Rapid Fertility Decline and the Changing Timing of Births in Iran

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ABSTRACT

Iran has experienced a dramatic decrease in fertility that saw the Total Fertility Rate decline from 7 children per woman in 1984 to just 2 by 1999. This paper examines the experiences of different marriage cohorts of women who were at different stages of their childbearing careers when period fertility rates began to fall. We use retrospective data from the 2000 Iran Demographic and Health Survey to examine variation in the timing of births across marriage cohorts. Our findings point to the importance of contraceptive use and education as key determinants of birth timing. Moreover, the strength of the association between education and birth timing is greater among younger women. This may suggest that significant differences in completed fertility by level of education will emerge among women in the more recent cohorts.

INTRODUCTION

The Islamic Republic of Iran has experienced one of the most dramatic declines in fertility ever recorded. From a Total Fertility Rate (TFR) of 7.0 in 1984, the TFR plunged to 2.0 in 2000. This remarkable transition in period fertility is especially striking given the popular image of the country as a modern form of a "theocratic" state. Since the 1979 Islamic Revolution, religious authorities, led by the late Supreme Leader, Ayatollah Ruhollah Khomeini and his successor, Ayatollah Ali Khamenei, have played a leading role in the social and political life of the country. Yet this has not impeded the movement to low fertility; indeed, some observers argue that the support of the Islamic leadership has been crucial to the success of the country's family planning program that has brought marked declines in fertility rates to virtually all sectors of Iranian society (Abbasi-Shavazi, 2005; Hodfar and Assadpour, 2000; Mehryar et al., 2000; Aghajanian and Mehryar, 1999a, 1999b; Mehryar, 2005).

As remarkable as the fall in fertility has been, questions remain about the nature and permanence of the decline. Age-specific rates of fertility have fallen sharply for all age groups (Abbasi-Shavazi et al. 2002). For older cohorts, this has meant an end to childbearing for women who have borne, on average, a large number of children. For younger cohorts, the steep decline in fertility at younger ages could represent delay in fertility. These women still have many years in which to bear further children, and we cannot assume that the current period TFR, which is at replacement level, will match the eventual completed fertility rate for any cohort.

Given the uncertainty in predicting the future path of fertility in Iran, this paper seeks to increase our knowledge of the situation by using data from the 2000 Iran Demographic and Health Survey (IDHS) to examine the timing of births in Iran. We explore how the timing of births has varied across recent marriage cohorts and ask whether the results of this analysis can help us better understand current fertility while also giving us clues as to the future. Secondly, we examine determinants of variation across sub-groups of the population in the timing of births. Recent analyses of fertility change in Iran have emphasized the simultaneity of the decline across different sectors of Iranian society (for example, see Abbasi-Shavazi, 2002; Abbasi-Shavazi and McDonald, 2005); however, declines of similar magnitude in TFRs may hide important differences in the timing of births. Such differences may be eventually linked to differences in completed fertility.

The CONTEXT OF FERTILITY CHANGE IN IRAN

Over the last three decades, Iran has experienced pronounced swings in period fertility (Abbasi-Shavazi, 2005; Mirzaie, 2005). As Figure 1 shows, four quite distinct phases of fertility change can be identified.

---- Figure 1 about here ----

Period 1: 1972-79. Despite the efforts of the Shah's government to promote fertility control, fertility rates in Iran remained stubbornly high, with the TFR average approximately 6 children per woman. A strong economy supported by oil revenues, relatively low levels of female literacy and employment, and the importance of marriage and childbearing in Iranian culture and society contributed to persistent high fertility and resistance to the government's program to promote lower fertility (Aghajanian, 1991).

Period 2: 1980-84. The 1979 Islamic Revolution brought with it a dramatic change in population policy (Aghajanian, 1995). The previous family planning program was terminated and the new government put forward a strongly pro-natalist policy of its own. The growth of religious fervour, promoted by the new government, encouraged early marriage and childbearing. The government also put in place policies designed to support larger families financially, which provided an incentive to childbearing. While estimates of the TFR are subject to some uncertainty, fertility was likely somewhat higher than in the immediate pre-revolutionary era.

Period 3: 1985-89. The gradual ebbing away of revolutionary enthusiasm combined with the economic hardship associated with the continuing war with Iraq called into question for ordinary families the wisdom of having a large number of children. At the same time, government efforts to improve the standard of living and to reduce regional inequality led to better access to clean water and electricity, especially in rural areas, and to an increase in female literacy (Statistical Center of Iran, 1999). One result was a modest decline in fertility

Period 4: 1990-2000. The late eighties and early nineties were a time of profound change in Iran. The end of the Iran-Iraq War, success brought about by government programs designed to further socio-economic development, and, importantly, the nation-wide family planning and health program implemented in 1989 all helped foster a sharp decline in fertility. The TFR plummeted from over 5 in 1989 to just 2.0 in 2000. And, while rural-urban differences did not disappear, the gap fell to just 0.6 by the year 2000, with the urban TFR estimated to be 1.8 and the rural TFR 2.4 (Ministry of Health and Medical Education, 2000).

The remarkable path followed by the TFR in Iran over this roughly 30 year period is a unique story. Many factors contributed to the decline, including striking improvements in the standard of living, rising levels of literacy and education, and the introduction of a comprehensive family planning program that was strongly supported by both civil and religious authorities. What is also striking is the very different paths followed by cohorts of women in their childbearing years during the dramatic fertility decline of the 1990s (Abbasi-Shavazi et al., 2007). As Abbasi-Shavazi (2005) has pointed out, age-specific fertility rates were falling across all age groups. For the older cohorts this meant an earlier end to childbearing but for women who had already borne a large number of children. For younger women it meant a slower start to childbearing. And while it is very likely they will bear significantly fewer children than their predecessors, the period data available do not allow us to make firm predictions about their completed fertility. What we can observe, however, is differences in the timing of births across cohorts and different socio-demographic sub-groups of the population. The few studies on the timing of births in Iran that have been undertaken have limited to the periods before or right after the revolution, and hence the effect of the post-revolutionary family planning program has been overlooked (Raftery et al, 1996; Salehi-Isfahani and Tandon, 1999; Mansoorian and Fernando, 1993). The availability of the recent IDHS allows this study to investigate systematically determinants of variation in the timing of births across different marriage cohorts who lived under the effects of the revolution, war and the family planning program. It is our hope that such an analysis will provide further insight into the likely future of the younger cohorts. It should also allow us to see whether the dramatic decline in fertility that has touched all different sub-groups of the population has produced conformity in the timing of births as well.

CONCEPTUAL MODEL

In this article, we study timing of births by analyzing successive birth intervals as dependent variables. The length of a birth interval, which is the extent of time elapsing between a birth and its preceding event, i.e., marriage or a previous birth, is the outcome of a complicated bundle of biological, proximate and socio-demographic factors that refer to the situation of women at the time of risk of experiencing a given birth. In this study, the independent variables include women's years of schooling[1], survival status and gender of previous children, women's age at first marriage, and length of previous birth intervals.

Proximate Factors

It has well established that the period of a birth interval is a function of duration of postpartum amenorrhea, anovulatory cycles, time to conception, and duration of the pregnancy (Potter, 1963; Potter and Parker 1964; Wolfers, 1968). These biological factors are in turn largely affected by proximate determinants of fertility, namely age at first marriage, contraceptive use, and duration of breastfeeding (Bongaarts 1978, 1982 and Bongaarts and Potter, 1983). The duration of lactation is positively associated with the length of the period of postpartum amenorrhea, and age at first marriage controls the onset of exposure to the childbearing process, particularly in a society like Iran where out-of-wedlock births are rare. Contraceptive use reduces or eliminates the probability of conceiving. In the case, where event history data on contraception or lactation have not been collected by large-scale surveys, such as the case of the IDHS, the *length of the previous birth interval* has been proved to be an efficient proxy for information on duration and efficiency of contraception, frequency of intercourse, lactation and fecundity of women (e.g., Rodriguez et al, 1983; Trussell et al, 1985; Teachman and Heckert, 1985)[2]. Our general expectation is that the previous birth intervals positively affect the current inter-birth intervals. Moreover, it has been widely shown that *age at first marriage* in the Iranian society and elsewhere is negatively related with the spacing of the first birth, while it is positively linked

[1] Women's year of schooling refers to the situation of respondents at the time of the survey. However, since women in Iran complete their education before entering into a marital union, we assume women's level of education at the time of the survey corresponds to the level of education at the time of experiencing a given birth.
[2] The rationale behind this choice is that the length of the previous birth interval may contain some of the information in these unmeasured variables, especially if couples' contraceptive, breastfeeding and sexual behaviors persist during the interval.

with the length of subsequent birth intervals (e.g., Marini and Hodsdon, 1981; Tu, 1991; Mansoorian and Fernando, 1993; Mansoorian, 2008). This is because fecundity is often very low among women who marry at young ages (i.e., less than 16 years old), so the length of their first birth interval is usually longer than that of those marrying in the later reproductive ages. Since most couples in Iran do not practice contraception before they have had at least one child (especially among the older cohorts), it is expected that the timing of the first birth depends mainly on the fecundity of women. In contrast, the significant positive effect of age at first marriage on the timing of second, third, and fourth births is mainly due to women's characteristics rather than fecundity. As Cleland and Hobcraft (1985) argued, women who enter childbearing later often hold characteristics that make them different from those who marry early. These characteristics include having higher education, living in modernized and urban areas and being employed, characteristics which are associated with greater fertility control at higher birth orders.

Socio-Demographic Factors

According to the Bongaarts's aggregate fertility framework (1978, 1982), the proximate determinants of fertility will be affected in turn by individual socio-demographic characteristics. Therefore, socio-demographic variables largely affect fertility indirectly. However, individual-level analyses of birth intervals have shown that structural socio-demographic covariates influence the birth intervals rather directly, after controlling for proximate covariates (Bumpass, et al., 1986; Palloni 1984; Trussel et al., 1985). Rindfuss et al., (1987) suggest that the discrepancy between the aggregate conceptual framework and empirical micro-level analyses can be due to inadequate measurements of the proximate determinants, specification errors related to the omission of important intermediate variables such as coital frequency or abortion, and specification error embodied in multivariate analysis which seems to be the least likely reason for the discrepancy between the theory and the results. Accordingly, in this study, we expect that the socio-demographic factors have more direct impact on the dynamic of the birth intervals, after controlling for proximate determinants. To validate this assumption, all analyses of the birth intervals will be produced in four sub-models, representing gross and net effects of the proximate and socio-demographic factors.

As mentioned earlier, the conceptual model includes three socio-demographic covariates: women’s education, survival status and gender of previous children. Past research has shown that women with higher *education* move on to have their subsequent births slower than women with opposite characteristics (e.g. Easterlin, 1975; Bhrolchain, 1985; Easterlin and Crimmins, 1985). This is especially true for the timing of higher parities (Tu, 1991). It has widely shown that education consistently and negatively influences fertility (e.g., Bongaarts, 2003, Martin, 1995, Cleland and Hobcraft, 1985). In Iran, the highly educated women have been in the forefront of acceptance of fertility control due to their increased knowledge of fertility control and investments in activities other than childbearing. In a provincial study in Iran, for instance, Mansoorian and Fernando (1993) found that education was the only factor that had a persistent strong negative effect on the risk of having births among different cohorts of women. The negative effect of education on the length of birth intervals largely operates through a later age at first marriage and an increased likelihood of contraceptive use (Cleland and Hobcraft, 1985).

The impact of the death of the immediately previous child, referred to as the “index” child, on the length of the subsequent birth interval is multifaceted (Preston, 1978; Chandran 1989;

LeGrand et al, 2003). Biologically, when the index child dies, the breastfeeding suddenly terminates. Hence, the period of postpartum infecundity shortens and ovulation resumes, which leads to a faster conception and birth of the subsequent child. Behaviorally, when couples lose their previous births, they will go on to have the next births in order to achieve their desired number of children. The timing of the "volitional response" of a woman after the death of her previous child depends on the current fertility rate or the stage of the fertility transition in a population (Mensch, 1985). In a population where fertility and desired family size are high, like the Iranian population at the revolutionary period of 1979-84, women respond to the death of their prior children, say the first or second child, in higher parities. In contrast, in a context of low fertility, as was the case in Iran in the period 1990-2000, the reaction to the death of previous children would be largely seen in the second or third parity, as couples wish to reach their desired family size in a specific span of time. This is particularly true in a contraceptive society where contraceptive use is widespread and women tend to achieve their desired small family size quickly. Therefore, we can expect that women who have lost their previous child will go on to have the next birth faster than those who have not.

Likewise, gender of previous children may have two types of effects on the length of subsequent birth intervals: a composition or a preference effect. The couples' intentions for further births are influenced by either the desire to balance the current gender composition of their children or preference for one gender over the other. For instance, Teachman and Schollaert (1989) found that the gender of children affects birth timing of American couples; however, the effect was not due to "whether a child is a boy or a girl ... Rather, it is gender composition." (P. 420). In other settings, the strong significant effect of gender of previous children on subsequent birth intervals is mainly due to a son preference (e.g., Arnold, 1985; Tu, 1991; Mace and Sear, 1997). Evidence concerning the effect of gender preferences on birth timing is not well documented in Iran, though one recent study (Salehi-Isfahani and Tandon 1999) found no son preference in the second and third birth intervals. However, we expect that the couples with only girl children go on faster to have their subsequent births, compared with those having boy children or a mix of boy and girl children.

Control

Finally, we include a variable as the marriage cohort of individuals in the models in order to control the cohort effect on the timing of births. The variable marriage cohort holds five categories: 1960-79, 1980-84, 1985-89, 1990-94, and 1995-2000 cohorts. The classification of the marriage cohorts is based on the periods of fertility change in Iran, discussed earlier and illustrated in Figure 1, and on the assumption that childbearing among Iranian women begins with marriage. Each marriage cohort contains individuals linked by period of marriage who have been effectively exposed to similar historical situations and events. Though only women in the cohorts 1990-94 and 1995-2000 were not exposed directly to the revolution and the war, the timing of births of women in all the five marriage cohorts was affected by the 1989 family planning program, but at different parities. As a result, we expect different patterns of timing of births among the five cohorts. To take into consideration possible effects of the revolution, war, and the family planning program on the timing of births, the conceptual model will be controlled for the effect of marriage cohorts.

METHODOLOGY

Data

This study takes advantage of data drawn from the 2000 Iran Demographic and Health Survey. The survey was conducted by the Ministry of Health and Medical Education during October 2000, in collaboration with the Statistical Centre of Iran. It is a single-stage disproportionate stratified-cluster survey, where the sample was stratified by province and place of residence (urban–rural) within each province. Thus, the population was divided into 57 strata, including 28 rural and 29 urban strata. Based on the sampling frame generated by the 1996 census, 200 households were selected in each stratum using a systematic random sampling method. Assuming each of these selected households is the head of a cluster, nine more households adjacent to the selected household were included. Therefore, a sample size of 114,000 households was expected. Interviewers were asked to select one informant to complete a household questionnaire and, if an ever-married woman aged 10–49 was present, to select an eligible respondent to complete the woman's questionnaire. Investigators succeeded in contacting 113,957 households, and household questionnaires were completed for 111,627 households, yielding a response rate of 97.7% (Ministry of Health and Medical Education, 2000, pp. 5, 10). Within the 111,627 households, the interviewers conducted complete interviews with 90,740 ever-married women aged 10–49. The study sample, however, consists of 9071 ever-married women aged 15-49 living in the selected *head* households of the survey. We restricted the study sample to the head households for two reasons. First, the households in a given cluster were strongly correlated in terms of key socioeconomic and demographic characteristics (analysis not shown here), violating the assumption of independent observations. Second, the rationale used to select the adjacent households in a cluster is statistically dubious. The sampling weights provided by the Statistical Centre of Iran (Ministry of Health and Medical Education, 2000, pp. 138–139) will be used in all the analyses in this study so as to obtain representative estimates from the disproportionate sample. The external and internal evaluation of the quality of the survey showed significant reliability and validity (Ministry of Health and Medical Education, 2000, pp. 120–130), and this was attributed to the professional supervision conducted directly during the process of data collection. The access to data for the current study has been made possible by the permission of the Ministry of Health and Medical Education of Iran.

Measurements

The dependent variables are durations of the first, second, third and fourth birth intervals measured in months. The reason for limiting the analysis to the first four birth orders is that the number of women progressing to higher parities is limited, especially among the more recent marriage cohorts. Also, to avoid any sample selection biases, multivariate analyses of the second, third and fourth birth intervals are limited to the cohorts prior 1995, 1990, and 1985 respectively. The first birth interval is defined as the duration from marriage to the first birth, and the other intervals are inter-birth durations.

The distribution of the sample across the covariates is shown in Table 2. Women's education is measured by the number of years of schooling completed by the women which is grouped into five categories: None, 1-5, 6-11, and 12^+ years. The survival status of previous children is measured by a dummy variable with 0 for all alive and 1 for 'at least one child died' to avoid under-representation of women in certain categories of a multi-category variable like gender of previous children. Also, the "previous birth interval" is grouped into three categories: 8-18, 19-36, and 37^+ months. The rationale for this categorization is that the 1989 family planning program considered a 36-month birth interval as its target. Therefore, women in the first and third categories are respectively behind and beyond the target.

Methods

Parity progression ratios are used to study the quantum of births among different marriage cohorts. A parity progression ratio shows the proportion of women with parity i who will go on to have parity $i+1$. To study successive birth intervals, we use appropriate non-parametric and parametric methods of survival analysis that can deal with the problem of *censoring* introduced by birth history data[3]. The life table and the Kaplan-Meier methods are two non-parametric survival methods that produce estimates of survival functions, including descriptive statistics and survival curves. In this study, we use the Kaplan-Meier methods to estimate median survival time of the occurrence of births. The non-parametric methods, however, do not allow us to investigate the effects of covariates on the hazard rates of experiencing births in a multivariate context. Instead, we use parametric hazard models to estimate the impact of the selected covariates on the successive birth intervals. The parametric hazard models, which combine the features of the life table and multiple regression methods, follow a general hazard function as $h(t \mid X) = h_0(t) \times e^{(\beta X)}$. The baseline hazard function is $h_0(t)$, β is the vector of coefficients to be estimated, and X is a vector of covariates supposed to explain the occurrence of the event at time

[3] Within each birth interval women may either experience a birth or may not experience the birth up to the time of the survey. In the latter scenario, women are considered to be right censored. The conventional statistical methods (e.g., ordinary least square regression) cannot easily handle censoring, without leading to biased estimates (Allison, 2004).

t. The baseline hazard function can follow a specific known mathematical distribution[4]. In this study, we applied a log-logistic distribution to examine the timing of births in Iran. The choice of the log-logistic distribution was derived from some graphical and empirical analyses. Using life table methods, graphical distributions of the hazard rates by duration of birth intervals are depicted in Figure A.1 in Appendix. All of the four figures clearly suggest that the duration structure of the timing of births will be well represented by a log-logistic distribution. This is because the shape of a log-logistic distribution, like the distributions in Figure A.1, is non-monotonic, with an initial increase in the hazard of the next parity following with a peak and thereafter a decrease. We also compared the multivariate results taken from hazard models, applying different mathematical distributions available in Stata. The likelihood ratio tests taken from the different models suggest that the hazard models that follow a log-logistic distribution provide the best fit models, with larger log-likelihood.

Although it is assumed that all heterogeneity in the timing of births is to be captured by the set of included covariates in hazard models, it seems there is still unmeasured heterogeneity due to the factors outside the models. Therefore, we expect some unobserved heterogeneity will not be captured by the current hazard models. Overlooking the unobserved population heterogeneity in the hazard models would lead to misleading results, decreasing and increasing hazard rates (Heckman and Singer, 1984; Blossfeld et al, 1989: 91-95; Trussell and Rodriguez, 1990). Therefore, it seems to be necessary to correct the hazard models for unobserved heterogeneity in order to avoid the model misspecification and also to obtain the true effects of the observed

[4] Cox (1972) suggested a semi-parametric hazard model, known as Proportional Hazard model, in which we do not need to specify the distribution of the baseline hazard, and the baseline hazard function can take any form, provided that a series of important assumptions are met.

explanatory variables. The frailty models with *gamma* distribution available in Stata were used to introduce an unobserved heterogeneity term in all hazard models in this study. The frailty term represents the fact that individuals in the study population are heterogeneous due to factors that remain unobserved (Cleves et al, 2004: 279). The statistics *Theta* shows the variance of unobserved heterogeneity in the models.

The results of the parametric hazard models are presented in terms of *time ratios*. A time ratio greater than unity means a longer time until a subsequent birth, while a ratio less than one denotes a shorter birth interval, and hence a quicker transition to a birth, compared with the reference group . A time ratio of 1.5, for example, means that women in a given category experience the event (i.e., a birth) 50 percent *slower* than women in the reference category. We chose time ratios for two reasons. First, this study aims at examining how much *faster* or *slower* a woman with specific characteristics experience a birth. Second, a majority of women in almost all marriage cohorts in Iran experience parities one and two as shown by the parity progression ratios in Table 1. Also, a majority of women in older cohorts have experienced parities three and four. In this context, the use of hazard rates, denoting relative risk of experiencing a birth, does not reveal much, as almost every woman experiences the birth. Instead, we need to know how quickly they have experienced the births. It should be noted that the cohort 1990-2000 at the fourth birth was discarded from the analysis, as the sample size for this group of women was very small. Also, cautions should be exercised when the time ratios for this cohort at parity three are interpreted due to a small sample size.

FINDINGS

Before proceeding to the analysis of the timing of births in Iran, we will first briefly examine parity progression ratios as well as the mean age at first marriage for the cohorts included in this study. This background information will allow us to put the analysis of cohort differences in the timing of births in its proper context. Table 1 shows parity progression ratios (PPRs) by marriage cohort up to parity eight. For the more recent cohorts, only the PPRs for the first few births are of significance as the women in these cohorts have not yet had sufficient time to move on to higher parities.

The mean age at first marriage has been increasing among the more recent cohorts. From a very low figure of 14.0 for the 1960-69 cohort, the mean age began to move upwards, though stalling for the 1980-84 cohort who married just after the Islamic Revolution. The average age at first marriage for the most recent cohort is almost six years later than for the 1960-69 cohort. As we will see, this shift to later marriage has implications for the timing of births.

The progression ratios for the first parity indicate that a first birth is a near-universal event for married women in Iran[5]. The ratios remain astonishingly high for the older cohorts – 90% of women in the 1960-69 cohort who had a fifth birth went on to have a sixth – but are markedly lower among more recent cohorts. Women in the oldest cohort had largely completed their childbearing by the time the 1989 family planning program came into effect, while those married in the seventies and early eighties were in the middle of their childbearing years and the youngest cohorts only began childbearing after the program was put into effect. This fact makes it hard to

[5] It is too early to speak about the progression of 1995-2000 cohort to the first birth, as many women in this cohort married very close to the time of interview, and many others may delay their first birth.

arrive at firm conclusions about the full dimensions of the change in fertility that has been documented using period data. Nevertheless, the data in Table 1 provide strong evidence that there has been a steady decline in completed fertility across the cohorts. For example, among women in the 1980-84 cohort, who had been married an average of 17.5 years at the time of the survey, only 67% of those who had experienced a third birth went on to have fourth. As many of these women have not reached the end of their childbearing years, this figure may rise but is very unlikely to reach the levels observed among the oldest cohorts. The level of uncertainty rises, of course, when looking at the youngest cohorts. For those married between 1985 and 1989 – married an average of 12.5 years at the time of the survey – *a3* is equal to just 0.58. Similarly, for those in the 1990-94 cohort, *a2* is just .68. These women still have many years in which to have additional children and it is impossible to predict how many more will ultimately experience further births. Still, it seems a fair conclusion that these lower figures suggest levels of completed fertility well below those of previous cohorts even if some of the younger cohorts attain a level of completed fertility that surpasses the current period rate. The parity progression analysis also suggests that we examine more carefully the timing of childbearing across the various cohorts in an effort to deepen our understanding of this remarkable fertility transition.

---Table 1 about here ---

Timing of Births

Table 2 presents the percentage distributions of women and the median survival times for women experiencing a given-order birth by women’s characteristics and marriage cohorts. A large median survival time by implication means a longer birth interval. The grand medians of births show that, on average, women in Iran space their first and second births by less than three years, but space their third and fourth births by greater than three years. As expected, the medians for each birth monotonically increase when moving from the oldest cohort (i.e., 1960-79) to the youngest (i.e., 1995-2000), with the exception of the medians on the first birth. While the large median in the cohort 1995-2000 is due to contraception used to delay the first birth, the corresponding large median in the cohort 1960-79 is due to the prevalence of low fecundity resulting from early marriage. Based on results not shown here, for instance, 49 percent of women in the cohort 1960-79 with at least one child, married under age 16.

The most striking result in Table 2 is that variations in the length of the third and fourth birth intervals across marriage cohorts are much greater than those in the first and second birth intervals. For example, while median survival times for the occurrence of the second birth range from 24 months in the cohort 1960-79 to 46 months in the cohort 1990-94, the medians of the third birth range from 29 in the cohort 1960-79 to 64 months in the cohort 1985-89. The large variations in the third and fourth birth intervals among the cohorts are mainly due to long *open* or *closed*[6] birth intervals among women who are at the middle of their reproductive lifetime (i.e., cohort 1985-89). Similarly, variations in the median survival times by the covariates are larger for the third and fourth births than for the first and second births. These variations will be further examined by analyzing the net effect of the covariates on the birth intervals.

--- Tables 2 to 6 about here ---

[6] An "open" interval refers to the period started by experiencing the last birth and has not yet been ended by another next birth or by sterilization or menopause. A "close" interval refers to the period between two successive births or the period between marriage and the first birth.

Tables 3 to 6 present the results of multivariate hazard regression analyses of the timing of first, second, third, and fourth births. The respective Chi-squares and P-values indicate that all the models are statistically significant. The significant Thetas in the models indicate that there are still unobserved heterogeneities in the timing of births that could not be captured by the covariates in the models. This could be due to the lack of retrospective data on the socio-economic factors, such as employment and economic statuses, proximate factors, such as duration of breastfeeding of the index child, contraception, and abortion. The net effects of the two sets of covariates in the conceptual model are presented below.

Proximate Factors

Two proximate determinants, age at first marriage and previous birth intervals, are included in the analysis. As expected, higher age at first marriage is associated with a shorter first birth interval. This significant relation that persists even after controlling for the effects of education and marriage cohorts likely reflects the infecundity among those who married at very young ages. This interpretation is supported by the results for higher-order births, which show weak or non-significant effects for age at marriage.

In line with the conceptual model, longer preceding birth intervals are significantly associated with later timing and thus a lower risk of second, third and fourth births. However, comparing the effects of the length of previous birth intervals on the timing of second, third and fourth births, we observe two important changes that are worth further scrutiny. First, the magnitude of the effects of long birth intervals increases from the second to the fourth births, with a rise in time ratios from 11 to 40 percent in the full models. Second, while for the second birth interval, the largest ratios are associated with a previous interval of 19-36 months, for the third and fourth births, the largest ratios are associated with a preceding interval of above 36 months.

Two factors likely contribute to this pattern of results: the impact of infecundity related to very early marriage and the effects of contraceptive use. Infecundity is likely associated with the somewhat anomalous finding noted above for second births. Women with a first birth interval above 36 months (see Table 4) are largely those who married very early, and hence infecundity, not contraceptive use, led to such a long first birth interval. Their transition time to the second birth may well be shorter than the corresponding time for women with a shorter first birth interval because they seek to compensate for their delay in childbearing. Therefore, it would be reasonable to believe that a first birth interval of 19-36 months is more likely to capture the effect of contraception than a first birth interval of 8-18 and above 36 months, which respectively represent lack of contraceptive use and long infecundity, especially among women in the oldest cohort (i.e., 1960-79).

By contrast, the effect of longer intervals (37+ months) on later births is far more likely to reflect the effects of contraceptive use. We will return to this point later in the presentation of results.

Socio-Demographic Factors

Recent analyses of the fertility decline in Iran have stressed its universal character. All sectors of the population have participated in the spectacular transition that has occurred since the late 1980s. Certainly significant decline has occurred in all important social groups, but the findings presented here point to the persistence of differences in the timing of births among social groups. The most consistent and important differential relates to women's schooling. For all four birth intervals, a woman's education is significantly associated with the timing of births, even after controlling for the effects of proximate factors and marriage cohorts. Secondly, the magnitude of the effect of schooling on the timing of births increases when moving from the first to the fourth birth. For instance, while the transition time to the first birth is 10 percent longer among women with above 11 years of schooling than among those without schooling , the time to the second, third and fourth births is respectively 48, 113 and 140 percent longer among the most educated group of women.

Among the demographic factors, the survival status of previous children has the largest significant effect on the timing of second, third and fourth births. As expected, the death of at least one of a woman's preceding children significantly reduced the transition time to the second and third. The significant negative effect of the death of the index child on the timing of births persists across all the sub-models for each birth, but with greater effects on the second and third births. These results are in line with our assumption that women in the middle and younger cohorts who lost their first or second child responded to the death of their previous children faster because they wish to reach their desired small number of children in a specific span of their reproductive careers.

Finally, the results for the net effects of the gender of previous children show that women with more girls than boys have shorter transition times to the next births. Consistent with the expectation, the magnitude of the effect increases when moving from the second to the fourth births. Comparing time ratios in the full model on the fourth birth, for example, we observe that while women with previous births consisting of one boy and two girls move on to have their fourth birth significantly faster than those with three boys, the transition time to the fourth birth among women with two boys and one girl does not differ from that observed among women with three boys. This suggests that the effect of the gender composition of previous children on the timing of the fourth birth is primarily due to a *son preference* rather than to any attempt to balance the gender composition of the family. The fastest speed of moving to the fourth birth belongs to women with three girls. Compared with the weak or non-significant effects of gender of previous children on the second and third births, , the significant time ratios for the cohorts prior to 1985on the fourth birth suggest the prevalence of son preference among women in these older cohorts and hold out the possibility that such a preference may be less relevant for younger women.

DISCUSSION AND CONCLUSION

The Islamic Republic of Iran has experienced perhaps the most rapid and far-reaching fertility decline demographers have ever witnessed. Moreover, while the state played an important role in promoting the fertility transition, government policy never resorted to the types of coercive measures that have been employed elsewhere. Data presented here confirm that the implementation of the government's Family Planning program influenced women at all stages of their childbearing years. Older women, who had already borne a significant number of children, delayed or stopped childbearing. Younger women, to date, are bearing far fewer children. Our assumption is that the delay we are observing will translate into early stopping and completed fertility close to replacement levels for these cohorts of women.

While the universality of fertility decline in Iran is beyond dispute, the findings presented here suggest the persistence and, in some cases, emergence of fertility differentials that will have significance for Iran in the future. Education stands out as the strongest social determinant of the timing of births. The positive effects of women's schooling and length of previous birth interval (which can be seen as a proxy for contraceptive use) on the timing of the second and third births may indicate that more highly educated women were leaders in the movement towards lower fertility. The evidence presented above also suggests that more educated women now delay the birth of their first child, a clear contrast to the situation in the past. Lastly, the strong role of education when looking at higher-order births likely points not only to a slower pace of childbearing but very possibly the emergence of significant differences in completed fertility by level of education. To be sure, even women with the lowest level of education have very substantially reduced the size of their families, but it is very likely that the childbearing careers of the least educated and most educated women will diverge in the years ahead.

As demographers continue to chart this remarkable case of demographic change, several issues deserve special attention. Our analysis notes but does not explore the implications of a rising age at marriage. It will be of great interest to look at emerging differentials in age at marriage, especially as they may relate to education, and the subsequent link to both the number and timing of births. Second, demographers will need to monitor the labour force involvement of Iranian women. As other analysts (Abbasi et al. 2002) have emphasized, a key element of government policy through the eighties and nineties was the expansion of educational opportunities. Indeed, this almost certainly played an important role in the fertility decline. Despite this trend, women's involvement in the labour force in Iran remains limited because of socio-political constrains associated with women's employment, and high demand for jobs from young men in an economic situation where unemployment rates has been escalating. This is an anomalous situation and one that may change. If so, there could be important consequences for fertility as well. Finally, we briefly alluded to the issue of gender preference. As low fertility becomes firmly established among the more recent cohorts, this is a topic worthy of further attention. If there is a preference for sons among younger couples, there may be increasing pressure for access to abortion. On the other hand, an absence of son preference in the younger cohort would be striking given the popular image of Iran in the West as a country in which women occupy a subordinate role.

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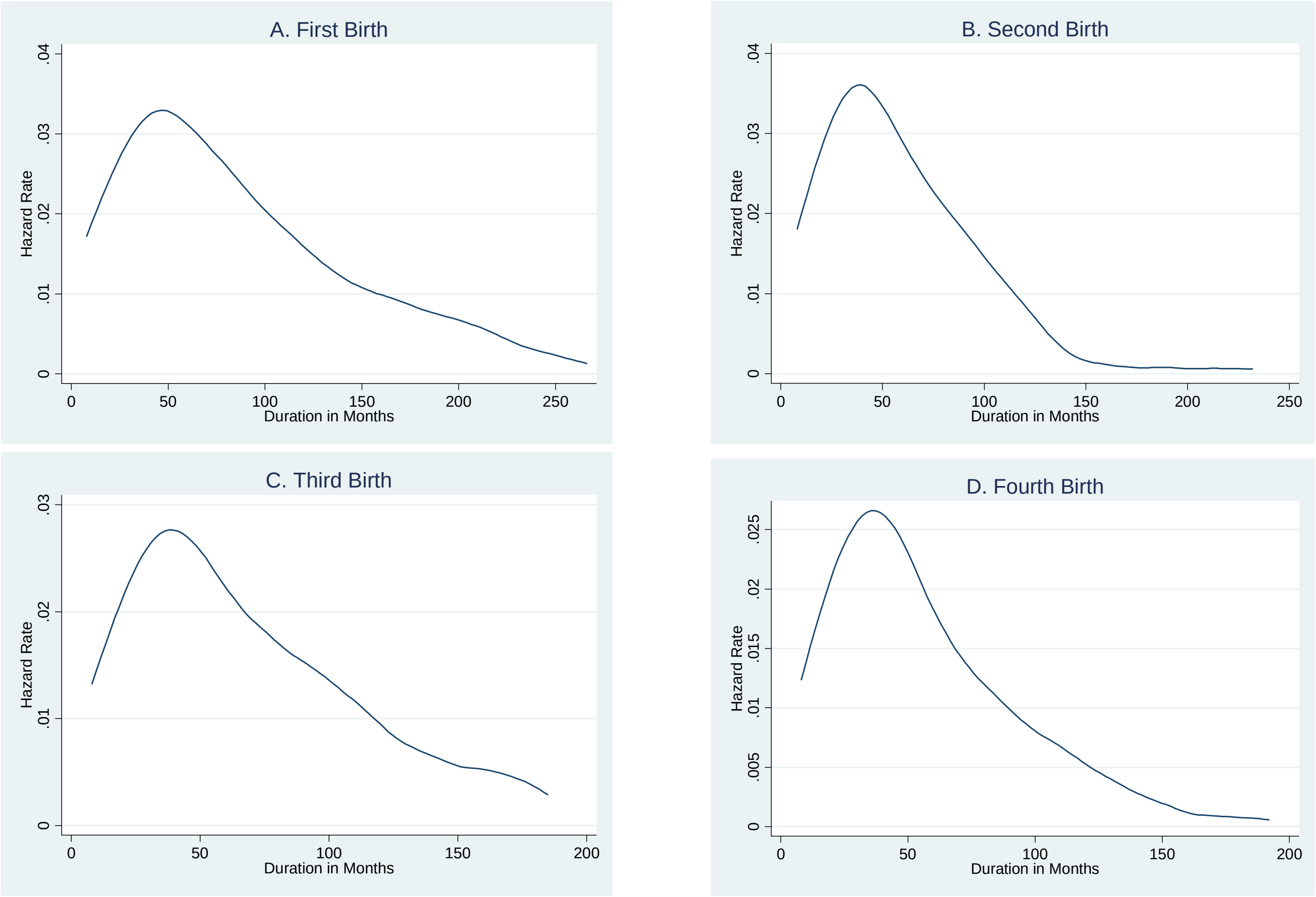
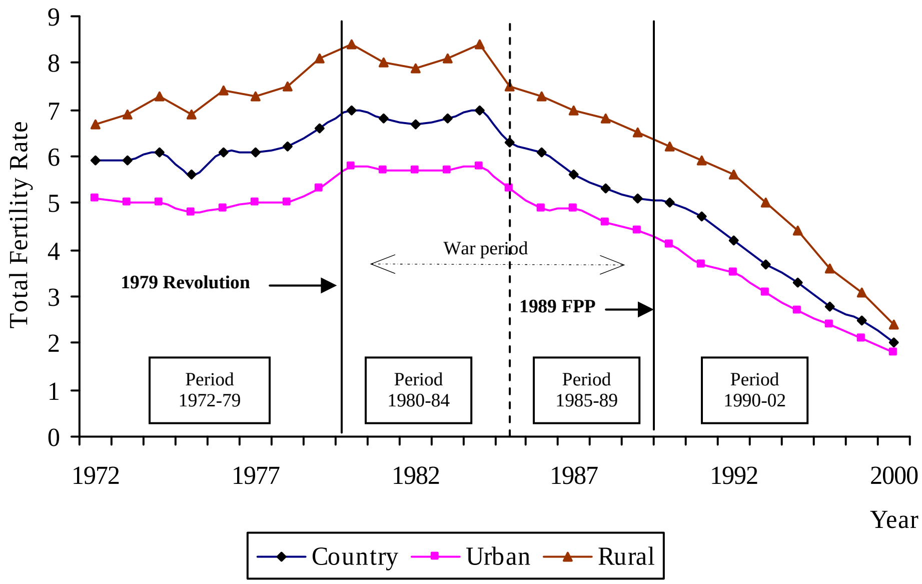
Appendix

Figure A.1. Hazard of having a specific-order birth by duration of birth interval in months, Iran 2000



Source: Computed by the author using the 2000 Iran Demographic and Health Survey.

Figure 1. Total Fertility Rates of Iran: 1972-2000



Source: Statistical Center of Iran (2000); Ministry of Health and Medical Education (2000).

Table 1. Parity progression ratios of ever-married women aged 15-49 at each birth by marriage cohorts, Iran 2000

Marriage Cohorts	Parity Progression Ratios in each specific-order parity, a(i)									Mean Age at first Marriage
	N_0	a1	a2	a3	a4	a5	a6	a7	a8	
1960-69	666	0.98	0.98	0.98	0.94	0.94	0.90	0.82	0.72	14.0
1970-74	1098	0.99	0.97	0.98	0.91	0.87	0.81	0.78	0.63	15.9
1975-79	1445	0.97	0.97	0.92	0.82	0.75	0.70	0.70	0.59	17.2
1980-84	1481	0.98	0.95	0.85	0.67	0.58	0.56	0.49	0.34	17.2
1985-89	1353	0.98	0.90	0.58	0.46	0.43	0.37	0.32	0.00	18.1
1990-94	1307	0.94	0.68	0.29	0.22	0.18	0.00	0.00	0.00	19.3
1995-2000	1721	0.49	0.15	0.04	0.00	0.00	0.00	0.00	0.00	19.8
All women	**9071**	**0.88**	**0.82**	**0.76**	**0.74**	**0.74**	**0.73**	**0.72**	**0.61**	**17.7**

Note: N_0 represents the total absolute, unweighted number of women at the beginning of each marriage cohort.
Source: All the above ratios and means were computed by the author using weighted data from the 2000 Iran and Demographic and Health Survey.

Table 2. Percent distribution of the sample, and median survival times (in bracket) of the occurrence of births in months by birth order and selected covariates, Iran 2000

Covariates	Women exposed to the risk of having			
	First Birth	Second Birth	Third Birth	Fourth Birth
Years of Schooling				
None	29.7 (30)	32.2 (23)	36.5 (28)	44.1 (29)
1-5 years	33.4 (29)	34.0 (28)	34.6 (36)	34.7 (40)
6-11 years	20.1 (27)	18.8 (37)	17.2 (65)	12.5 (79)
12+ years	16.8 (29)	14.9 (45)	11.8 (82)	8.7 (*)
Survival Status of Prior Children				
All alive		90.9 (30)	83.5 (40)	75.9 (40)
At least one died		9.1 (18)	16.5 (24)	24.1 (29)
Gender of Previous Children				
One boy		51.4 (29)		
One girl		48.6 (28)		
Both boys			26.2 (38)	
Both girls			24.3 (34)	
One boy, one girl			49.5 (36)	
Three boys				14.2 (41)
Three girls				12.3 (33)
Two boys & one girl				37.8 (38)
One boy & two girls				35.7 (36)
Age at First Marriage				
Less than 16 years	30.5 (36)	32.9 (25)	36.9 (30)	41.7 (33)
16-19 years	42.5 (27)	42.8 (29)	43.1 (38)	41.4 (40)
20+ years	27.0 (26)	24.3 (35)	20.0 (49)	16.9 (48)
Length of Prior Birth Interval				
8-18 months		30.9 (27)	27.7 (29)	19.5 (30)
19-36 months		34.1 (32)	42.1 (35)	40.5 (33)
37+ months		35.0 (27)	30.2 (60)	40.0 (60)
Marriage Cohorts				
1960-1979 cohort	34.8 (33)	38.8 (24)	45.7 (29)	57.2 (32)
1980-1984 cohort	16.7 (26)	18.6 (26)	21.4 (35)	23.8 (46)
1985-1989 cohort	15.2 (27)	16.8 (32)	18.4 (64)	14.1 (*)
1990-1994 cohort	14.4 (27)	15.4 (46)	12.6 (*)	4.8 (*)
1995-2000 cohort	18.9 (29)	10.4 (*)	1.9 (*)	0.1 (*)
Total Number Exposed to the Birth (median)	**9071 (29)**	**8017 (28)**	**6702 (36)**	**5334 (37)**
Total Experienced the Birth	**7917**	**6496**	**5086**	**3911**
Missing cases	**156**	**206**	**248**	**219**

Notes: Missing cases refer to those women who experienced a specific-order birth, but did not report date of the birth. All the percentages and medians in the above table are based on weighted data. The medians were computed for the total number of women exposed to the risk of a specific-order birth, including censored cases. (*) The medians were not computed, as more than half of the cases were censored.

Source: Calculated by the first author, using the 2000 Iran Demographic and Health Survey.

Table 3.Time ratios of having a first birth by selected covariates for the whole sample at different hazard models, Iran 2000

Covariates	Model 1	Model 2	Model 3	Model 4
Years of Schooling				
None (*reference*)	1.00		1.00	1.00
1-5 years	0.98		1.00	1.01
6-11 years	0.91***		0.96*	0.98
12+ years	0.97		1.10***	1.10***
Age at First Marriage				
Less than 16 years (*reference*)		1.00	1.00	1.00
16-19 years		0.79***	0.78***	0.79***
20+ years		0.76***	0.74***	0.74***
Marriage Cohorts				
1960-1979 cohort (*reference*)				1.00
1980-1984 cohort				0.82***
1985-1989 cohort				0.91***
1990-1994 cohort				0.91***
1995-2000 cohort				1.04@
Total experienced the birth	7917	7917	7917	7917
Total censored	998	998	998	998
Model Chi-square	22.4	292.5	322.1	464.3
P-value	0.0001	0.0001	0.0001	0.0001
Theta	0.15	0.14	0.15	0.14
Theta Chi-square	148.0	152.1	156.0	152.4
P-value	0.0001	0.0001	0.0001	0.0001

* $p \leq 0.05$, ** $p \leq 0.01$, ***$p \leq 0.001$, @ $p \leq 0.10$

Note: All figures (except Total experienced the birth and Total censored) in the above table are based on weighted data.

Source: Calculated by the first author, using the 2000 Iran Demographic and Health Survey.

Table 4.Time ratios of having a <u>second birth</u> by selected covariates for the marriage cohorts prior to 1995 at different hazard models, Iran 2000

Covariates	Model 1	Model 2	Model 3	Model 4
Years of Schooling				
None (*reference*)	1.00		1.00	1.00
1-5 years	1.17**		1.17***	1.32***
6-11 years	1.46***		1.47***	1.38***
12+ years	1.55***		1.52***	1.48***
Survival Status of Prior Children				
All alive (*reference*)	1.00		1.00	1.00
At least one died	0.69***		0.70***	0.71***
Gender of Previous Children				
One boy (*reference*)	1.00		1.00	1.00
One girl	0.96**		0.96**	0.96**
Age at First Marriage				
Less than 16 years (*reference*)		1.00	1.00	1.00
16-19 years		1.10***	0.99	0.96**
20+ years		1.20***	1.00	0.97
Length of Prior Birth Interval				
8-18 months (*reference*)		1.00	1.00	1.00
19-36 months		1.17***	1.14***	1.13***
37+ months		1.12***	1.05*	1.11***
Marriage Cohorts				
1960-1979 cohort (*reference*)				1.00
1980-1984 cohort				1.02
1985-1989 cohort				1.21***
1990-1994 cohort				1.52***
Total experienced the birth	6349	6349	6349	6349
Total censored	554	554	554	554
Model Chi-square	979.3	151.93	1066.6	1502.3
P-value	0.0001	0.0001	0.0001	0.0001
Theta	0.38	0.41	0.37	0.31
Theta Chi-square	625.7	634.9	622.1	527.7
P-value	0.0001	0.0001	0.0001	0.0001

** $p \leq 0.05$, ** $p \leq 0.01$, ***$p \leq 0.001$*

Note: All figures (except Total experienced the birth and Total censored) in the above table are based on weighted data.

Source: Calculated by the first author, using the 2000 Iran Demographic and Health Survey.

Table 5.Time ratios of having a <u>third birth</u> by selected covariates for the marriage cohorts prior to 1990 at different hazard models, Iran 2000

Covariates	Model 1	Model 2	Model 3	Model 4
Years of Schooling				
None (*reference*)	1.00		1.00	1.00
1-5 years	1.19***		1.19***	1.15***
6-11 years	1.72***		1.67***	1.55***
12+ years	2.37***		2.13***	2.13***
Survival Status of Prior Children				
All alive (*reference*)	1.00		1.00	1.00
At least one died	0.66***		0.70***	0.71***
Gender of Previous Children				
Both boys (*reference*)	1.00		1.00	1.00
Both girls	0.95*		0.96@	0.97
One boy, one girl	1.00		0.99	1.00
Age at First Marriage				
Less than 16 years (*reference*)		1.00	1.00	1.00
16-19 years		1.15***	1.07***	1.03@
20+ years		1.34***	1.16***	1.08**
Length of Prior Birth Interval				
8-18 months (*reference*)		1.00	1.00	1.00
19-36 months		1.19***	1.12***	1.10***
37+ months		1.62***	1.41***	1.37***
Marriage Cohorts				
1960-1979 cohort (*reference*)				1.00
1980-1984 cohort				1.11***
1985-1989 cohort				1.56***
Total experienced the birth	4794	4794	4794	4794
Total censored	619	619	619	619
Model Chi-square	1240.3	490.2	1471.5	1838.8
P-value	0.0001	0.0001	0.0001	0.0001
Theta	0.35	0.49	0.28	0.21
Theta Chi-square	206.3	372.1	138.0	99.3
P-value	0.0001	0.0001	0.0001	0.0001

* *p = 0.05, ** p = 0.01, ***p = 0.001, @ p ≤0.10*

Note: All figures (except Total experienced the birth and Total censored) in the above table are based on weighted data.

Source: Calculated by the first author, using the 2000 Iran Demographic and Health Survey.

Table 6.Time ratios of having a <u>fourth birth</u> by selected covariates for the marriage cohorts prior to 1985 at different hazard models, Iran 2000

Covariates	Model 1	Model 2	Model 3	Model 4
Years of Schooling				
None (*reference*)	1.00		1.00	1.00
1-5 years	1.21***		1.21***	1.19***
6-11 years	1.88***		1.86***	1.80***
12+ years	2.40***		2.41***	2.40***
Survival Status of Prior Children				
All alive (*reference*)	1.00		1.00	1.00
At least one died	0.81***		0.83***	0.84***
Gender of Previous Children				
Three boys (*reference*)	1.00		1.00	1.00
Three girls	0.90**		0.88**	0.88***
Two boys & one girl	0.99		0.99	0.99
One boy & two girls	0.93*		0.91**	0.91**
Age at First Marriage				
Less than 16 years (*reference*)		1.00	1.00	1.00
16-19 years		1.07***	1.04*	1.03
20+ years		1.04	0.99	0.97
Length of Prior Birth Interval				
8-18 months (*reference*)		1.00	1.00	1.00
19-36 months		1.12***	1.06*	1.05*
37+ months		1.44***	1.39***	1.40***
Marriage Cohorts				
1960-1979 cohort (*reference*)				1.00
1980-1984 cohort				1.21***
Total experienced the birth	3421	3421	3421	3421
Total censored	552	552	552	552
Model Chi-square	496.2	189.1	650.4	716.5
P-value	0.0001	0.0001	0.0001	0.0001
Theta	0.72	0.97	0.59	0.56
Theta Chi-square	477.6	829.9	344.3	327.5
P-value	0.0001	0.0001	0.0001	0.0001

* $p \le 0.05$, ** $p \le 0.01$, ***$p \le 0.001$

Notes: All figures (except Total experienced the birth and Total censored) in the above table are based on weighted data.

Source: Calculated by the first author, using the 2000 Iran Demographic and Health Survey.