbated by study effects if they occur. One implication of the finding of inconsistency of measurement of age at marriage and the first birth interval is that these data may not be pooled from the GFS and the GDHS to obtain a larger and possibly more stable series. Also, though the differences in the data found to be inconsistent in this analysis are generally small, it is necessary to exercise caution in interpreting observed differences when such data are compared for the GFS and GDHS. For the first birth interval, this study has shown that it may be possible to find segments which are comparable. Finally, the general level of consistency of data, albeit only at the aggregate level, shows reliability at this level and thus considerably increases our confidence in the data.

The study examined closed intervals as well as open intervals. The closed and open intervals were analysed in the life-table and hazard-models framework. The analysis of closed intervals by the year of closure indicates an apparent lengthening of the average intervals with time. The evidence for the earlier time periods is subject to relatively wider fluctuations, probably because of less accurate reporting. With focus on the intervals closed within ten years preceding the surveys, it is found that the increases in the last five years before the later survey are significant. Furthermore, the GFS yearly averages appear to run below the GDHS averages for the most recent periods. While the increases observed for the ten years before the earlier survey are not statistically significant, those for the GDHS are. The observed trend of widening average birth intervals with time does not appear to be significantly reflected yet in fertility measured

through rates. As mentioned earlier, only a slight decline, that is, about 9.7 per cent, was recorded in the population growth rate between 1981 and 1990 (Global Coalition, 1992), and fertility rates have remained virtually stable between the GFS and GDHS. The quality of the data obviously contributes to the observed trends. However, if the underlying trend here constitutes genuine evidence of a fertility decline and if the conditions sustaining it persist, then it will be reflected in the fertility rates in future surveys.

The study has also found general stability in the pace and quantum of fertility. The quantum for the second birth in both surveys is about 89 per cent, while average time taken to close the second birth interval is about 32 months in GDHS and 31 months in the GFS. The overall distribution of the second birth interval is only marginally significant for the two surveys; first, third and fourth interval distributions are not significantly different in either survey. The distribution of the second to the fourth birth intervals for comparable cohorts are not significantly different for the two surveys. There are also fairly symmetrical distributions for the second to the fourth intervals given the closeness of the median and trimean values: while the medians lie between 29 and 36 months, the trimeans range from 30 to 35 months with an indication of the younger cohorts showing slightly longer delays for these births.

Overall, age at first marriage appears to be generally stable: about 17.7 years both in the GFS and in the GDHS. However, small increases are observed for later periods and younger cohorts. It increased from about 17 years for the uneducated to about 20 years for women with 11 or more years of education. It has been noted that age at first marriage is important for fertility particularly when childbearing outside marriage is negligible. It has also been seen that premarital births appear to be increasing over time. If this trend is true, the possible effect of education in lowering fertility through delayed marriage may become less important in Ghana. The level of premarital births is, however, subject to errors in the dating of first marriage and first birth and may therefore be unreliable. Age at first birth is also generally stable both within and between the

surveys. The only significant differential for age at first birth is education: women with 11 or more years had higher ages at first birth in both surveys. Care is required in emphasizing differences observed for age at first marriage and first birth in the two surveys because of possible study effects.

The analysis of durations of breastfeeding, postpartum amenorrhoea and sexual abstinence suggests only modest increases: median durations of breastfeeding and postpartum sexual abstinence either are stable or have increased slightly between the GFS and GDHS. For example, there was an increase in median breastfeeding duration of about three months in the open birth interval and about five months in the last closed birth interval. The demonstrated direct relationship between birth interval length and breastfeeding duration means that this increase implies longer birth intervals. A positive relationship was observed between fertility on the one hand and amenorrhoea and abstinence on the other. Median durations for postpartum amenorrhoea are generally longer than the duration of postpartum sexual abstinence, thus amenorrhoea appears to be more important for achieving birth spacing than postpartum sexual abstinence (see Locoh and Adaba, 1981).

Also ethnicity, place of residence and education are significantly related to breastfeeding and postpartum sexual abstinence in both surveys. The Mole-Dagbani, breastfeed longer than other ethnic groups and also observe the longest periods of postpartum sexual abstinence on average. Ethnic differences in breastfeeding and postpartum sexual abstinence in Ghana have been discussed in the anthropological literature (Schoenmaeckers et al., 1981; Caldwell and Caldwell, 1981). For example, the short postpartum taboo among the Akan of Ghana is well recognized. It has been noted that a distinctive feature of Akan culture is maternal inheritance and there is some speculation about how this characteristic may explain the relatively short postpartum taboo. Caldwell and Caldwell (1981) suggested that in patriarchal societies, female sexuality is not seen as very important, and long sexual abstinence may be easier to maintain in such societies. Also, because women's views are likely to carry more weight in matrilineal

societies, the dominance of the husband is lessened and it is plausible that the duration of abstinence should be shorter in the matrilineal societies. Caldwell and Caldwell (1981) suggested that this is possibly the reason for the short postpartum sexual abstinence among the Akan. The short duration of sexual abstinence noted among the Ga who unlike the Akan are patrilineal, could perhaps be attributed to factors of modernization with which may be associated economic independence and hence less dominance by husbands.

It was observed in Chapter 3 that apart from the Ewe ethnic group, the Mole-Dagbani are somewhat less associated with factors of modernization in Ghana: they have relatively large proportions of respondents in the rural areas and adhere largely to traditional religion. They also have recorded the highest proportions of respondents who claimed to have had no formal education in both surveys. It therefore accords with expectation that they are found to predominantly adhere to the traditional values of long breastfeeding and postpartum abstinence. This is consistent with the finding in Chapter 6 that the Mole-Dagbani and the Ewe have relatively lower risk of closing the second to sixth birth intervals.

It has been demonstrated that the length of the last closed birth interval increased with the duration of breastfeeding. This indicates the contraceptive effect of breastfeeding, and implies that the long periods of breastfeeding in Ghana are advantageous not only for the sake of infants' health but also for birth spacing. In view of low contraceptive use and the tendency to continue childbearing within the reproductive life-span, long durations of breastfeeding will also have beneficial effects for fertility reduction. Caldwell and Caldwell (1981) argued that fertility in ethnic groups which practise long durations of postpartum sexual abstinence could be much higher in the absence of such practices.

A significant effect of education on the use of modern contraception has also been observed for both surveys. The rate of adoption of modern contraception in Ghana is

still very low. A common educational message associated with the family planning program in Ghana urges couples to have that number of children that they can adequately care for; there are perhaps serious problems with this message. This decision in the Ghanaian context requires some level of abstraction involving the aspirations of parents for their children and how seriously they are committed to seeing their children attain these: there is also the possibility that aspirations for 'the good life' may be lower in the rural areas. The notion of number of children that can be adequately cared for can be very much blurred for many couples. If this is so, then from van de Walle's (1992) suggestion that fertility decline can only take place if families have a general idea about ideal family size and where they stand in respect to that, it can be inferred that an appreciable fertility decline in many areas in Ghana may still be far from realization.

Causes for the limited impact of family planning programs include official suspicion and lack of interest. Other researchers have cited the continued neglect of men as an equally important target in such programs, and the powerlessness of women with regard to fertility decisions (Locoh, 1990; Ezech, 1993). There is evidence that good family planning programs may not necessarily result in lower fertility (Jones, 1993; Abernethy 1993) However, carefully planned and executed family planning programs, with adequate educational content which effectively demonstrates the advantages of smaller families may be beneficial in Ghana. This knowledge may be important in changing beliefs that favour having many children for economic or psychological reasons. One observation in this study that is related to the ineffectiveness of the family planning program in Ghana is the evidence that women whose penultimate children died proceeded to have the next child at a quicker pace on average than women whose penultimate children survived. With widespread acceptance of modern family planning methods, users who wish can prevent unwanted pregnancy which comes about as a result of the interruption of breastfeeding following the death of a child who is still suckling.

Overall, the indication from this study is that the evidence for reproductive change is weak. There were few and generally weak differentials within and across surveys; there

is little association between postpartum variables and age and parity which indicates general lack of change in the traditional fertility regime; the pace and quantity of fertility are generally stable. Lesthaeghe et al. (1981) noted that such lack of parity-specific variation is evidence that the child-spacing tradition in sub-Saharan Africa is not for purposes of family limitation; customary prescriptions regarding breastfeeding and postpartum sexual abstinence act the same way after every child, and are intended to ensure the survival of the maximum number of children. However the weak signs of fertility decline that have been observed appear to be related to recent periods and also younger cohorts, so that if this trend continues, fertility in Ghana will eventually start to decline.

APPENDIX A

FURTHER METHODOLOGICAL NOTES

A1. Life Table Methods

The hazard function has been defined as

$$h(t) = f(t)/S(t) \text{ (see text)}$$

The distribution function is expressed as

$$F(t) = 1 - S(t) = \int_0^t f(u)du$$

which for birth interval analysis is called the birth function and often denoted by $B(t)$. In the application to the second birth interval for example, $B(t)$ denotes the proportion of women who had their second child before time t . The survivor function for discrete distributions is expressed as,

$$S_x = \prod_{i=0}^{x-1} (p_i)$$

where p_i is the probability associated with an event of interest in the i th time interval.

Thus the birth function may be expressed as,

$$B_x = 1 - S_x.$$

This survivor function may be estimated using the product-limit method or the actuarial method. The life table analysis in the text is based on the actuarial approach which is now described. Consider a partition of time into a sequence of intervals $T_1, T_2, \dots, T_r$ bordered by points $a_1 < a_2 < \dots < a_r$.

Let n_i = the number of units who did not experience the event at the start of T_i

d_i = the number of units who experienced the event in the interval T_i

c_i = the number of units censored in the interval, T_i

p_i = prob.(unit survived through T_i | unit did not experience event at the start of

T_i and

$$q_i = 1 - p_i.$$

It is assumed that units censored in interval T_i were exposed to risk for half of the interval T_i , hence the effective number of units at risk during T_i is

$$n_i' = n_i - 0.5c_i.$$

And q_i and p_i are estimated as:

$$q_i^* = d_i / n_i' \text{ and } p_i^* = 1 - q_i^* \text{ and the survivor function is}$$

$$S_x^* = \prod_{i=0}^{x-1} p_i^*.$$

A2. Lee-Desu statistic for comparison of survival distributions

Let

N = number of units

$X_{(k)}$ = ordered survival time for unit k .

w_k = weight for unit k

g = number of nonempty groups in the comparison

W_j = sum of weights of units in group j

W_c = sum of weights of censored cases

W = sum of weights of all units.

Also let U_k = sum of weights of uncensored units with survival times less than or equal to that of unit k

C_k = sum of weights of censored units with survival times less than or equal to that of unit k

U_k^* = sum of weights of uncensored units with survival times equal to that of unit k

C_k^* = sum of weights of censored units with survival times equal to that of unit k .

For uncensored X_k , the score for unit k is

$$S_k = U_k$$

and that for censored X_k is,

$$S_k = M_1 - M_2 - M_3$$

where,

$M_1 = U_k - U_k^*$ uncensored units surviving shorter than unit k

$M_2 = W_c - C_k + C_k^*$ censored units surviving longer than or equal to unit k

$M_3 = W_u - U_k$ uncensored units surviving longer than unit k .

The Lee-Desu test statistic is

$$D = (W-1)B / T$$

where

$$B = \sum_{j=1}^g SS_j^2 / W_j$$

SS_j = sum of scores of cases in group j

$$T = \sum_{i=1}^N S_j^2$$

Given the null hypothesis that the groups have the same survival distribution, D is asymptotically distributed as chi square with $(g-1)$ degrees of freedom (Lee-Desu, 1972).

A3 Logistic Regression

The logistic regression model assumes a dichotomous response variable Y with mean μ whose dependence on the k independent variables is expressed as

$$\ln(\mu/1-\mu) = \eta_i = \beta_0 + \beta_1 X_1 + \dots \beta_k X_k.$$

The likelihood function for n observations $y_1, \dots, y_n$ having means $\mu_1, \dots, \mu_n$ and case weights $c_1, \dots, c_n$ can be written as

$$L = \prod_{i=1}^n \mu_i^{c_i y_i} (1 - \mu_i)^{c_i (1 - y_i)}$$

where

$$\mu_i = \exp(\eta_i) / (1 + \exp(\eta_i))$$

and

$$\eta_i = \beta_0 + \beta_1 x_{i1} \dots \beta_k x_{ik}$$

The log likelihood is given by

$$\ln L = \sum_{i=1}^n (c_i y_i \ln(\mu_i) + c_i (1 - y_i) \ln(1 - \mu_i))$$

Maximum likelihood estimates of the β s are obtained by solving

$$\delta \ln L / \delta \beta_j = \sum_{i=1}^n c_i (y_i - \mu_i) x_{ij} = 0 \text{ for } j = 0, \dots, k$$

where $x_{i0} = 1$ for $i = 1, \dots, n$ using a Newton-Raphson type algorithm.

The asymptotic covariance matrix is obtained by the inverse of the information matrix I , where,

$$I = -[E(\delta^2 \ln L / \delta \beta_i \delta \beta_j)] = X' C V^* X$$

where

$$V^* = \text{Diag}\{\mu_1^* (1 - \mu_1^*), \dots, (\mu_n^* (1 - \mu_n^*))\}$$

$$C = \text{Diag}\{c_1, \dots, c_n\}$$

$$\mu^* = \exp(\eta^*) / (1 + \exp(\eta^*))$$

$$\eta^* = \beta_0^* + \beta_1^* x_{i1} + \dots + \beta_k^* x_{ik}$$

A4 Discrete Time Proportional Hazards Model Estimation in GLIM

For the discrete time proportionalhazard model the probability that the event occurs to the i th unit with covariate vector x in the j th interval.

$$h_{ij} = 1 - \exp(- \exp(\beta'x_i + \theta_j))$$

and
$$\log(-\log(1-h_{ij})) = \beta'x_i + \theta_j$$

Hence the model can be fitted by considering units in each interval as independent with the censoring indicator as the dependent variable with a Bernoulli distribution and a complementary log-log link function.

The complementary log-log link transformation of the probability of failure is meant to solve the problem of fitted values falling outside the finite range (0, 1) for the probability. Such transformations require that the cumulative distribution function (cdf) $F(\lambda)$ is strictly a increasing function function of λ where $-\infty < \lambda < \infty$, such that $F(-\infty) = 0$, $F(\infty) = 1$. Then the transformation of p from (0,1) to $(-\infty, \infty)$ is given by

$$\lambda = F^{-1}(p) = g(p)$$

A linear model for such transformed parameter has the property that any finite value of the linear predictor yields a value of p in the range (0,1). The complementary log-log transformation is one of the standard options in GLIM and is defined by the link function, $g(p)$.

$$\lambda = \log(-\log(1-p)), F(\lambda) = 1 - \exp(- \exp(\lambda))$$

and $F(\lambda)$ is the cdf for the extreme value distribution (see Aitkin et al., 1989).

APPENDIX 8

Table 4.2. Percentage Distribution of Women of Reproductive Age, for the 1970, 1984 Censuses and the GFS and GDHS data

Age	1970 Census	GFS	diff	1984 Census	GDHS	diff.
15 - 19	19.4	22.4	-3	21.4	18.9	2.5
20 - 24	19.4	19.9	-0.4	20.1	19.3	0.8
25 - 29	18.0	16.5	1.5	18.0	19.3	-1.3
30 - 34	15.7	13.1	2.6	13.7	14.3	-0.6
35 - 39	11.4	11.5	-0.1	10.6	11.8	-1.2
40 - 44	9.3	9.5	-0.2	8.7	8.1	0.6
45 - 49	6.8	7.2	-0.4	7.4	8.4	-0.8
Total	100	100		100	100	

Table 5.9 Mean Age at First Marriage Among Women Marrying at Age Less than 24 Years

	GFS	GDHS
Age		
< 24	16.8	16.9
25 -29	17.8	17.8
30 +	17.5	17.4
Total	17.3	17.4
Educ		
None	17.0	17.1
1 - 10	17.6	17.4
10 +	19.8	19.4
Total	17.3	17.4
Period *		
69 - 73 GFS	17.5	17.8
74 - 78 GFS	17.9	18.2
Total	17.7	18.0

* equivalent periods for the GDHS are 78-82 and 83-87

Table 5.10 Mean Age at First Birth by Selected Covariates by Survey

	GFS			GDHS			T-stat
	Mean	Var	No.	Mean	Var	No	
Age							
15 - 24	17.8	4.3	1218	18.0	4.6	789	-2.1 ^a
25 - 29	19.3	9.4	933	19.0	9.2	794	1.9
30 +	20.0	18.3	2452	19.3	14.5	1870	5.4 ^c
Total	19.3	13.6	4603	19.0	11.3	3453	3.8 ^c
Educ							
None	19.3	16.0	2782	18.8	12.5	1574	3.9 ^c
1 - 10	18.9	8.9	1682	18.8	9.5	1682	0.9
11 +	22.4	13.0	139	21.4	11.8	197	2.6 ^b
Total	19.3	13.7	4603	19.0	11.3	3453	4.3 ^c
Period							
69 -73 GFS	19.4	11.7	1021	19.5	11.0	731	-0.9
74 - 78 GFS	19.1	8.5	957	19.5	8.4	718	-3.0 ^b
Total	19.2	10.2	1978	19.5	9.7	1449	-2.7 ^b

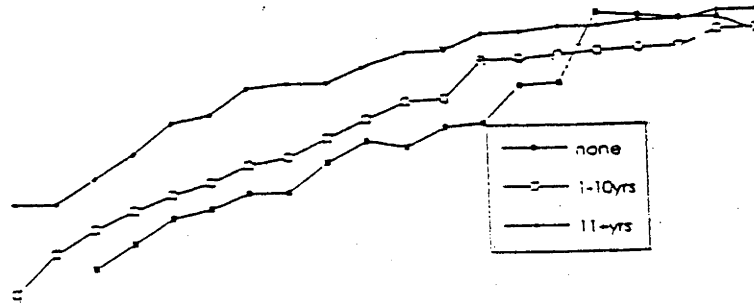
* equivalent periods for the GDHS are 78 - 82 and 83 87

a implies significance at .05 *b* implies significance at .01 and *c* implies significance at .001.

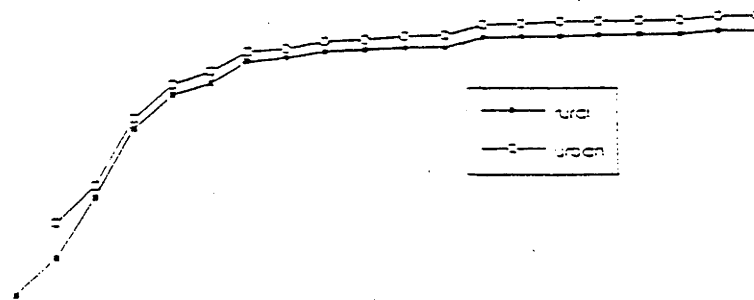
APPENDIX C

Graphs of $\log(-\log S_o(t))$ against time, t

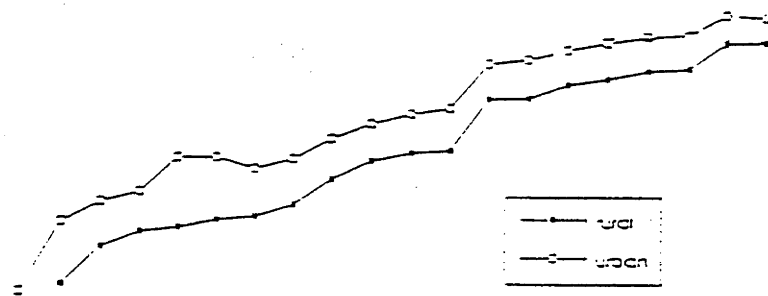
Abstinence (Years of education) (GFS)



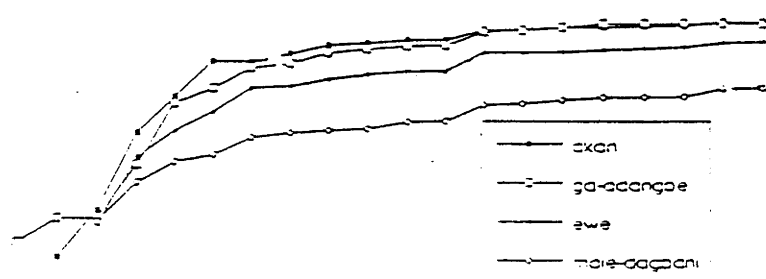
Abstinence (place of residence) (GFS)



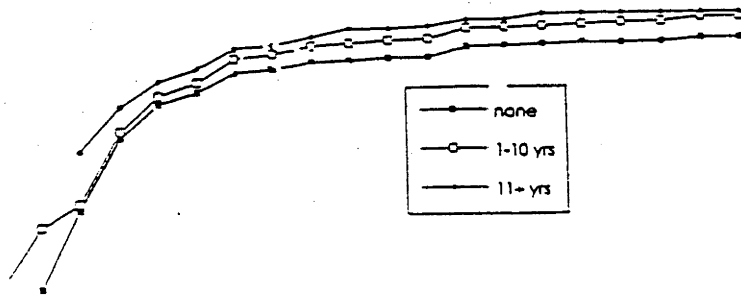
Breastfeeding (place of residence) (GFS)



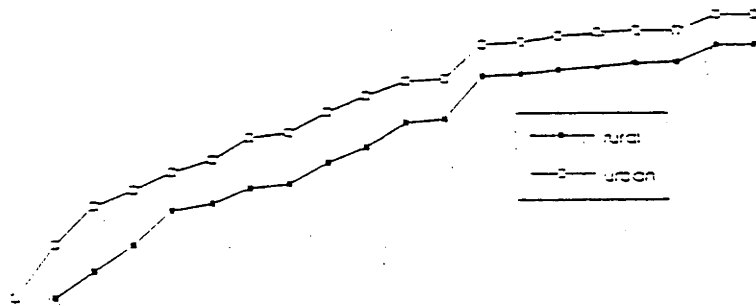
Abstinence (GFS)



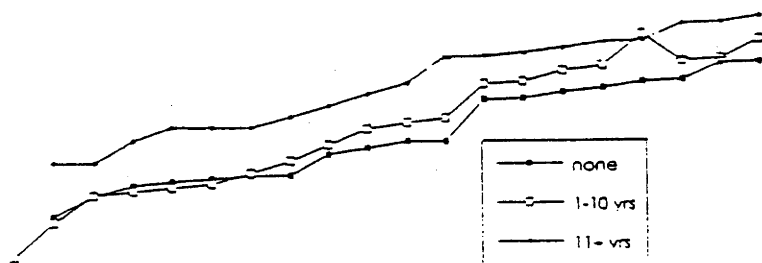
Title Abstinence (Years of education) (GDHS)



Breastfeeding (place of residence) (GDHS)



breastfeeding (Years of education) (GDHS)



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