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GREATER THAN EXPECTED FERTILITY DECLINE IN GHANA: UNTANGLING A PUZZLE

ANN K. BLANC* AND STEVE GREY†

**Blancroft Research International, Columbia, Maryland, USA and*
†National Population Council Secretariat, Accra, Ghana

Summary. This study examines fertility decline that is larger than expected on the basis of recorded increases in contraceptive prevalence in Ghana. The primary sources of data are three Demographic and Health Surveys (DHS) conducted in the country in 1988, 1993 and 1998. First, the trend in fertility and contraceptive prevalence in Ghana is considered and compared with the trend that would be expected on the basis of prior research. Next, an attempt is made to uncover the explanation behind this unexpected trend. Measures of the quality of the survey data are looked at, as well as trends in the proximate determinants of fertility: contraceptive use, marriage and sexual activity, postpartum insusceptibility and induced abortion. Finally, evidence is presented that couples adjust their coital frequency in accordance with their fertility preferences, behaviour that would influence fertility rates but would not be captured by conventional measures of the proximate determinants of fertility.

Background

On the basis of evidence accumulated over several decades of fertility research, it has been well established that a strong correlation exists at the national level between contraceptive use and fertility rates. The relationship can be summarized statistically using a linear regression of the contraceptive prevalence rate (CPR) on the total fertility rate (TFR). A recent version of this regression based on more than 100 observations indicates that for every increase of 15 percentage points in the use of contraception among married women, a decline of one child in the total fertility rate may be expected (Ross & Frankenberg, 1993). Significant deviations from this expectation (mostly in sub-Saharan Africa) have been noted in a number of studies (Bongaarts, 1989; Brown; 1996; Curtis & Diamond, 1995; Rutenberg, 1995, unpublished; Thomas & Mercer, 1995). In this study, fertility decline that is larger than expected on the basis of contraceptive use in Ghana is examined. The primary sources

of data are three Demographic and Health Surveys conducted in the country in 1988, 1993 and 1998.

The evidence for three possible explanations of the TFR–CPR inconsistency is examined:

(1) The decline in fertility rates derived from the surveys may be overestimated. This overestimation could have occurred as a result of the omission of births in one or more surveys or other inaccuracies in the birth history data.

(2) The increase in contraceptive prevalence rates may be underestimated. This could have occurred as a result of inaccuracies in the contraceptive use data in one or more surveys.

(3) Both fertility and contraceptive use are correctly estimated and the seeming inconsistency between the two results from trends in determinants of fertility other than contraceptive use. If this is true, it implies that the TFR–CPR relationship in Ghana does not conform to the international relationship.

First, the trend in fertility and contraceptive prevalence in Ghana is considered and compared with the trend that would be expected on the basis of prior research. It is found that the survey estimates of fertility decline in Ghana are substantially greater than would be expected on the basis of recorded increases in contraceptive prevalence. Next, an attempt is made to uncover the explanation behind this unexpected trend. Measures of the quality of the survey data are looked at, as well as trends in the proximate determinants of fertility: contraceptive use, marriage and sexual activity, postpartum insusceptibility and abortion. Finally, the possibility is considered that couples adjust their coital frequency in accordance with their fertility preferences, behaviour that would influence fertility rates but would not be captured by conventional measures of the proximate determinants of fertility.

Data

Ghana has conducted three surveys under the Demographic and Health Surveys programme (GSS & IRD, 1989; GSS & MI, 1994, 1999). The surveys were conducted at roughly 5-year intervals in 1988, 1993 and 1998. All of the surveys are nationally representative and include data for women aged 15–49. The sample sizes range from 4488 women in 1988 to 4843 women in 1998. The two latter surveys also included smaller subsamples of men aged 15–59. In the 1988 and 1993 surveys, a full live-birth history was collected from all women, while in 1998 a full pregnancy history (i.e. live and non-live-birth pregnancies) was obtained. The fertility rates used in this paper are calculated using the birth history data for various periods prior to the survey. Information on contraceptive use was also collected in all three surveys using questions that were identical across surveys.

Results

Trends in fertility, 1988–1998

According to the estimates derived from the DHS surveys, the total fertility rate in Ghana declined from 6·4 children per woman in the late eighties to 5·5 in the early

Table 1. Age-specific and total fertility rates for the 5 years preceding the survey, and confidence intervals

Age group	1988	1993	1998
15–19	124	119	90
20–24	258	231	192
25–29	278	244	206
30–34	248	215	183
35–39	195	163	143
40–44	117	99	79
45–49	60	29	16
Total fertility rate	6·4	5·5	4·6
Confidence interval (±2SE)	6·2–6·6	5·2–5·7	4·3–4·8

nineties. By the mid-nineties, a further drop of 0·9 children per woman to 4·6 was recorded (Table 1). Confidence intervals around the estimates do not overlap, indicating that the declines are statistically significant.

The largest percentage decline in the period between the 1988 and 1993 surveys occurred in the age group 45–49 and the smallest decline occurred among 15–19-year-olds. Among 5-year age groups from age 20 to 44, the percentage declines were similar, ranging from 11% to 16%. Between the 1993 and 1998 surveys, the pattern of decline was different. In this period, the largest percentage declines occurred among the 15–19-year-olds and among women age 40 and over. Among the age groups from 20 to 39, the percentage declines were slightly larger than in the previous period, ranging from 12% to 17%.

Trends in contraceptive use, 1988–1998

Total contraceptive prevalence among married women increased by 7·4 percentage points from 12·9% in 1988 to 20·3% in 1993. This represents a change of 57% between the two periods. From 1993 to 1998, however, the increase amounted to only 8%. In all three surveys, periodic abstinence accounts for the largest share of contraceptive use, followed by the pill (Table 2).

During the 1988–1993 period, condom use increased more than sevenfold, from 0·3% to 2·2%, injectables by over fivefold from 0·3% to 1·6%, withdrawal by 133% and the pill by 78%. The corresponding changes between 1993 and 1998 were much smaller in percentage terms.

The prevalence rate for men in 1993 and 1998 was generally higher than that for women for all methods except injectables and female sterilization. Particularly striking is the high prevalence of condom use in the two surveys as opposed to the prevalence for the same method reported for women. The difference between the two figures may be attributed to men using the condom with women who are not their regular partners or to women under-reporting condom use with their partners. Studies from

Table 2. Method-specific and overall contraceptive prevalence rates among currently married men and women

Method	1988	1993		1998	
		Women	Men	Women	Men
Pill	1·8	3·2	4·7	3·9	5·0
IUD	0·5	0·9	1·1	0·7	0·9
Injectables	0·3	1·6	0·9	3·1	3·7
Diaphragm/foam/jelly	1·3	1·2	2·1	0·9	0·4
Condom	0·3	2·2	10·4	2·7	8·2
Female sterilization	1·0	0·9	0·7	1·3	1·1
Male sterilization	—	—	—	0·0	0·1
Implant	—	0·0	—	0·1	0·1
LAM[a]	—	—	—	0·5	0·3
Periodic abstinence	6·2	7·5	9·1	6·6	8·4
Withdrawal	0·9	2·1	4·0	1·5	2·5
Other methods	0·6	0·5	0·5	0·6	0·6
Total	12·9	20·3	33·5	22·0	31·5
Confidence interval (±2SE)	11·5–14·2	18·7–21·9	na	20·3–23·6	28·1–34·9

[a]Lactational amenorrhoea method.

Ghana and elsewhere in Africa have found under-reporting of condom use by wives (Becker *et al.*, 2000) and the secret use of other methods by women (Biddlecom & Fapohunda, 1998).

The TFR–CPR relationship

In Fig. 1, the total fertility rate and contraceptive prevalence rate are plotted for 30 sub-Saharan African surveys. The solid line represents a regression line based on approximately 100 surveys from developing countries. The equation that defines the line (TFR = 7·29–0.070CPR) indicates that in the absence of contraceptive use (CPR = 0), the total fertility rate would be 7·29 and that a one percentage point increase in the CPR is associated with a 0·07 decrease in the TFR. The CPR explains a large proportion of the variation in the TFR: the R^2 for the equation is 0·88. The data point for the 1988 survey in Ghana falls exactly on this line. For the second survey the point falls below the line, and for the third survey the point falls even further below the line. For the most recent survey, the 'expected' total fertility rate is 5·75, while the actual TFR is 4·60, a difference of almost 1·2 children per woman.

The dashed line in Fig. 1 represents a regression line based only on the data points shown in the graph (i.e. only sub-Saharan African countries). The intercept decreases to 6·69, the slope decreases by about half to 0·035 and the R^2 declines to 0·31. This suggests that fertility in the absence of contraception is lower in sub-Saharan Africa than elsewhere, probably due to longer durations of breast-feeding and postpartum

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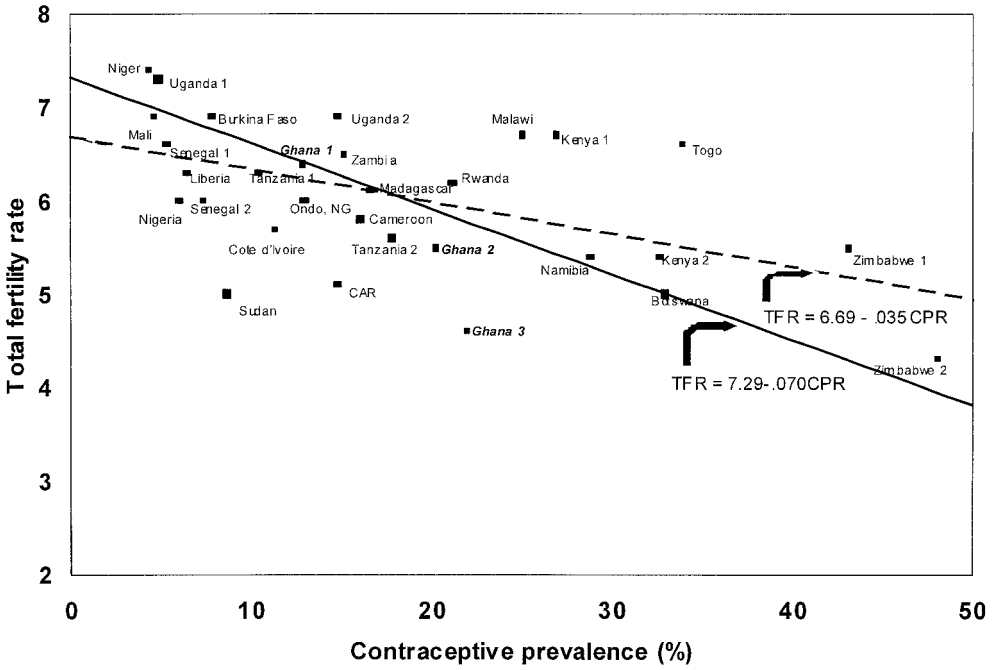

Fig. 1. Total fertility and contraceptive prevalence.

abstinence. In addition, the impact of contraception on fertility appears to be less in these countries since a one percentage point increase in the CPR is associated with a 0·035 decrease in the TFR. This weaker association may be due to the greater use of less effective methods of contraception.

In Fig. 2, the *change* in the TFR is plotted against the *change* in the CPR for three periods in Ghana and for several other countries for comparative purposes. The solid line is based on the regression line for all countries. For the first period in Ghana (1979–1988; the fertility estimate for 1979 is taken from the Ghana World Fertility Survey), the point is actually above the line indicating that fertility declined slightly less than would be expected on the basis of the increase in contraceptive prevalence. For the period from 1988 to 1993, the 7·4 percentage point increase in the CPR is expected to be associated with about a 0·5 child decline in the TFR, while the actual decline in the TFR was 0·9. Most dramatically, in the latest period, the 'expected' TFR exceeds the actual TFR by about 0·8 children per woman. The discrepancy between the TFR and CPR is evident in both urban and rural areas but it is more pronounced in urban areas (data not shown).

Data quality

Inaccuracies in the birth history data that are used to calculate fertility rates are potentially significant factors in the TFR–CPR inconsistency. The inaccuracies most likely to occur are under-reporting of births and incorrect reporting of the timing of

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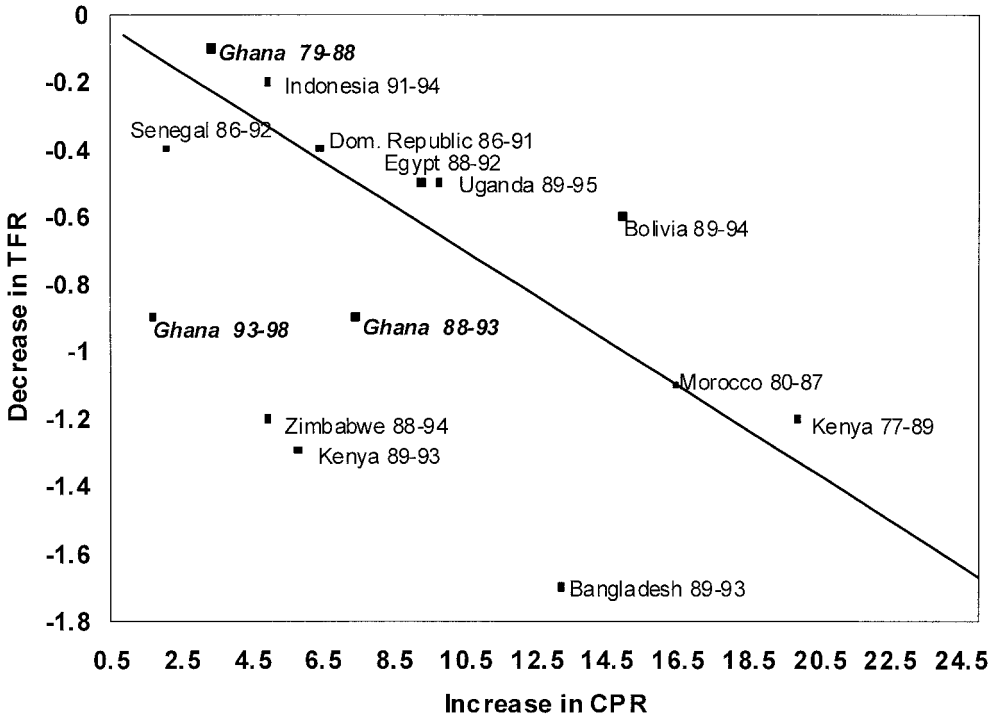

Fig. 2. CPR increase and corresponding TFR decrease.

births. In order for these data problems to influence the consistency between the change in fertility compared with the change in contraceptive prevalence, they would have to be more severe in each subsequent survey. If the level of under-reporting was the same in each survey, the TFR–CPR inconsistency may still exist, but the change calculated on the basis of two subsequent surveys would be consistent with expectations.

A simple measure of data quality – the percentage of births in the past 15 years with both month and year reported – suggests an improvement in data quality across the three surveys. This percentage increased from 79% of births in 1988 to 87% in 1998.

The omission of births and the misreporting of children's birth dates are two potentially serious data quality problems that affect birth history data. A particular form of misreporting of birth dates that has been detected in DHS surveys is birth displacement. Specifically, the DHS surveys contain a lengthy series of questions referring to children born in the five calendar years prior to the survey. The evidence suggests that interviewers may shift births back in time in order to avoid asking these questions. In the case of Ghana, the 1988 and 1998 questionnaires included a 5-year cut-off point for these questions (Arnold, 1990; Marckwardt & Rutstein, 1996). The 1993 questionnaire, however, included a 3-year cut-off as part of a DHS-wide attempt to reduce the displacement problem by reducing the number of children about whom the long set of questions were asked.

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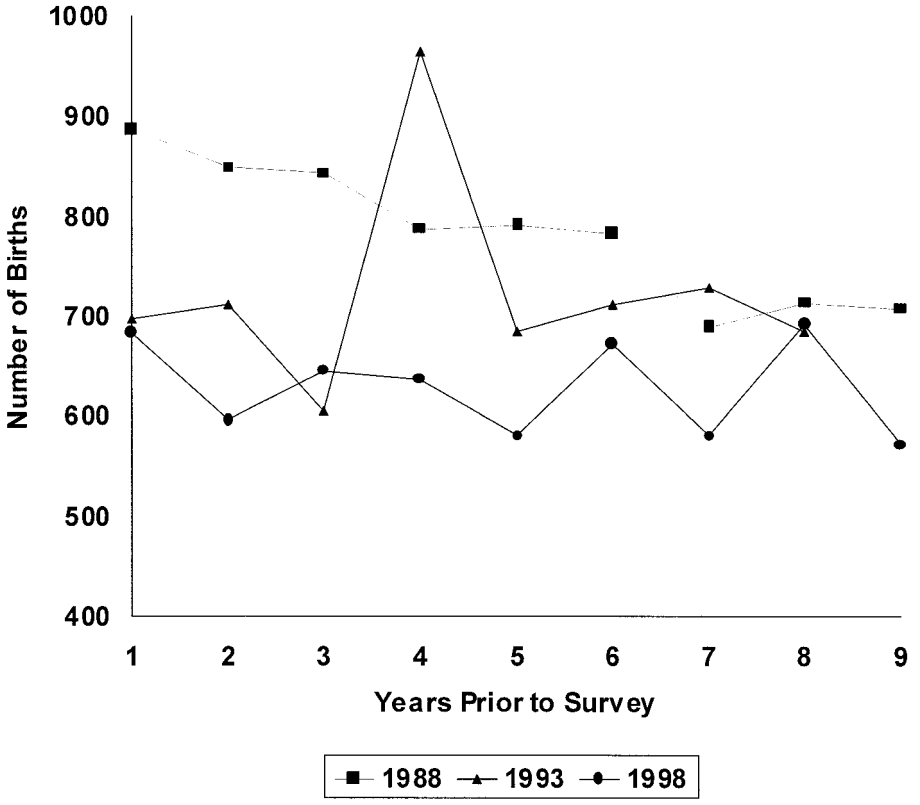

Fig. 3. Number of births by calendar year prior to survey.

The number of births reported in each of the nine complete calendar years prior to the survey is plotted in Fig. 3. (The year of the survey is excluded because it represents an incomplete year.) In the absence of displacement, the number of births will be relatively smooth across the years. The displacement problem in the 1993 survey is obvious. A deficit of births in the third calendar year prior to the survey is followed by a large excess in the fourth calendar year.

A total fertility rate based on the births in the 3 years prior to the survey would clearly underestimate fertility. A rate based on births in the 5 years prior to the survey, as is used in this paper, would presumably include the displaced births since most of them will have been shifted from the third to the fourth year prior to the survey, both of which are included in the 5-year TFR. There is also some evidence of displacement in the 1988 survey from the fifth to the sixth year prior to the survey, although the magnitude is much less than in 1993. This displacement would have the effect of underestimating the TFR for the 5 years prior to the survey but its effect would be very small and certainly not enough to explain the TFR–CPR inconsistency.

Omission of children is much harder to detect than displacement but it tends mostly to affect recent births. This is evident in some countries in a drop in the number of births in the years just prior to the survey. Based on this criterion, there

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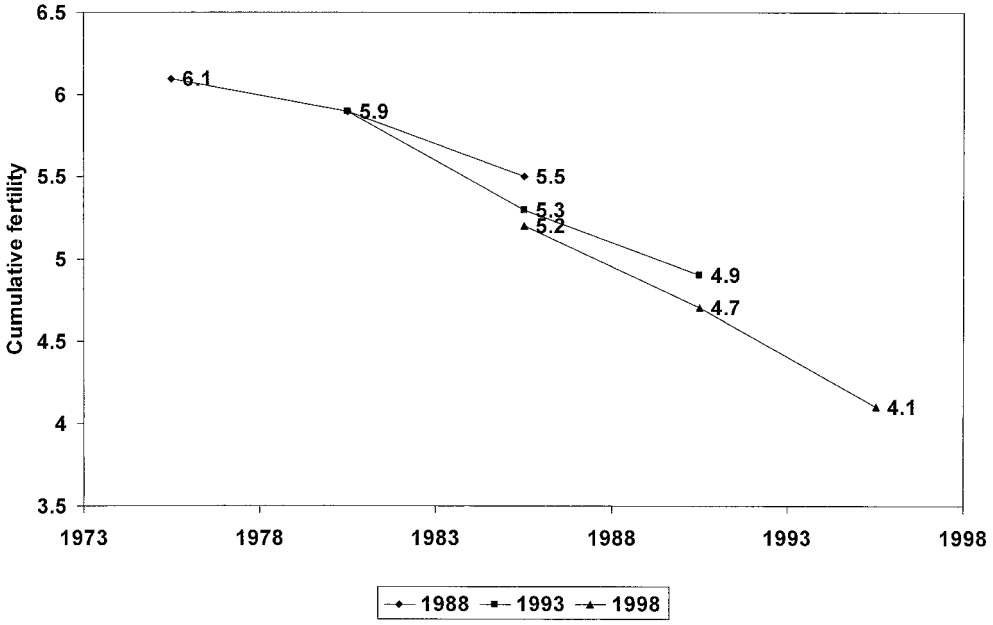

Fig. 4. Cumulative fertility rates (age 15–39) from three surveys.

is no evidence that significant omission of births has occurred in any of the three surveys in Ghana.

Another way of evaluating the birth history data is to compare the consistency of estimates derived from different surveys for overlapping time periods. In Fig. 4, cumulative fertility rates for women aged 15–39 are shown for the periods 0–4, 5–9 and 10–14 years prior to the survey, as calculated from the three surveys. The rates are cumulated only up to age 39 because age truncation occurs as one moves further back in time (i.e. there are no women in the survey who were older than age 39 ten years prior to the survey). The rates are remarkably consistent across surveys. For the period in which all three surveys overlap, the rates vary in a narrow range between 5·2 and 5·5 births per woman. Where two of the surveys overlap, the differences between the estimates are even narrower. Overall, there is little evidence that the birth history data have produced underestimates of the total fertility rates. To the extent that it is possible to judge, the quality of the birth history data has not deteriorated over time.

Proximate determinants

Contraceptive use

Empirical data from several countries across the world indicate that an acceleration of fertility decline can be achieved through a shift to more effective, modern and long-term contraceptive methods. The statistical relationship that has been established between total fertility and contraceptive prevalence incorporates the effects of the

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Table 3. Distribution of contraceptive users by type of method

Method	1988	1993		1998		Average across 167 surveys by overall prevalence[a]			
		Women	Men	Women	Men				
Modern	40·3	50·0	59·4	60·5	63·5	60·0	75·0	76·0	85·0
Traditional	59·7	50·0	40·6	39·5	36·5	40·0	25·0	24·0	15·0
Total	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0
Prevalence	12·9	20·3	33·5	22·0	31·5	<20	20–39	40–59	60+

[a]Ross & Frankenberg (1993), p. 12.

Table 4. Distribution of contraceptive users by fertility intention

	1988	1993		1998		Average[a]	
		Women	Men	Women	Men	23 sub-Saharan surveys	29 non-sub-Saharan surveys
Using for spacing	62·1	51·9	61·4	55·8	60·8	52·3	25·4
Using for limiting	37·9	48·1	38·7	44·2	39·2	47·7	74·6
Total	100·0	100·0	100·0	100·0	100·0	100·0	100·0

[a]Westoff & Bankole (1995).

method mix in each country. If the method mix in Ghana had a higher than average concentration of the most effective methods, this could account for the TFR–CPR inconsistency.

Table 3 presents the distribution of contraceptive users by type for the three surveys for men and women, as well as Ross & Frankenberg's (1993) calculation of the average distribution of contraceptive use across 167 countries. There has been an almost consistent 10 percentage point increase within every 5-year period between surveys in the share of modern contraceptive methods for women. However, the shift from the use of traditional methods to the use of modern methods by currently married contraceptive users from 40% to 50% between 1988 and 1993 falls short of the 60% observed average among countries at the same level of prevalence. In 1998 there was a further increase to 61% of currently married women using modern methods. This increase was still not sufficient to match the expected 75% calculated for the countries with similar levels of prevalence.

Evidence from Table 4 shows that over the 10-year period there has been a gradual shift by contraceptors from use for spacing to use for limiting. Use for limiting purposes is expected to have a greater impact on fertility decline through more effective and longer duration of use. Although use for limiting among women has increased from 38% in 1988 to 44% in 1998, it still falls below the 48% average

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Table 5. Median age at first sex and first marriage for women by current age

	1988		1993		1998	
Age group	Sex	Marriage	Sex	Marriage	Sex	Marriage
20–24	16·8	18·7	16·9	19·0	17·5	19·3
25–29	16·7	18·5	17·0	18·9	18·0	19·6
30–34	16·4	18·1	16·8	18·6	17·7	18·7
35–39	16·6	18·1	17·1	19·0	17·6	19·4
49–44	16·4	17·6	17·4	18·7	17·5	18·7
45–49	16·5	17·8	17·6	19·0	17·5	18·7
20–49	16·6	18·3	17·0	18·9	17·6	19·1

for sub-Saharan African countries and further below the 75% for the non-sub-Saharan countries. The data for men reveal that their use of contraception for limiting purposes has not changed much, having increased by only 0·5 percentage points between 1993 and 1998. The figure for 1998 (39%) is far below the average for both sub-Saharan African and non-sub-Saharan countries.

Marriage and first sex

Marriage patterns affect fertility through their association with exposure to sexual intercourse. In settings in which sexual intercourse (and childbirth) occurs exclusively within marriage, marital status is an adequate proxy for exposure. In settings like Ghana, however, where exposure to sexual intercourse also occurs outside of marriage, it is important to examine information that directly measures sexual behaviour, although this information may be less reliable than the information on marriage. A trend towards delayed initiation of sex and later age at marriage would, all else being equal, contribute to reduced fertility.

Table 5 presents the median age at first sexual intercourse and median age at first marriage for women in 5-year groups of current age. In 1988, the median age at first sex was less than 17 years for all age groups from 20 to 49. By 1998, the median was 17·5 years or higher in all age groups. The overall median for women aged 20–49 increased from 16·6 in 1988 to 17·0 in 1993, and again to 17·6 in 1998.

A similar but slightly smaller shift upwards in marriage age has occurred over the 10-year period. The median age at marriage increased by about 0·8 years between the 1988 and 1998 surveys. The gap between age at first sex and age at first marriage has varied from 1·5 years to 1·9 years across the three surveys.

Calculation of the median presented in Table 5 relies on women's reporting of their date of first marriage and age at first sex (date of first sex is not collected). Data of this type are known to be subject to certain types of errors (Gage, 1995). In particular, women often report higher ages at marriage as they get older. This pattern

Table 6. Percentage of 20–24-year-old women who have ever had sex and ever been married

	1988		1993		1998	
	Ever had sex	Ever been married	Ever had sex	Ever been married	Ever had sex	Ever been married
Urban	93·1	65·8	93·2	56·9	85·2	57·2
Rural	97·7	83·7	97·4	87·1	95·1	79·3
Total	96·1	77·4	95·8	75·3	91·4	71·0

is evident in the data in Table 5. For example, women who were aged 25–29 in 1988 reported a median age at marriage of 18·5 years. Five years later, in 1993, the same cohort of women (who were then aged 30–34) reported a median age at marriage of 18·6 and 5 years later they reported a median of 19·4. A similar pattern can be seen for the reporting of age at first sex within age cohorts.

Simpler measures of the timing of first sex and first marriage that do not rely on the reporting of dates or ages are shown in Table 6. The percentage of women aged 20–24 who ever had sex decreased from 96% in 1988 to 91% in 1998. This decline has occurred almost entirely within urban areas and since 1993. In contrast, the shift downwards in the overall percentage ever married from 77% to 71% is the result of declines in both urban and rural areas. The decline in urban areas occurred entirely between 1988 and 1993 while the decline in rural areas occurred between 1993 and 1998. Overall, the data suggest that there has been a relatively modest shift towards later initiation of first sex and later age at marriage in Ghana over the 10-year period. It is likely that this shift has contributed to the trend towards lower fertility. The contribution of marriage and patterns of sexual exposure to fertility rates will be examined in a later section of the paper.

Postpartum insusceptibility

In addition to marriage and initiation of sex, women's exposure to the risk of pregnancy is determined by postpartum behaviour. Postpartum amenorrhoea – which is largely determined by the duration and intensity of breast-feeding – and postpartum abstinence, are the two components of the length of postpartum insusceptibility. The overall duration of insusceptibility has remained almost constant between 1988 and 1993 (16·8 months and 16·2 months respectively; Table 7). This figure fell to 14 months at the 1998 survey. The duration of breast-feeding and postpartum abstinence have also remained almost unchanged over the three surveys, while the period of amenorrhoea has decreased from 15 to 11 months. These changes imply that, all other things being equal, women in Ghana experienced about the same or slightly shorter periods of insusceptibility to pregnancy risk following a birth over the 10-year period from 1988 to 1998.

Table 7. Median duration of breast-feeding, postpartum amenorrhoea, postpartum abstinence and postpartum insusceptibility (in months)

	1988	1993	1998
Breast-feeding	21·5	21·4	21·5
Amenorrhoea	14·7	13·0	10·9
PP abstinence	8·8	9·0	8·5
Insusceptibility	16·8	16·2	14·0

Studies have suggested that, at a given level of contraceptive use, a reduction in 'redundant use' (i.e. the proportion of currently married contraceptive users who are either amenorrhoeic or abstaining) could result in a sharp drop in fertility (Adamchak & Mbvizo, 1990; Sambisa & Curtis, 1997). Changes in the level of redundant use can result either from shorter durations of breast-feeding or postpartum abstinence, or from women initiating contraceptive use at longer durations postpartum. In effect, for the same level of contraceptive use, a drop in redundant use creates a larger fertility effect because a greater proportion of users is fecund. The overall proportion of contraceptive users who are amenorrhoeic or abstaining declined sharply from 22% in 1988 to 11% in 1993. There was only a one percentage point reduction in 1998 over the 1993 figure. The decline in the overlap between postpartum abstinence and contraceptive use appears to have contributed most to the overall reduction in redundant use.

Abortion

In some countries, a substantial percentage of pregnancies are terminated by an induced abortion (Henshaw, Singh & Haas, 1999). In order to quantify the contribution of induced abortion to observed fertility decline it would be necessary to calculate or be able to estimate indirectly an abortion rate. Unfortunately, although a number of studies of abortion in Ghana have been conducted, none contains the data required to calculate such an induced abortion rate at the national level. Induced abortion is legal in Ghana only in cases where the mother's life is at risk, where the pregnancy is the result of incest or rape, and where there is evidence of fetal impairment (Alan Guttmacher Institute, 1999). It is therefore not surprising that quantitative data on the extent of the practice are rare and difficult to obtain. Nevertheless, the information that can be extracted from existing studies offers the impression that induced abortion is practised quite commonly (Table 8).

Findings from these and other studies suggest that abortions are most common among young women, especially to prevent a first and premarital pregnancy (Lamptey *et al.*, 1985), and that the majority are performed outside of health institutions, sometimes by the women themselves (Lassey, 1995; Ahiadeke, 2001). One study of abortion patients in hospitals found that 54% of the pregnancies were aborted because

Table 8. Estimates of the prevalence of induced abortion, various sources and years

Source	Year of estimate		Type of data
Bleek & Asante-Darko (1986)	1973	About 15% of pregnancies in the lineage were terminated by an abortion More than half of the women had had at least one induced abortion	A matrilineage in a rural town in southern Ghana (42 women)
Lamptey *et al*. (1985)	1981–82	Twenty five per cent of women reported at least one induced abortion prior to the current hospitalization One-third of women with only one previous pregnancy reported that their pregnancy ended in an abortion	A random sample of 4990 women hospitalized for a birth at Korle-Bu hospital in Accra
Nabila & Fayorsey (1996)	1990–91	The percentage of all maternal deaths due to abortion at the major referral hospitals in the country increased from 9% in 1990 to 13% in 1991	Hospital records
Taylor & Mercy (1994) (unpublished)	1990–92	Twenty per cent of hospital admissions between 1990 and 1992 were due to abortion-related complications	Hospital records in a hospital in Eastern region
Ahiadeke (2001)	1997–98	Abortion rate estimated at 17 per 1000 women Abortion ratio estimated at 27 per 100 births	Community-based survey of 1689 pregnant women in four regions (Central, Eastern, Volta, Greater Accra)
Ahiadeke (2001)	1998	Abortion rate estimated at 32 per 1000 women Abortion ration estimated at 14 per 100 births	Medical records for women hospitalized for pregnancy complications at Korle-Bu hospital in Accra
Alan Guttmacher Institute (1999)	1999	Average abortion rate for West Africa estimated at 37 per 1000 women	Various sources

they were non-marital. In addition, about one-fourth of the women in the study stated that they had decided to abort the pregnancy to achieve better spacing between their children. Most of the women in the study knew about contraception but did not use it because they were wary of health risks or thought contraception was messy, complicated or difficult to use (WHO, 1994).

Data on induced abortion are not available in the DHS surveys conducted in Ghana (GDHS). However, the 1998 GDHS included a full pregnancy history in which women were asked to identify stillbirths (i.e. babies born dead) and early pregnancy losses. They were not asked to further identify early pregnancy losses as induced or spontaneous abortions so an induced abortion rate cannot be derived from these data. Nevertheless, it can be informative to examine the results on early pregnancy loss (which should include induced abortions). A total pregnancy loss rate can be calculated for the 5-year period prior to the survey. This rate is analogous to the total fertility rate except that all pregnancy losses are counted in the numerator instead of live births. The total pregnancy loss rate for the 5-year period prior to the 1998 GDHS is 0·72 pregnancies per woman. After removing lost pregnancies identified as stillbirths, the total rate of early pregnancy loss is reduced to 0·65. This number indicates that, at current rates, a woman would have 0·65 early pregnancy losses during her reproductive years (and 4·55 births according to the total fertility rate for the same period). At the rates prevailing during the 5 years prior to the survey, early pregnancy losses thus accounted for around 12% of the total number of pregnancies women experienced. This estimate is used in the next section to assess the potential contribution of pregnancy loss to the observed fertility rate.

Estimation of the Bongaarts proximate determinants model

The contribution of each of the proximate determinants to observed fertility levels can be summarized by computing indices from the Bongaarts proximate determinants model (see Bongaarts, 1978). The model provides quantitative estimates of the fertility-reducing effects of marriage, postpartum infecundability, contraceptive use, and induced abortion on maximum biological fertility. The model is written as:

$$\mathrm{TFR} = \mathrm{TF} \times C_m \times C_c \times C_i \times C_a$$

where TFR is the total fertility rate; TF is the total fecundity rate; C_m is the index of marriage; C_c is the index of contraception; C_i is the index of infecundability; and C_a is the index of abortion.

The value of the indices can vary from 0 to 1. Since the model is multiplicative, the closer the value of an index is to 0, the greater effect it has on reducing fertility from its biological maximum (the total fecundity rate).

The values of the first three indices derived from each of the surveys are shown in Table 9. As in a previous study of the proximate determinants in sub-Saharan Africa (Blanc & Poukouta, 1997), C_e – the index of exposure to sexual intercourse – is also calculated. The index is based on a fertility rate that divides all births to women who ever had sexual intercourse by all exposure subsequent to first intercourse. It equals one if all women are exposed to sexual intercourse continuously

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Table 9. Bongaarts model indices

	1988	1993	1998
Insusceptibility: C_i	0·57	0·58	0·62
Index of contraception: C_c	0·87	0·80	0·78
Index of marriage: C_m	0·84	0·80	0·77
Index of exposure: C_e	0·98	0·95	0·92
Predicted fertility using C_m	6·4	5·7	5·7
Predicted fertility using C_e	7·4	6·7	6·8
Actual fertility	6·4	5·5	4·6

from age 15 to age 49. This index is calculated as an alternative to the index of marriage because the calculation of C_m incorporates the assumption that all childbearing takes place within marriage, an assumption that is clearly inaccurate in the case of Ghana. C_e is probably an underestimate and C_m an overestimate of the effect of non-exposure to the risk of pregnancy.

The value of C_i increases slightly from 1988 to 1998, which is consistent with trends in the duration of breast-feeding and abstinence. While the effect of postpartum insusceptibility has diminished over time, it is still the proximate determinant with the largest effect on the reduction of fertility from its biological maximum.

The index of contraception, C_c, incorporates both increases in contraceptive prevalence and shifts in the average method effectiveness that result from changes in the mix of methods. The value of the index has declined from 0·87 to 0·78 over the 10-year period. This decline signals an increasing role for contraception in fertility reduction.

Both C_m and C_e fell over the course of the three surveys. This is a result of the shift towards later ages at first sex and first marriage. The index of marriage – which most likely overestimates the fertility effect of non-exposure to pregnancy – is of roughly the same magnitude as the index of contraception. The index of non-exposure to sexual intercourse is larger, suggesting that the overall effect of non-exposure is less important than either the effect of postpartum insusceptibility or contraception.

In Table 9, the values of the indices are used to calculate a 'predicted' fertility level based on the equation $TFR = 15{\cdot}3 \times C_m \times C_c \times C_i$. Two predicted values are presented: one using C_m and one using C_e. In 1988, the actual fertility rate is equal to the value predicted using C_m, which is the lower limit. In 1993, the actual value is below both of the predicted values, and in 1998 the actual value is more than one child lower than the predicted values. These results indicate that the proximate determinants measured in the model do not fully account for the reduction in fertility from its maximum biological value and, further, that the gap between the predicted value from the Bongaarts model and the actual value has become larger over time.

The remaining proximate determinant that has not been included in the model is induced abortion. As described above, there are no data on this in the two earlier

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DHS surveys. Based on the pregnancy history in the 1998 survey, however, a total early pregnancy loss rate of 0·65 has been calculated. If *all* of these early pregnancy losses were induced abortions, then the value of C_a would be 0·88 and the predicted fertility value for 1998 would be 5·0 using C_m and 6·0 using C_e. Both of these values are still well above the actual fertility rate. The data on early pregnancy loss may well underestimate the actual level of early pregnancy loss since in some cultures/societies a pregnancy loss may never be reported and probably underestimates induced abortion to an even greater degree. Unfortunately, it is not possible to determine from these data the extent of underestimation but, based on the existing data, early pregnancy loss does not fully account for the gap between the predicted and actual fertility rates.

Sexual behaviour and fertility preferences

This examination of standard measures of the proximate determinants has yielded some clues but has not fully explained the puzzle of the TFR–CPR inconsistency in Ghana. In this section, the possibility that couples practise fertility-regulating behaviour that is not contraceptive use and is not captured by the standard measures of the proximate determinants is considered. Specifically, reduced coital frequency as a fertility-regulating behaviour is looked at.

The notion of regulating fertility through modifications in sexual behaviour is not a new one in sub-Saharan Africa. Observation of a period of postpartum abstinence is a traditional and virtually universal practice in the region. It is hypothesized that couples may adapt the practice of postpartum abstinence in order to prolong the length of birth intervals or avoid additional births by abstaining from sexual intercourse for periods of varying length and without systematically practising periodic abstinence or rhythm. If this practice were occurring, coital frequency would be expected to vary predictably according to fertility preferences. Specifically, those who want to have a birth soon would be expected to have higher coital frequency and those who want to delay or avoid a birth to have lower coital frequency. A larger than expected decline in fertility could occur if this practice is substantial and if it becomes more pronounced over time. Even if the practice did not become more pronounced over time, however, an unexpectedly large fertility decline could occur if fertility preferences shifted so that more women wanted to delay or avoid births.

In order to assess the hypothesis that women adjust coital frequency in accordance with fertility desires, linear regression models were run in which the dependent variable is the number of days since last intercourse. Under the assumption that the probability of coitus is constant, the greater the number of days since last intercourse, the lower the frequency of coitus (Leridon, 1993). The analysis is limited to women who are exposed to the risk of pregnancy (‘exposed’ women are those who are currently married/living together, not pregnant, not amenorrhoeic, and who did not declare themselves infecund when asked about future fertility preferences) and who had sexual intercourse at least once in the 12 months preceding the survey (women who said they last had sex prior to their last birth are also excluded in order to eliminate those who are abstaining postpartum and those who are married but not regularly cohabiting with their partner). The models are estimated separately for

Table 10. Linear regression coefficients from model of days since last intercourse among exposed women who had sex in the last 12 months

	Not using contraception			Using a modern method		
	1988	1993	1998	1988	1993	1998
Wants 2+ years	13·7**	33·0**	29·9**	− 3·6	2·8	1·6
Undecided	22·4**	21·8*	15·6	3·3	2·1	22·7
Wants no more	24·1**	29·7**	26·5**	13·8	0·2	− 0·3
R^2	6·2	6·6	6·8	14·7	7·2	8·5
N (unweighted)	1099	1077	1197	128	275	358

Omitted category is 'wants another child within 2 years'. Model includes controls for age, number of children ever born, polygynous/monogamous union, ethnicity, level of education, urban–rural residence, and age at first sex.
**p<0·01; *p<0·05.

women who are not using contraception, among whom it is expected that there will be a relationship between fertility preferences and coital frequency, and for women who are using a modern method of contraception, among whom it is not expected that there will be a relationship. Controls for other variables that are thought to be related to coital frequency are included (see Table 10).

The regression coefficients for the fertility preference variables are shown in Table 10. Women who want a child soon (i.e. within the next 2 years) are the omitted category. The results show that in all three surveys, among women who are not using contraception, fertility preferences are statistically significantly related to coital frequency. Women who want to delay or avoid a birth or who are undecided had sexual intercourse less recently than women who want a birth soon. In contrast, as expected, there is no evidence that women who are using modern methods of contraception adjust their coital frequency according to their fertility preferences.

Table 11 shows the predicted number of days since last intercourse among exposed women who are not using contraception by fertility preference. The predicted values are calculated by holding each of the independent variables (including each fertility preference category in turn) at its mean. Thus, the predicted values incorporate effects of both the changes in the size of the coefficients over time as well as shifts of women across categories of fertility preferences. The results show that, in every survey, women who want a child soon have had sex most recently followed in order by women who are undecided, those who want to delay the next birth and those who want no more children. These results are strong evidence that women who are not using contraception modify their coital frequency in accordance with their fertility desires.

The extent to which women implement this modification jointly with their husbands or partners can only be speculated on. According to results from the three surveys, the fertility preferences of wives and husbands have become more similar over time in Ghana. This suggests that joint action to control fertility may have

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Table 11. Predicted number of days since last intercourse among women who are not using contraception, by fertility preference

	1988	1993	1998
Wants soon (1)	26·5	16·5	16·6
Undecided (2)	27·6	17·7	17·5
Wants later (3)	31·0	25·4	23·2
Wants no more (4)	31·5	26·1	25·9
(4) − (1)	5·0	9·6	9·3

become more likely. Recent analyses show that couples in Ghana are significantly more likely to be using contraception when only the wife wants to stop having children than when only the husband wants to have children, indicating that women are also able to implement their preferences independently (Bankole & Singh, 1998). Recent research from seven regions in Ghana shows that the majority of married women can, and sometimes do, refuse to have sex with their husbands (Apewokin, Grey & Agbakli-Zakli, 2001, unpublished). Given the institutional barriers to contraceptive use in Ghana and the widespread fear of side-effects of modern contraceptive methods (Stanback & Twum-Baah, 2001; GSS & MI, 1999), women may find it easier to negotiate fertility control with their partners through reducing the frequency of sexual relations.

Whether the effect of fertility desires on coital frequency has become stronger over time is difficult to assess. The difference in the number of days since last intercourse between those who want a child soon and those who want no more children increased from 5 days in 1988 to almost 10 days in 1993 and 9 days in 1998. The results for 1993 and 1998 are very similar, which suggests that the relationship did not change much in the 5 years between the two later surveys.

Discussion and conclusion

Estimates of fertility decline derived from three DHS surveys in Ghana spanning the late 1980s to the late 1990s are substantially greater than would be expected on the basis of recorded increases in contraceptive prevalence. Based on a linear regression equation representing international experience, the decline in the TFR that would be expected in Ghana as a result of the 9 percentage point increase in contraceptive prevalence is about 0·6 children, as opposed to the observed decline of 1·8 children.

This analysis has attempted to explore the reasons behind the greater than expected fall in fertility. An examination of various measures of the quality of the birth history data did not reveal any major problems that would lead to overestimates of the fertility decline. However, based on the differentials in reporting of contraceptive use among women and men and on previous research in Ghana and elsewhere

(Phillips *et al.*, 1997; Becker *et al.*, 2000), it seems probable that some under-reporting of method use (especially condoms) may have occurred among women. It is not possible to determine whether the reporting of contraceptive use has improved or deteriorated over time but, for all three surveys, the actual level of contraceptive prevalence probably lies somewhere between that reported by women and that reported by men. This may be the case for a number of countries in sub-Saharan Africa and probably accounts for a portion of the TFR–CPR gap.

A number of changes in the composition and dynamics of contraceptive use have occurred over the 10-year period that would contribute to an increasingly strong effect of contraceptive prevalence on fertility reduction. First, there has been a substantial shift in Ghana from traditional methods towards the use of modern contraceptives. Second, a moderate reallocation from the use of contraception for birth spacing towards the use of contraception for the limitation of births has been observed, a change that implies longer average durations of use. Finally, there has also been a substantial reduction in 'redundant' use or the overlap between postpartum insusceptibility and contraceptive use. This means that at the same overall contraceptive prevalence level a larger fertility reduction will occur because greater proportions of contraceptive users are exposed to the risk of pregnancy.

Increases in age at marriage and age at onset of sexual activity are observed in the country over the past decade. There is a consistent decline in the proportion of young women who have ever had sex or who have ever been married. This prolongation of the period prior to initiation of sex and marriage has been a factor in the fertility decline in Ghana, but it is not unusual relative to other countries and does not seem a likely explanation for the TFR–CPR inconsistency.

The contribution of postpartum insusceptibility to fertility decline was also examined. It was observed that while the duration of breast-feeding has remained relatively unchanged over the decade and postpartum abstinence has also not reduced to any appreciable extent, there has been an overall reduction in postpartum insusceptibility due to a decline in amenorrhoea. This trend would have the effect of increasing fertility in the absence of compensating changes in the other proximate determinants.

An attempt was made to explore the extent to which the prevalence of induced abortion can contribute to an understanding of the TFR–CPR debate. The limited information that exists suggests that the practice is widespread. Although it was not possible to calculate a reliable quantitative estimate of its contribution to the decline in fertility, the use of induced abortion is a probable explanation for some portion of the TFR–CPR gap. That the TFR–CPR inconsistency is greater in urban areas, where access to abortion is expected to be greater, lends support to this explanation.

Since standard measures of the proximate determinants are unable to fully explain the reasons behind the unexpectedly large decline in fertility in Ghana, the possibility that couples adjust their sexual activity in accordance with their fertility desires is looked at further. Although this is a form of abstinence, it would not be captured by standard DHS questions on contraceptive use. As the desire for more children has declined over time, it is hypothesized that couples who are not using a method of contraception modify their coital frequency such that those who want to delay or avoid a birth have sex less frequently than those who want to have a birth

soon. Using multivariate regression models, strong evidence was found that this is the case in all three surveys.

Some answers to the puzzle of why fertility decline in Ghana has exceeded expectations based on the increase in contraceptive prevalence are supplied by this analysis: shifts in the composition of contraceptive use, under-reporting of use by women, a high prevalence of induced abortion, and the control of fertility through reduced coital frequency. Further research on the reporting of contraceptive use and it relationship to the social and cultural setting would be useful. In addition, although a difficult methodological challenge, research on the prevalence and characteristics of induced abortion would allow a more reliable quantitative estimate of its role in fertility decline.

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