Consequences of Early Marriage for Women in Bangladesh[†]

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Abstract: This paper provides empirical evidence on several dimensions of the potential socio-economic and physical consequences for girls of adolescent marriage using data from rural Bangladesh. I explore the commonly cited hypotheses that women attain less schooling, experience more frequent reproductive health complications, have higher fertility and experience lower levels of equality in marriage as a result of marrying young. I isolate the causal effect of marriage timing on adult outcomes by exploiting variation in the timing of menarche as an instrumental variable for age of first marriage. My results indicate that marriage age matters: Each additional year that marriage is delayed is associated with an estimated reduction of 0.27 pregnancies. This is achieved primarily through an increase in age of first pregnancy, providing additional health benefits in the form of lower incidence of stillbirths and miscarriages among younger cohorts of women. Delayed marriage is also associated with a significant increase in female schooling, adult literacy, and quality of marital life. Though they are substantial, the benefits appear to come at a high cost to families: dowry payments increase an estimated 40% of baseline cost with each additional year that marriage is postponed.

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1 Introduction

In much of the developing world, adolescent and child marriage continues to be a strong social norm, particularly for girls. Early female marriage is associated with a number of poor social and physical outcomes for young women and their offspring. On average, girls who marry as adolescents attain lower schooling levels, have lower social status in their husbands' families, report less reproductive control and suffer higher rates of maternal mortality and domestic violence.[1] In addition, these individual outcomes suggest a number of larger social consequences of early marriage, including higher population growth, greater spread of disease, and a higher incidence of orphans.

As a result of these patterns, early marriage is an issue of significant concern to policy-makers and human rights advocates. Governments in developing countries face increasing pressure to eradicate the practice with legal sanctions against parents who marry daughters before a standard age of consent. Proponents of "child protection" and age of consent laws argue that forcing parents to delay marriage will increase female educational attainment and reproductive control, and decrease incidence of domestic violence. For the same reason, social programs such as education scholarships for girls increasingly contain program rules excluding girls who marry young in an effort to discourage the practice.

However, while statistics indicate that women who marry young fare worse, it is difficult to assess the extent to which these outcomes are driven by the timing of marriage as opposed to common factors related to poverty and traditional gender views that also hinder female advancement. Given that child marriage is most common in impoverished and culturally traditional settings, the observation that women who married young have, on average, lower education levels and less decision-making power in marriage clearly do not imply that forcing girls to postpone wedlock would improve these outcomes.

This paper attempts to shed light on these issues by studying the socio-economic and physical consequences of early marriage for girls in rural Bangladesh. Bangladesh is

[1] Jensen and Thornton (2003) provide a recent overview of these patterns in a cross-section of countries worldwide.

an appropriate setting in which to examine the practice since the country has one of the highest rates of child marriage worldwide.[2] I focus my examination on three areas of impact that reflect the principal social welfare costs commonly associated with the institution: reproductive outcomes, including completed fertility and rates of pregnancy complications; education, including schooling attainment and literacy; and reported quality of marital life, including domestic violence, personal freedoms, and participation in family decisions.

To estimate the causal effect of marriage timing I make use of variation in the timing of menarche as an instrumental variable (IV) for age of first marriage. The idea behind this identification strategy is the following: While there are many incentives to marry daughters as young as possible, in Bangladesh as in many parts of the world girls are typically withheld from the marriage market until the onset of puberty. This institutional feature in the context of high rates of very early marriage presents a binding constraint on exposure to early marriage. In particular, natural variation in the timing of first menstruation within the natural age range of 11 to 17 generates quasi-random differences in the earliest age at which girls are at risk of marriage. My estimates indicate that each additional year that menarche is delayed postpones marriage 0.67 years. This forced physical barrier to younger marriages, in so far as it is independent of adult outcomes, presents a unique opportunity to assess the effects of early marriage on a broad range of outcomes.

This approach fills an important gap in the existing literature on marriage institutions in developing countries by generating possibly the first estimates of the causal effect of early marriage on adult outcomes. While there is a small literature that investigates the correlates of marriage timing, the direct influence of early marriage has not been thoroughly examined. This is presumably due to the difficulty of finding plausibly exogenous variation in marriage timing. While current age of consent laws are logical candidates for a natural experiment approach, in general the effect of delaying

[2] An estimated 75 percent of rural girls in Bangladesh marry before the age of 16, and only 5 percent marry after 18 years (Barkat and Majid, 2003).

marriage cannot be assessed from past legal changes since these laws are rarely enforced (Bates et al., 2004).

Meanwhile, there are a number of important and unanswered policy questions that warrant empirical exploration. For instance, due to inconsistent and problematic empirical evidence, the effect of age at marriage on fertility in developing countries remains mostly speculative.[3] While age of marriage is in theory one of the strongest determinants of the total fertility rate (TFR), it is uncertain whether fertility levels would fall significantly with a modest rise in marriage age given even partial ability to limit childbearing with contraception. Present understanding of the relationship between schooling and marriage postponement is similarly weak. Certainly it is unclear whether parents would choose to increase investment in girls' schooling if opportunities for marriage at young ages fell. Yet while several recent studies have examined the effect of education programs for girls on marriage patterns, the reverse direction has not been addressed.[4] In the area of marital conflict and female empowerment, even less empirical work has been done. To my knowledge, no research has addressed the causal effect of marriage timing on domestic violence or gender equality in marriage.

My results indicate that early marriage leads directly to many of the negative outcomes that have been postulated. Delayed marriage is associated with a significant increase in female schooling and adult literacy: One year postponement increases schooling by an estimated 0.32 years and literacy by 5-10%. In addition, each additional year that marriage is delayed among the sample of women in rural Bangladesh reduces the total number of pregnancies a woman experiences by 0.27. This implies that estimated effect on TFR of delaying marriage by three years is comparable in magnitude to the massive and costly contraceptive intervention that took place in the Matlab region of Bangladesh beginning in 1978. The fertility effects are achieved primarily through an increase in the age of first pregnancy, which appears to provide additional reproductive health benefits to later marriages in the form of lower incidence of stillbirths and

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[3] See McDonald, Ruzicka & Caldwell (1980), Ogawa and Rele (1981), Chang (1982), Loza (1982), Adioetomo (1983), Chen, Feng & Rochat (1983), Audinarayana (1986), Sinha (1987), Kayastha (1991), Khan (1991), Coale (1992).
[4] See Arends-Kuening and Amin (2000, 2001) and Amin (1995).

miscarriages among younger cohorts of women. In addition to possible biological health advantages of delaying first birth, women who marry later are also more likely to seek prenatal care and have health care workers present at birth. Finally, delayed marriage is associated with a decrease in gender inequality in marriage. In particular, later marriage is associated with 16% lower incidence of domestic violence for older cohorts of women, and significantly greater personal freedom and decision-making power in the household for younger women. Though they are substantial, the benefits of delayed marriage appear to come at a fairly high price to women's families: dowry payments increase an estimated 40% of baseline cost with each additional year that marriage is postponed.

2. Background

2.1 Predicted consequences of early marriage

For a number of reasons, forcing girls to postpone marriage may not improve their well-being. A "personal freedom" view of the issue maintains that young children cannot give adequate consent due to lack of personal development and maturation, thus are more likely to end up in less satisfactory unions. Yet in traditional settings of arranged marriage, it is unlikely that slightly older girls are given much additional autonomy over choice of spouse, so that daughter's satisfaction or overall match quality of the marriage is unlikely to improve with age.

A related concern about early marriage is that younger girls may end up in more exploitative domestic situations. However, this outcome is also ambiguous. Since the cost of marriage generally increases with age, it is likely that later brides have worse prospects for husbands in terms of wealth and education if their families cannot afford to pay more in dowry. To the extent that poverty and lack of education are related to poor treatment of women, it is not obvious that girls will end up in more comfortable domestic situations or with more control over their daily lives and reproduction. On the other hand, the fact that older girls are more likely to marry "down" – or have a more similar level of education and family background as their husbands – and bring more wealth into the marriage through dowry might increase their bargaining power in marriage.

The reproductive effects of delayed marriage are also ambiguous, and even straightforward theoretical predictions have come into question by demographers and population biologists. Though delaying marriage should lead mechanically to lower birth rates by reducing the number of reproductive years, in settings in which contraception is employed to limit fertility, late starters can easily catch up in terms of completed fertility unless they marry very late. Furthermore, the health advantage of delaying age at first birth may be counteracted by pressure from husbands and in-laws to compensate for lost years of childbearing by decreasing birth spacing or reducing the first birth interval, both of which could have damaging effects on the health of mother and child.

Yet another critique of the institution is based on the notion that removing children from their biological households reduces the share of resources they receive and therefore limits their prospects for schooling.[5] However, the reasons parents marry daughters at young ages is often strongly related to economic circumstances of the family. Younger brides can typically attain higher status husbands with lower dowries, in addition to directly lowering the family's economic burden of providing for their daughter. Hence, families who would otherwise choose this path may be exactly those that are unable to provide for their daughters or worse yet may be those who care least about their daughters' welfare. Higher education may further increase the price a girl has to pay for a spouse if social norms require that husbands have higher education levels than their wives, giving further disincentive for parents to invest in daughters' schooling. In contrast, women's education is rarely valued in traditional marriage markets so would not directly improve her set of choices. Finally, with respect to schooling, delaying marriage will only increase girls' education in settings in which schooling is readily available to girls in late adolescence. In the absence of schooling opportunities, daughters may be sent into the labor force to provide for their families and cover the increased cost

[5] Fundamental to the argument that early marriage should be outlawed is the assumption that women will receive more resources and personal freedoms by remaining with their biological families if they are unable to marry. In general, while it is reasonable to assume that biological parents are on average more altruistic than in-laws, it is difficult to understand why preventing altruistic parents from giving a daughter away in marriage would lead them to devote more resources to her once she is constrained to remain at home. On the other hand, if parents are not completely altruistic towards female offspring or fail to recognize the dire consequences of marrying young, legal sanctions may be welfare-improving.

of marriage, replacing child marriage with child labor. Whether labor market exploitation is better for girls than domestic exploitation in the houses of in-laws is an open question.

2.2 Setting

I examine these hypotheses by studying the consequences of early marriage among a representative sample of women in Matlab, a relatively impoverished region of rural Bangladesh. Early marriages are customary for female adolescents throughout rural Bangladesh, almost all of which are arranged by parents.[6] South Asia has one of the world's highest rates of early female marriage, and Bangladesh is an outlier in the region. In 2000, four times as many girls in Bangaldesh married below the age of 17 compared to India. In response to the problem, the country has attempted on several occasions to institute age of consent laws, none of which have had a significant effect on marriage practices in rural areas.[7] Another important feature of local marriage markets is the dowry system. Although the dowry system is currently illegal in Bangladesh, it is extremely prevalent among Muslims and Hindu families alike. Dowry is typically under control of the woman's husband and in-laws, and it can be difficult for a woman to secure for her own use should the marriage terminate (Bates et al., 2004). Finally, the outcomes of interest in my analysis are also extremely prevalent in the Matlab region. Women in Matlab have extremely low levels of education and literacy and relatively high fertility.[8]

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[6] In Matlab, only one percent of women report independently selecting their current spouse (1996 MHSS data).

[7] Indeed, Arends-Kuening and Amin (2000) report that the series of child marriage acts in Bangladesh, which gradually increased the legal age of marriage from 12 to 18, had almost no effect on the timing of marriage for rural households other than to encourage massive misreporting on marriage documents. As will be described in the next section, the data I will employ in the analysis have the additional advantage of avoiding age misreporting and recall bias in marriage dates since they are linked to a regional demographic surveillance system that linked respondents' age at marriage to both marriage registration and birth records

[8] This statement is based on sample means from the 1996 Matlab Health and Socioeconomic Survey. The sub-sample of women with completed fertility had an average of 6 pregnancies and 5 live births.

3 Data and Methods

3.1 Data

Data come from the 1996 Matlab Health and Socioeconomic Survey (MHSS). The primary survey consists of household- and individual-level information on 4,364 households clustered in 2,687 baris, or residential compounds, an approximate one-third random sample of the total number of baris in the surveillance area (Rahman et al., 1999). The primary sampling unit of the MHSS was the bari.[9] A family group residing in a bari functions as the basic unit of economic endeavor, landholding, and social identity. In each selected bari a maximum of two households were selected for interview. Within the household, all individuals over the age of 55, the head and spouse and parents of the head, and a random sample of other household members between the ages of 15 and 49 were selected for interview.

The MHSS data are ideal for implementing my identification strategy to study early marriage. First, detailed economic and demographic data were collected at the individual, household and village levels. In particular, each ever married woman was asked to provide complete schooling, marital and reproductive histories, including the timing of menarche, age at first marriage and outcome of all pregnancies known to her. An important advantage of the data is the fact that survey reports of births and marriages were cross-checked at the time of interview with vital statistics information including marriage and birth records from the regional Demographic Surveillance System (DSS), eliminating much concern over recall bias and misreporting for these variables. All sample members were also asked about current health status and survey-takers collected anthropometric measures including height and weight on site. Information on family background was collected in a survey module pertaining to sample members' parents. Finally, in the social network module, currently married women were asked about details of their marital life, including whether they require permission from their husband to make purchases, whether they participate in major household decisions, whether they have ever been seriously physically abused, whether they are required to wear a burqa

[9] Baris were randomly selected using the 1994 DSS sample frame.

outside of the house, and whether their husband has prevented them from leaving the house to work or visit family.

3.2 Sample construction

I limit my sample to the 4,028 ever married women aged 25 and older residing in the household who were selected for interview.[10] The cut-off point is chosen to minimize censoring of women who marry for the first time late in life while retaining the largest possible share of the sample. Among women aged 40-60 in the data, 99.5% of those who ever married did so for the first time before the age of 20. Since age of marriage has risen over the past few decades, 25 is arguably an appropriate maximum observed first age of marriage to maximize these objectives.[11] Of all women in the sample over the age of 24, 82% are currently married, 16% are widows, 1% are separated or divorced, and the remaining 0.7% is unmarried. An unfortunate disadvantage of these data is that the sample of ever-married women contains very few sibling or mother-daughter pairs due to the fact that, in rural areas of the country such as Matlab, married couples generally live in the son's parents' household during his father's lifetime.

Summary statistics for the sample of ever married women are presented in Table 1. The data reflect the national patterns of low female marriage age, schooling and literacy, and high fertility. The median age of first marriage in the sample is 15, and median age of menarche precedes marriage by one year. The sample has extremely low levels of education and literacy rates, and relatively high fertility. The sub-sample of women with completed fertility (ages 50-76) had an average of 7.8 pregnancies and 6 live births. Roughly one third of the sample reports some form of subservience to their spouse, as indicated by incidence of domestic violence, exclusion from family decisions and meals, and being prevented from leaving the house for work.

Comparison of schooling and reproductive outcomes between women who marry early and late is consistent with the global trends: The literacy rate among women who

[10] Women in the DNFS subsample were excluded from the analysis.
[11] While these women are indeed younger on average than women in the other three categories, the small number leaves little room for bias from right censoring.

married before age 15 is half that of women who marry later, and fertility levels and schooling are also significantly lower. The fact that father and mother's schooling and own school enrollment at age 8 are also significantly higher for women who marry later indicates important unobservable differences between these subsamples confounding OLS estimates of the relationship between marriage age and adult outcomes.

3.3 Estimation strategy

To assess the causal impact of early marriage on the above outcomes, I use age of menarche as an instrumental variable (IV) for the timing of marriage. In Bangladesh, age at first marriage is traditionally bounded below by menarche (Begum, 2003). Currently, less than 5% of girls are married before first menstruation. Although pre-arrangements may be made when children are very young, it is relatively rare to enter a girl into an official union before she has reached puberty. Meanwhile, menarche generates a strong shift in parents' demand to marry daughters. As explained by Begum (2003), "In Bangladeshi society a teenage daughter reaching menstruation becomes a burden for many parents because preservation of her virginity is the greatest concern for a bride. As a result … parents like to get their daughters married as early as possible."

For the most part, the MHSS data reflect these patterns. Table 2a reports the mean and maximum age at first marriage corresponding to each year of menarche in the sample, also illustrated in Figures 1a and 1b. Over 70% of first marriages take place within 2 years of menarche. As evident in Figure 1a, after age 12 the timing of first marriage climbs steadily with the onset of puberty. In Figure 1b the maximum age of first marriage for women in the data is plotted alongside mean age of marriage, revealing that the range of ages in which a woman marries stays surprisingly constant. All married women in the sample find a partner within fourteen years of reaching puberty, though the average time between menarche and marriage falls with age. This could reflect either parents' eagerness to marry off older daughters, longer periods of premenarcheal search, or a tendency to postpone wedlock for very young girls on account of adolescent subfecundability.[12] Figures 2a and 2b show the distributions of age of marriage and menarche, revealing a significant symmetric shift in the timing of marriage with each tercile of menarcheal age.

The IV approach involves estimating a two-stage model of the following form, where θ_i the outcome of interest, *Z* is individual *i*'s age of marriage, and *A* is individual *i*'s age at menarche, the instrument used to identify the first-stage equation:

$$\theta_i = \alpha_0 + \alpha_1 Z_i + \alpha_2' X_i + \upsilon_i \qquad [1]$$

$$Z_i = \beta_0 + \beta_1 A_i + \beta_2' Y_i + \nu_i \qquad [2]$$

In all of the estimates, X_i includes the following set of controls: age, adult height in centimeters, family background and family composition characteristics, religion, and a dummy variable indicating whether the woman currently resides in a district of Matlab that is part of the treatment region for the national fertility intervention.[13] Family background characteristics include: father and mother's education, whether father owned farmland or a family business, value of father's property, number of male and female siblings, number of brothers over age 15 at age 12, whether mother and father survived to age 40, and whether the individual was enrolled in school at age 8. I also include dummy indicators for villages and five-year age intervals. Weights equal to the inverse of probability of selection are used in the analysis and robust standard errors correct for clustering at the village and bari level.[14] In the above model, θ_i and Z_i are continuous variables. For all binary dependent variables, including literacy and indicators of quality

[12]Foster et al. (1986) note this tendency and confirm that the period of first birth interval decreases with age at onset of puberty.
[13] In the sample approximately 90% of households are Muslim and 10% Hindu.
[14] In the MHSS, within-bari selection of households and within-household selection of individuals produces a sample that is not representative of households and individuals in the region (Rahman et al, 1999). Up to 2 households were picked per bari. One household per bari was chosen at random while the second household in multiple household baris was selected if it contained elderly relatives (aged 50+). Within the household, respondents had varying probability of being selected into the survey depending on age, marital status and relationship to household head.

of marital life, the effect of marriage timing is estimated with the IV probit model described in Filmer and Lokshin (2000).

Identification of the IV model requires a strong correlation between age of menarche and age of first marriage. As the patterns in Figure 1a illustrate, this requirement is well satisfied in the MHSS data. Results from the first stage regression are presented in Table 3. For every additional year that puberty is delayed, marriage is postponed an estimated 0.67 years. Identification also requires that variation in the timing of menarche is independent of other factors influencing the outcomes of interest, controlling for observable measures. This issue is discussed below.

4 Estimation Issues

4.1 Endogenous instruments

The major threat to validity of the IV strategy I employ is the potential existence of third factors influencing both adolescent maturation and adult outcomes. In order to identify an IV model using age of menarche as an instrument for marriage timing, the exclusion restriction requires that the relationship between puberty and adult outcomes is fully mediated by changes in age at first marriage, such that delayed marriage is the only pathway through which physical maturation influences schooling, reproductive outcomes and marital life.

While biological research into the determinants of age of menarche reveals that genetic factors are by far the strongest predictor of adolescent development and that random variation is a significant component of timing, extreme nutrition has also been found to delay puberty in some settings.[15] Though the literature is relatively inconclusive on the size of the effect, the most consistent finding has been that only chronic

[15]A very recent study concluded that height and adiposity are weakly associated with pubertal development. Sedentary activity or higher polyunsaturated fat might possibly influence maturation, though no other nutrients or physical activity measures were related to pubertal development (Britton et al., 2004). Similar findings are reported by Koo et al. (2002), Koprowski et al. (1999) and Meyer et al. (1990). A handful of studies have also found evidence of psychosocial influences such as post-traumatic stress syndrome and manic depression, but the direction of influence is inconsistent (Romans, 2003)

malnutrition severe enough to cause stunting in preschool years causes a delay in menarche (Stathopolu et al., 2003). Nonetheless, this influence could be relevant for girls in the MHSS sample: the rate of acute malnutrition in rural Bangladesh was 10.7% in 1999.[16]

The potential association between age at menarche and early childhood nutritional status is a concern primarily for the fertility estimates. Some investigators have suggested that women in poor health have lower fecundity, implying that the relationship between parity and marriage timing is overstated if healthier women marry earlier (Mitra et al. 1997). The potential associations between schooling and childhood poverty and between spousal treatment and family background are less of a concern due to the fact that low socio-economic status (SES) is almost universally associated with lower educational attainment and gender equality.[17] Hence, omitted variables related to childhood SES would presumably bias downward my estimates of the casual effect of delayed marriage on schooling attainment and women's status in marriage.

Nonetheless, because endogeneity is an issue of central concern to the analytical methods, it is important to establish that potential correlations between menarche and unobservable traits do not confound the identification strategy. The first step I take to reduce the likelihood that maturation is correlated with family background is to limit the range of ages of first menarche used my analysis to between 11 and 17 years. This range covers 95% of women in the sample. Both very early and very late first menstruation is linked to chronic medical conditions, as well as extreme physical and emotional stress.

Among the remaining sample of women, I investigate available measures from the MHSS for evidence of omitted variables related to age of menarche and adult outcomes. Table 2b presents summary statistics broken down by menarche age terciles for a number of these. I begin by looking at anthropometric data. While the MHSS data contain no direct measures of women's nutritional intake early in life, adult anthropometric measures have been linked to early health status and nutrition. In

[16] WHO Global Database (1999).
[17] For instance, Pitt and Rosenzweig (1990) find that that infant morbidity in the household reduces teen daughters' school attendance.

particular, adult height, which is largely driven by prepubescent growth, is widely considered to capture the degree of stunting due to inadequate nutrition and health in childhood.[18] If the claim is correct that under-nutrition severe enough to interfere with menarche will necessarily reveal itself in extreme stunting, the data indicate no significant association between nutrition and age of menarche in the study population. In a regression of adult height on age of menarche the coefficient estimate is very close to zero and insignificant, as is evident in the height data in the fourth column of Table 2. Figures 2c and 2d present kernel density estimates of adult height and BMI by terciles of menarcheal age, revealing that the population distributions and not just averages are remarkably similar across all subsamples.[19] This evidence is also consistent with the results of a recent detailed health study conducted in four rural villages of Bangladesh which found no statistically significant differences in the prevalence of major health conditions among menstruating and non-menstruating girls below age 16 (Chowdury et al., 2000).

Other family background characteristics reinforce the anthropometric evidence. None of the following measures appear to differ significantly by age of menarche: father's and mother's education, family wealth, and number of siblings (Figures 3a and 3b). Nor is there an apparent difference in menarcheal age, controlling for height, by time trends in economic conditions. Figure 3c splits the sample into three age cohorts which reflect distinct periods of national economic growth and recession. Children born between 1921 and 1955 reached age 12 during a period of steady but slow economic growth, those born between 1956 and 1965 reached adolescence during a period of sharp economic decline leading to sever depression until 1976, and those born between 1966 and 1971 reached adolescence during a period of rapid growth. While there is a slight but steady shift over time in reported age of menarche, there is no relationship between per capita growth rates and menarche timing. The comparison is illustrated in Figure 3,

[18] A number of studies suggest the height of a child by age four is a discriminating indicator of previous nutrition and the burden of childhood disease, and that this early measure of height is a reasonably accurate predictor of adult height (Fogel, 1990, 1991; Herrinton and Husson, 2001; Martorell and Habicht, 1986; Martorell, 1993).

[19] If anything, adult height appears to be slightly skewed to the left for girls who mature early, consistent with studies from development biology that show that reaching puberty early is associated with shorter stature in adulthood with no corresponding effects on health.

where cohort average marriage and menarcheal ages are plotted against a time trend in per capita GDP corresponding to the year in which girls in that cohort reached age 12. While economic trends fluctuate considerably over time, menarcheal age is extremely flat throughout the period and marriage age is steadily rising.

This set of evidence suggests that much of the variation in timing of first menstruation is uncorrelated with determinants of adult well-being other than marriage age and that differences in family background according to age of menarche are unlikely to confound the analysis. The availability of adult height information further enables me to estimate the relationships between adult outcomes and age at marriage taking some degree of early nutritional status into account by including height as a regressor in the IV analysis.[20] Because adult height may not be a sufficient statistic for childhood nutrition, I also control for a number of indicators of childhood SES, listed in Section 3.3.

4.2 Selective mortality

Another estimation issue in using retrospective information is selective mortality. I restrict the sample to women under the age of 75 to reduce the degree of selection while still permitting an analysis of completed fertility. However, since my estimates include women as old as 74 and average life expectancy for women in Bangladesh is well below this, if either early marriage or early menarche is associated with higher mortality in adulthood, the estimates will be biased. Unfortunately, this problem is difficult to address with the MHSS data alone. Eventually, vital statistics data from the monthly DSS will provide information on mortality and cause of death of all women in the sample during the eight years following the MHSS survey. These data will allow me to examine carefully the degree of sample attrition due to selective mortality related to age of menarche or early marriage. However, this data is presently unavailable.

[20] Body mass index (BMI) is also available from the anthropometric data. However, while height is generally taken as a measure of nutrition and health in childhood, BMI is thought to reflect recent conditions. All results are robust to controlling for either BMI or height.

In the meantime, limited inferences on potentially confounding patterns of age-specific mortality can be made by examining morbidity indicators from the MHSS data. These indicators include the reported incidence of the following adult health conditions, presented in table 2c: anemia, diabetes, arthritis, urinary infection, respiratory problems, gastritis, and a categorical indicator of self-reported health. Indeed, none of the available health indicators are significantly correlated with age of menarche among the sample of women who reach puberty between 11 and 17, controlling for the set of demographic characteristics listed above. Unless selective mortality is due to causes of death unrelated to the available health indicators, this would suggest little concern for mortality as an important source of selection.

4.3 Recall bias

A final concern with the data is potential measurement error due to recall bias in the variables collected retrospectively. As mentioned earlier, the ability to double check birth and marriage data with DSS records eliminates much of the concern over measurement error in these data. Age of menarche, however, is not possible to cross-check with outside sources as no records are kept of this event by government or health practitioners. Given this, one fear is that imperfect recall with respect to the timing of menarche may lead respondents to approximate menarche with marriage, such that the correlation is spuriously strengthened.

I do not expect measurement error to present a significant problem in these data for two reasons. First, special care was taken in collecting accurate reports of reproductive histories by MHSS survey-takers. In particular, survey-takers were trained to probe respondents with memory triggers and monitor responses with a range of consistency checks.[21] Second, due to the social importance of this event in rural Bangladeshi society, marked by many important lifestyle changes, it is reasonable to expect that women to remember the timing with relative precision. For example, as soon as a Muslim girl in Bangladesh reaches menstruation she is instructed to pray five times a

[21] For instance, reported age of menarche was checked against reported age of first childbirth and marriage. Respondents were also asked to compare the timing of this event to siblings in the household to trigger memory.

day, to keep fast, to wear special clothes such as long shirt and trouser, to cover her head and breast with a veil, and never move alone anywhere (Begum, 2003).

Finally, there is no empirical evidence of significant recall bias. For instance, imperfect recall should show up in changes in the distribution of menarcheal age over time, yet the data reveal no significant heteroskedasticity with respect to menarche reports and respondent's age. However, it is important to note that potential population changes over time in the timing of menarche limit the ability to perform standard diagnostic checks of additive measurement error with age. For instance, it is ambiguous whether the fact that average age of menarche rises slightly over time reflects a real biological phenomenon or a relationship between recall bias and age.

4.4 Intergenerational effects

The genetic component of age of menarche may imply that women with later onset of puberty have the additional advantage of having mothers that also experienced later marriage. In this sense, the benefits of late marriage may be transmitted through intergenerational linkages other than biology. If later marriage leads to lower fertility and improvements in the position of women, families in which this biological trait is prevalent across generations may be those with persistently lower fertility and more gender equality.

While the data will not allow me to directly measure intergenerational correlations between age of menarche and marriage timing, I predict the influence of this indirect channel to be relatively minor for a number of reasons. First, marriage timing has little potential influence on the schooling outcomes of older cohorts of women, for whom schooling opportunities were extremely scarce. Second, paternal genes will dilute this pattern since paternal genetic influence on menarche is presumably independent of maternal influence. Finally, regression controls for family background (including family size) will minimize the influence of second-order effects.

5 Results

5.1 Education

To gauge the impact of marriage timing on schooling attainment, I measure the impact of delayed marriage on the age at which women who have enrolled in school quit school, and on the total number of school years and literacy rates attained by all women in the sample. Nation-wide only about 70% of children in Bangladesh enroll in primary school, of which almost two-thirds drop out before completing the 5-year cycle. Bangladesh also has one of the lowest adult literacy rates in the world, averaging around 30% for adults over 40. Literacy is defined broadly from respondents' reports of reading and writing ability on a scale of one to three. Respondents that reported either one or two on both measures were defined to be literate for the purpose of the analysis.

For the schooling analysis I divide the sample into women between the ages of 26 and 50, and women over the age of 50. Before 1952, there were extremely limited educational opportunities for women in rural Bengal, with less than a third of women over the age of 50 ever enrolling in school. Hence, age of marriage should have little impact on the schooling of women in the older cohort. For obvious reasons, I also focus the schooling analysis on girls for whom the marriage constraint is binding by restricting the sample to those who were enrolled in school at age 8.

Results from the IV estimates for schooling and literacy for the younger cohort of women are reported in Table 4 alongside corresponding OLS estimates.[22] Columns 1-2 and 7-8 report years of schooling and literacy attained for women who entered school as children, and columns 5 and 6 report literacy rates for the full sample of women. The results indicate that postponing marriage by one year between the ages of 11 and 16 increases educational attainment by an average of 0.36 years. Correspondingly, an additional year of delay increases adult literacy by 6 percent among girls enrolled in

[22] Analogous estimates for the older cohort are excluded from the discussion since they yield no significant results. This is presumably due to the fact that schooling opportunities were severely limited and so few of the sample women ever enter school.

school, and by 9 percent among the entire sample.[23] These estimates imply that sufficient enforcement of child marriage would alone generate substantial increases in educational attainment and literacy in the region: An increase in the average age of marriage from 15 to 18 corresponds to a 16% increase in female schooling and a 25% increase in literacy.

Although late marriage is strongly correlated with schooling achievement, OLS estimates that control for observable demographic characteristics are smaller than the IV estimates. One possible reason is that OLS estimates are in fact biased downwards due to unobservable factors reducing the average schooling attainment of girls who marry late. This could be the case, for instance, if girls from impoverished homes were forced to delay marriage in order to save money for dowry.[24] However, additional evidence from the data presented in columns 2-3 of Table 4, indicates that is not the case. In particular, in the control experiment in which menarcheal age is regressed on school enrollment at age 8, the OLS estimates are positive and significant. Assuming parents cannot predict timing of puberty from girls' observable characteristics at age 8, this indicates the presence of unobservable determinants of both schooling and marriage age. Meanwhile, the IV estimate is close to zero and insignificant, suggesting that the instrument is not contaminated by the same unobservable correlates. Given this, the likely explanation for the difference between OLS and IV estimates is the difference between local average treatment effects (LATE) obtained from IV and population average effects. That is, the effects of delayed marriage are stronger than average among girls for whom menarche presents a binding constraint.[25]

The same analysis of schooling and literacy effects of marriage on the older sample of women indicates no effect of delayed marriage on schooling or literacy outcomes. While the OLS estimates reveal that marriage age is again correlated with both

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[23] The baseline fraction of women aged 25-50 who report quitting school to get married is 0.41. Further estimates imply that increasing the average age of marriage by three years would eliminate the present constraint marriage places on schooling attainment.

[24] Indeed, Amin et al. (2003) report that credit-constrained families in a different rural region of Bangladesh have mixed strategies towards marrying off girls when dowry money is limited, in some instances marrying girls younger than usual to save on dowry costs while other times delaying marriage until more dowry is available.

[25] See Angrist and Imbens (1994) for a discussion of LATE estimation.

measures, the standard errors on IV estimates are too large to detect an effect. A likely explanation for the difference is the extremely low baseline levels of the dependent variables: Only 10 percent of older women ever enrolled in school and only 18 percent are literate. Among those that enrolled, the median drop-out age is 11, indicating that among the enrolled, very few remained in school long enough for matriculation to be effected by physical maturation. Correspondingly, there is little evidence of an effect on literacy among the full sample (column 4).

5.2 Reproductive outcomes

The next set of outcomes relates to fertility and reproductive health. Here I examine the effect of marriage timing on the total number of pregnancies a woman experiences as well as an overall measure of her reproductive health captured by the fraction of pregnancies that result in miscarriage or stillbirth. The fertility analysis again divides the sample into women above and below age 50, this time with an interest in isolating the effect of early marriage on completed fertility in order to disentangle birth delays from changes in completed fertility.[26] Because women over 50 have reached the end of their reproductive cycles, I can back out a hypothetical effect of marriage timing on the total fertility rate (TFR) from this sub-sample.

For comparison across cohorts, I also estimate the average fertility response to early marriage among women between the ages of 25 and 50 by aggregating the effect on age-specific birth rates. While the comparison is complicated by the fact that these women have not reached the end of their reproductive years, it is nonetheless useful to compare cohorts in order to study the influence of marriage timing across different levels of fertility control. Because of increased reproductive control among younger women with greater access to contraception, the effect of marriage timing is likely to be larger among the older cohort of women.[27] Important differences between cohorts may also exist with respect to the reproductive health advantages of marrying late. In particular,

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[26] A more common cutoff point for completed fertility is 45. I use 50 as a cutoff point to make it consistent with the age categories in the schooling estimates. The analysis is robust to using either age cut-off.

[27] Average fertility rates in the region have fallen by an estimated 25% over the past two decades (WHO Global Database 2003).

younger women have access to more prenatal care and medical assistance during birth to help reduce pregnancy complications. Selective mortality is another source of potential cohort differences since maternal mortality has fallen sharply over the past four decades.

It is important to note throughout the fertility analysis that I may be unable to accurately estimate the average influence of age at marriage on fertility with the current identification strategy. In particular, since the health risk of early childbearing is a function of the interval between menarche and first birth, the predicted health advantage of delaying marriage among a random sample of women in the population is presumably greater than I can measure using girls with delayed physical maturation as a comparison group. For this reason, results from this analysis can be interpreted as lower bounds on the population average effect.

Table 6 presents the fertility and reproductive health results for women between the ages of 50 and 75. The dependent variable in columns 1 and 2 is the total number of pregnancies and in columns 3 and 4 is the fraction of pregnancies resulting in stillbirth or miscarriage. The IV analysis indicates that an annual delay in age at marriage decreases the total number of pregnancies a woman experiences in a lifetime by 0.27. Although the effect is relatively small given a TFR of 7.9 among women in this sample, the estimate implies that increasing the age of marriage from 15 to 18 would alone reduce the regional TFR by 10% without any corresponding increase in schooling subsidies or work opportunities for women. Interestingly, there is no corresponding change in the fraction of failed pregnancies, or reported rates of stillbirth and miscarriage. The most likely explanation for the absence of an effect is related to the instrumental variable used in the analysis, described above.

Results from analogous estimates for the sample of younger women are presented in Table 7. Among the younger cohort, number of pregnancies is harder to interpret since these women have not reached the end of their reproductive years. However, unless women “catch up” for the lost years of exposure, most of the total fertility effect of delayed marriage should show up in differences in very young age-specific fertility rates.[28] Hence, were fertility levels and the fertility effect of delayed marriage the same among younger cohorts of women, age-specific estimates in Table 7 should be larger than the completed fertility estimates of Table 6. In fact, the implied reduction in the number of pregnancies among women between the ages of 24 and 50 is half as large as the estimated reduction among older women. While there are a number of possible reasons for this pattern, it is most likely due to the increased reproductive control among younger women. As the amount of excess fertility in the population falls and ability to limit fertility with contraception rises, it appears that fertility levels among women who marry early and late converge.

Another interesting difference between Table 6 and Table 7 is the fact that younger women appear to experience a reproductive health advantage to later marriage that is not observed among older cohorts. In particular, an annual postponement in marriage is associated with a 12.4% reduction in the fraction of pregnancies that end in miscarriage or stillbirth. Furthermore, most of this health advantage operates through reducing pregnancy complications during a woman's first pregnancy (column 8). Examining the proximate determinants of changes in fertility sheds light on the source of health advantage of delaying marriage. In particular, fertility reductions achieved through an increase in the age of first pregnancy are likely responsible for a portion of the reproductive health benefits to later marriages in the form of lower incidence of stillbirths and miscarriages.

However, age of first birth cannot account for cohort differences in reproductive health benefits of marriage delay. One possible reason that the effect differs over time is that younger women have greater access to prenatal care and medical assistance during birth. If late marriage is related to the propensity to utilize medical services, younger but not older cohorts would experience a reproductive health advantage from delaying marriage. To explore this hypothesis, I analyze data on health care practices during pregnancy available from the MHSS. These include whether a woman seeks pre-natal

[28] The exception is if women "catch up" immediately for the lost years of exposure, and ages are aggregated to some degree. Where fertility control is very limited, this is not likely to happen.

care during pregnancy and whether either any type of health care worker is present during birth.[29]

The effect of early marriage on the propensity to utilize these services may operate through several channels. Girls who begin their reproductive cycle at younger ages may be more isolated or less empowered and as a result less likely to seek appropriate health care during pregnancy and childbirth. Alternatively, utilization could work indirectly through the schooling effect if health care practices are a function of education level. To disentangle the effects of education from residual determinants of health care practices related to marriage age, I make use of the fact that the education effects of marriage timing are only binding for the subpopulation of girls who were ever enrolled in school. In this manner, marriage age and schooling attainment can be separately identified by the set of two instruments that includes age of menarche and age of menarche interacted with a school enrollment indicator.

Table 8 presents results from the IV analysis with both one and two endogenous variables. These estimates suggest that health care practices are likely to play a significant role in reducing pregnancy complications among girls who marry later. A year of marriage delay is associated with a 16% increase in the likelihood of prenatal care during first pregnancy, and a 10% increase in the rate of prenatal care throughout the reproductive cycle. There is also an associated increase in the rate of birth attendance by health care workers, though the effect is small. Finally, the estimates in columns 2, 4, 6 and 8 indicate that the bulk of the increase in health care services does not operate through changes in schooling. Correspondingly, separate estimates indicate that the majority of the average change in preventive health behavior is experienced among the subpopulation for whom schooling is unaffected by marriage age.

The last set of estimates in the fertility analysis explores whether delaying marriage is a compliment or substitute to standard fertility interventions by comparing

[29] Prenatal care is taken from survey question: "During pregnancy […] did you ever have a pregnancy check-up?" Birth attendance information comes from survey question: "Who provided care mainly during [...]'s birth /stillbirth/ miscarriage?"

women who are exposed and women who are not exposed to a comprehensive family planning intervention that took place in several areas of Matlab beginning in 1978. The treatment area has since received a series of health and family planning interventions from the International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDRB) including more frequent visits from female welfare assistants who provide counseling and deliver contraceptives, and access to ICDDRB health centers for family planning services. For evaluation purposes, the Matlab region was divided into a treatment and comparison areas, and MHSS data contain households residing in both areas.

Table 9 presents a comparison of the fertility effects of delayed marriage across these two sets of households. Interestingly, the estimates indicate that women who participated in the program experience roughly the same fertility reduction from delayed marriage but none of the reduction in pregnancy complications. Similar fertility effects among women with significantly different levels of access to contraception and resulting levels of fertility suggest that reductions in fertility from family planning programs and reductions from delayed marriage operate through very different channels. This likely reflects the fact that very young women are less responsive than older women to family planning interventions, so that most of the change in birth rates due to contraception appears in older age groups. Meanwhile, reductions in fertility due to marriage delay are driven almost entirely by increased age at first birth among very young women. This implies that public programs targeting early marriage and contraception are complimentary to reducing TFR in regions where reproductive cycles begin very young. In contrast, the reproductive health benefits of marrying later appear to be similarly achieved through intensive reproductive health interventions.

5.3 Quality of marital life

The final set of outcomes relate to married women's reports of marital conflict and gender equality. I use the following information from the Matlab survey to assess the quality of marital life experienced by currently married sample members as a function of the timing of marriage: (1) whether respondent reports experiencing an incidence of severe (physical) domestic violence, (2) whether she is required by her husband or in-laws to cover herself with a burqa outside of the house, and (3) whether she reports participating in major family decisions.[30] These outcomes correspond in order to the dependent variables in the Table 10 estimates. All outcomes are binary and are estimated using the probit IV model. Once again, I estimate the effects separately for older and younger sample members. In this case, age is likely to be an important determinant of spousal relations due to the fact that social norms regarding women's position in society and in the family have been changing over the past few decades.

Results from this analysis suggest that early marriages are characterized by more dominance of husbands over wives among both older and younger cohorts. The central difference between cohorts is the fact that improvements in spousal equality shows up in reduced rates of physical violence among older women, while among younger women gender equality is revealed in higher rates of participation in decision-making and fewer personal restrictions from family members. Young women report 12% lower incidence of being required to wear a burqa and a 3% higher incidence of participating in family decisions with each year of marriage delay. Perhaps most strikingly, older women report an 18% decline in the incidence of severe physical violence from their spouses with each year of delay.

The results indicate that postponing marriage improves women's bargaining power in marriage. The mechanism by which this occurs is likely related to both the increase in education and convergence in age between spouses that accompanies later marriage. The cohort differences are presumably due to a shift in common forms of spousal control. For instance, as more public attention is given to issues of domestic violence, younger husbands in the margin of influence for changing this behavior may have been persuaded towards more socially acceptable forms of coercion. The fact that work opportunities are larger for younger women is also likely related to the fact that marital disputes are increasingly related to personal freedoms and mobility.

[30] The following major family decisions are specified in the survey questionnaire: repaired/built new house; purchased goat; purchased cow; leased/share-cropped land; purchased or sold land; purchased or sold boat/rickshaw/van. It is worth noting that decisions over childbearing and contraception are excluded.

5.3 Spousal quality

The last stage of analysis examines parents' decision on marriage timing for daughters using data on daughters' dowry payment at marriage along with observable characteristics of spouses. Anecdotally, in rural Bangladesh dowries increase with each additional year that marriage is postponed. Meanwhile, past findings from India confirm a strong positive association between family socio-economic status and dowry payments, as well as between family income and the suitability of the husband, measured in terms of his relative superiority in education (Halli, 2003). Hence, if there are benefits to girls of delaying marriage, they are likely to come at a cost, either in terms of higher payments in marriage or less desirable spousal characteristics.

To explore the trade-offs, I estimate the dowry cost of later marriages using the IV strategy described in the previous section. I similarly explore how characteristics of spouses in terms of education level, age, and family wealth are related to marriage timing. For instance, parents may have a preference for allocating marriage payments across daughters to equate their marital outcomes, driven by either altruism or strategic behavior. If parents indeed spend more on daughters who marry later, I will assess based on the distribution of husbands' observable characteristics whether the additional expenditure on later marriages is sufficient to buy their daughters positions in families of comparable quality to those of younger brides. If late-bloomers are no worse off in terms of observable spousal quality, the average additional dowry cost of late marriage would serve as a good approximation of the decrease in female marriage market value that accompanies age in rural Bangladesh.

These estimates are presented in Table 11. Indeed, examination of the MHSS data reveals that the increased gender equality accompanying late marriage comes at a substantial cost to the family. An IV estimate of the dowry cost of later marriages, presented in column 1, indicates that the wealth a girl brings into marriage increases by an average of 40% with each additional year of age.[31] Further exploration of the data in

[31] The sample in column 4 includes only women in Muslim families and who reached age 15 before the Dowry Prohibition Act of 1980, which made the taking and giving of dowry an offence punishable by fine

columns 2-4 reveals no corresponding improvements in the characteristics of their spouses in terms of education level, age, or family wealth. In other words, based on the distribution of observable characteristics, parents' additional expenditure on later marriages buys these daughters positions in families of roughly identical quality to those of younger brides.

This combination of marriage market outcomes indicates that the average additional dowry cost of late marriage is a good approximation of the decrease in female marriage market value that accompanies age in rural Bangladesh. The fact that late-bloomers are no worse off in terms of observable spousal quality also suggests some preference among parents for allocating marriage payments across daughters to equate their marital outcomes. An equality preference could be driven by altruism or by strategic behavior of parents.

6 Conclusions

This paper provides empirical evidence that the institution of adolescent marriage in developing countries is costly for women in several dimensions. As a result of high rates of marriage at very young ages, girls in rural Bangladesh attain significantly less schooling, experience more frequent reproductive health complications, have higher fertility and experience lower levels of gender equality in marriage. While the fertility effects are large, they appear to be steeply declining in the availability of contraception. Among younger cohorts of women who have some ability to control pregnancy, the estimated effect of marriage delay on total birth rates is relatively minor. Meanwhile, the reproductive health advantage of delayed marriage is stronger among younger cohorts of women, and appears to operate in part through differences in preventive and promotive health care practices and the utilization of available health care services before and during birth.

The fact that early marriage appears to be causally related to female outcomes in adulthood indicates that the current policy focus on enforcing or instituting age of

and imprisonment. While many families continued the practice of dowry after this act was passed, the data show a significant decline in the fraction of families offering, or admitting to offering, dowries at marriage.

consent laws is justified in many contexts. Even imperfect enforcement of the current law in Bangladesh could have a dramatic effect: preventing enough child marriages to increase the average age of marriage from 15 to the legal minimum of 18 would increase the rate of female schooling and literacy by over 20% and reduce completed fertility by 10%. Such a fertility effect is roughly comparable to the estimated magnitude of the fertility reduction brought about by the 1978 contraceptive intervention in four regions of the country. In fact, my results indicate that delaying marriage is complimentary to the contraceptive program, as women who participated in the program achieve roughly the same fertility reduction on top of the program effects. The results also reveal that most of the benefits to marriage delay come from postponing marriages below age 14. Hence, legal bans on marriage below this threshold may be comparable in effectiveness and more feasible policy measures in settings in which adolescent marriage is costly to prevent.

7 References

[1] Adioetomo, Sri M. (1983). Age at marriage and fertility in Java-Bali: A Question of natural or controlled fertility. *Indonesian Journal of Demography* 10(20):49-72.

[2] Amin, Sajeda (1995). Female education and fertility in Bangladesh: The Influence of marriage and the family. In *Girl's Schooling, Women's Autonomy and Fertility Change in South Asia*, eds. Roger Jeffery and Alaka Basu. Sage Publications, New Delhi, London and Newbury Park.

[3] Angrist, Joshua and Guido Imbens (1994). Identification and Estimation of Local Average Treatment Effects. *Econometrica* 62:467-475.

[4] Arends-Kuenning, Mary and Sajeda Amin (2001). Women's capabilities and the right to education in Bangladesh. *International Journal of Politics, Culture and Society* 1(15):125–142.

[5] Arends-Kuenning, Mary and Sajeda Amin (2000). Effects of schooling incentive programs on household time allocation. Policy Research Division Working Paper No. 133, Population Council, and *Comparative Education Review* (forthcoming 2004).

[6] Audinarayana, N. (1986). The influence of age at marriage on fertility and family planning behaviour: A Cross-cultural study. Journal of Family Welfare 33:56-62.

[7] Begum, Lutfa (2003). Meaning Given to Adolescents' Reproductive Health in Bangladesh. *Journal of Population* 9(1).

[8] Barkat, Abul and Murtaza Majid (2003). Adolescent reproductive health in Bangladesh: Status, policies, programs and issues. POLICY Project Report, USAID Asia/Near East Bureau.

[9] Bates, Lisa M., Farzana Islam, Khairul Islam and Sidney Ruth Schuler (2004). Legal registration of marriage in Bangladesh: An intervention to strengthen women’s economic and social position and protect them against domestic violence? Mimeo, Academy for Educational Development, Washington DC.

[10] Bhat, P.N. Mari (1990). Estimating transition probabilities of age misstatement. Demography 27(1):149-63.

[11] Britton J.A., Wolff M.S., Lapinski R., Forman J., Hochman S., Kabat G.C., Godbold J., Larson S., Berkowitz G.S. (2004). Characteristics of pubertal development in a multi-ethnic population of nine-year-old girls. *Annals of Epidemiology* 14(3):179-87.

[12] Chang, Ming-Cheng (1982). Age at marriage and fertility in Taiwan. *Academia Economic Papers* 10:129-55.

[13] Chen, Charles H. C., Feng, Zhonghui & Rochat, Roger W. (1983). Effect of age at marriage on fertility in Xian City, the People's Republic of China. Paper presented at the 52nd Annual Meeting of the Population Association of America, Pittsburgh, April 14-16.

[14] Chowdhury S., Shahabuddin A.K., Seal A.J., Talukder K.K., Hassan Q., Begum R.A., Rahman Q., Tomkins A., Costello A., Talukder M.Q. (2000). Nutritional status and age at menarche in a rural area of Bangladesh. *Annals of Human Biology* 27(3):249-56.

[15] Coale, Ansley J. (1992). Age of entry into marriage and the date of the initiation of voluntary birth control. *Demography* 29:333-41.

[16] Duflo, Esther (2003). Grandmothers and granddaughters: Old-age pension and intra-household allocation in South Africa. *World Bank Economic Review* 17(1):1-25.

[17] Filmer, Deon and Michael Lokshin (2000). Maximum-likelihood estimation of the limited-dependent variable model with endogenous explanatory variable. Mimeo, World Bank.

[18] Fogel, R. (1990). The Conquest of high Mortality and Hunger in Europe and America," NBER Working Paper No. 16. Cambridge, MA (September).

[19] Fogel, R. (1991). "New Sources and New Techniques for the Study of Secular Trends in Nutritional Status, Health Mortality and the Process of Aging," NBER Working Paper No. 26. Cambridge, MA (May).

[20] Foster A., Menken J., Chowdhury A., and Trussell J. (1986). Female reproductive development: A hazards model analysis. *Social Biology* 33:183-198.

[21] Halli, Shiva S. (2003). Marriage patterns in rural India: Influence of socio-cultural context. Mimeo, University of Manitoba.

[22] Heckman, James, Lance Lochner, and Christopher Taber (1998). General equilibrium treatment effects: A study of tuition policy. NBER Working Paper #6426.

[23] Herrinton and Husson (2001). Relation of Childhood Height and Later Risk of Breast Cancer. *American. Journal of Epidemiology* 154:618-623.

[24] Huq, Lopita and Sajeda Amin (2001). Dowry negotiations and the process of union formation in Bangladesh: the implications of rising education. Paper presented at the Annual Meetings of the Population Association of America.

[25] Jensen, Robert and Rebecca Thornton (2003). Early female marriage in the developing world. In *Gender, Development and Marriage,* Caroline Sweetman, ed. Oxfam GB, Oxford, UK.

[26] Kayastha, S. L. (1991). Some aspects of fertility in India. In *The Geographical Approach to Fertility*, Jurgen Bahr and Paul Gans, eds. Geographisches Institut, Universitat Kiel, Kiel, Germany: 369.

[27] Khan, A. Q. (1991) Link between nuptiality and fertility in Pakistan. In *Studies in African and Asian Demography: CDC Annual Seminar.* Cairo Demographic Centre, Cairo: 749.

[28] King, S.E. and C.G.N. Macie-Taylor (2002). Nutritional status of children from Papua New Guinea: Associations with socioeconomic factors. *American Journal of Human Biology* 14:659-668.

[29] Koo M.M., Rohan T.E., Jain M., McLaughlin J.R., Corey P.N. (2002). A Cohort study of dietary fibre intake and menarche. *Public Health and Nutrition* 5(2):353-60.

[30] Koprowski C., Ross R.K., Mack W.J., Henderson B.E., Bernstein L. (1999). Diet, body size and menarche in a multiethnic cohort. *British Journal of Cancer*: 79(11-12):1907-11.

[31] Loza, Sarah F. (1982). Differential age at marriage and fertility in Egypt. In *Determinants of Fertility in Some African and Asian Countries*. CDC Research Monograph Series no. 10. Cairo Demographic Centre, Cairo:51-66.

[32] McDonald, Peter F., Ruzicka, Lado T. and Caldwell, John. C. (1980). Interrelationships between nuptiality and fertility: The Evidence from the World Fertility Survey. In *World Fertility Survey Conference 1980: Record of Proceedings* 2. International Statistical Institute, Voorburg, Netherlands.

[33] Martorell, R. (1993). Enhancing human potential in Guatemalan adults through improved nutrition in early childhood. *Nutrition Today* (January/February):6-14.

[34] Martorell, R., and J.P. Habicht (1986). Growth in early childhood in developing countries. In *Human Growth* Vol. 3, eds. F. Falkner and J.M. Tanner. New York: Plenum Press.

[35] Meyer F., Moisan J., Marcoux D., Bouchard C. (1990). Dietary and physical determinants of menarche. *Epidemiology* 1(5):377-81.

[36] Mitra, S. N., M. Nawab Ali, Shahidul Islam, Anne R. Cross and Tulshi Saha (1994). *Bangladesh Demographic and Health Survey 1993-94.* Dhaka: National Institute of Population Research and Training (NIPORT).

[37] Ogawa, Nashiro and Rele, J. R. (1981). Age at marriage and cumulative fertility in Sri Lanka. In ESCAP, *Multivariate Analysis of World Fertility Survey Data for Selected ESCAP Countries: The Report and Selected Papers of the Regional Workshop and Seminar on the Use of Multivariate Techniques in Second-Stage Analysis of World Fertility Survey Data*. Asian Population Studies Series no. 49. ESCAP, Bangkok:227-68.

[38] Pfeiffer, J., S. Gloyd and L.R. Li (2001). Intrahousehold resource allocation and child growth in Mozambique: An Ethnographic case-control study. *Social Science and Medicine* 53:83-97.

[39] Pitt, Mark M. and Mark R. Rosenzweig (1990). Estimating the intrahousehold incidence of illness: Child health and gender inequality in the allocation of time. *International Economic Review* 31(4):969-989.

[40] Rahman, Omar, J. Menken, A. Foster, C. E. Peterson, M. N. Khan, R. Kuhn, P. Gertler, ICDDRB, Mitra and Associates (1999). The 1996 Matlab Health and

Socioeconomic Survey: Overview and user's guide. RAND, DRU-2018/1-NIA, Santa Monica, CA.

[41] Romans S.E., Martin J.M., Gendall K., Herbison G.P. (2003). Age of menarche: The role of some psychosocial factors. *Psychological Medicine* 33(5):933-9.

[42] Schultz, T. Paul (1994). Integrated Approaches to Human Resource Development. Human Resources Development and Operations Policy, Working Paper HROWP 44. The World Bank, Washington, DC.

[43] Sinha, R. K. (1987). Impact of age at marriage on fertility and completed family size in eastern Rajasthan. *Journal of Family Welfare* 34:32 40.

[44] Stathopulu E., Antony Hulse, Canning D. (2003). Difficulties with age estimation of internet images of south-east Asian girls. *Child Abuse Review* 12(1):46-57.

[45] Strauss, J., and D. Thomas (1995). Human resources: Empirical modeling of household and family decisions. In *Handbook of Development Economics* IIIA, J.R. Behrman and T.N. Srinivasan, eds. Amsterdam, Elsevier.

[46] Thomas, Duncan (1990). Intrahousehold resource allocation: An inferential approach. *Journal of Human Resources* 25(4):635-664.

[47] Thomas, Duncan (1994). Like father, like son; like mother, like daughter: Parental resources and child height. *Journal of Human Resources* 29(4):950-988.

Table 1. Summary Statistics

	Full sample	Ages 25-49	Ages 50-74	Marriage age<15	Marriage age>14
Age	43.47	35.83	58.67	47.25	39.42
Menarcheal age	14.11	14.18	13.97	13.71	14.52
Height (cm)	148.79	149.74	146.84	148.27	149.41
Hindu	0.11	0.12	0.11	0.09	0.14
Contraceptive intervention region	0.53	0.53	0.52	0.51	0.55
Family Background					
Father farmer	0.78	0.77	0.80	0.78	0.78
Value father's property	59242	65634	46663	54039	65255
Father business	0.06	0.07	0.05	0.06	0.07
Father's schooling	2.25	2.63	1.50	1.93	2.58
Mother's schooling	0.59	0.75	0.27	0.42	0.77
Number siblings	3.90	4.55	2.60	3.57	4.26
Mom survived to 40	0.92	0.96	0.86	0.91	0.94
Dad survived to 40	0.96	0.97	0.93	0.95	0.97
Numbers brothers 15+	1.02	1.11	0.84	0.91	1.14
School Outcomes					
Literate	0.36	0.45	0.18	0.29	0.43
Enrolled in school at age 8	0.24	0.31	0.10	0.17	0.31
Years of school for enrolled	7.80	6.26	5.31	11.76	13.27
Marriage Outcomes					
Age of marriage	15.05	15.59	13.88	12.68	17.16
Value of dowry	7335	7479	4920	6049	7651
No dowry	0.73	0.62	0.95	0.83	0.63
Arranged marriage	0.01	0.01	0.01	0.01	0.02
Spouse education level	6.51	6.75	5.93	5.99	7.02
Reproductive Outcomes					
Total pregnancies	5.82	4.85	7.79	6.58	5.04
Fraction pregnancies failed	0.06	0.07	0.06	0.06	0.07
Age first birth	18.34	18.55	17.89	17.42	19.22
First birth interval	3.97	3.56	4.86	4.99	2.77
Birth spacing	2.31	2.27	2.39	2.38	2.23
Liklihood prenatal care	0.23	0.34	0.01	0.14	0.32
(first pregnancy)	0.06	0.09	0.00	0.02	0.10
Birth attended by non-relative	0.79	0.79	0.81	0.80	0.79
(first pregnancy)	0.19	0.22	0.12	0.15	0.22
Always wear burqa	0.20	0.18	0.23	0.20	0.19
Participate in decisions	0.88	0.89	0.85	0.88	0.87
Never share meals	0.10	0.09	0.10	0.09	0.10
Prevented from leaving bari	0.21	0.23	0.16	0.22	0.20
Domestic violence	0.26	0.27	0.25	0.26	0.26
Obs	4661	3116	1545	2356	2105

Table 2a. Summary Statistics by Age of Menarche

	Full sample (1)	Menarche 10-13 (2)	Menarche 14 (3)	Menarche 15-18 (4)	$\lvert t_{\Delta 3,2} \rvert$	$\lvert t_{\Delta 3,4} \rvert$
Age	43.47	45.16	43.33	42.05	(3.95)**	(2.84)**
Menarcheal age	14.11	12.76	14.00	15.52	(107.04)**	(85.10)**
Height (cm)	148.79	148.55	148.87	148.79	(1.34)	(0.52)
Hindu	0.11	0.11	0.12	0.12	(1.14)	(0.40)
Contraceptive intervention region	0.53	0.54	0.53	0.51	(0.32)	(1.09)
Family Background						
Father farmer	0.78	0.79	0.77	0.79	(0.92)	(1.17)
Value father's property	59242	58436	58670	63581	(0.04)	(0.85)
Father business	0.06	0.06	0.06	0.06	(0.49)	(0.54)
Father's schooling	2.25	2.29	2.25	2.27	(0.31)	(0.21)
Mother's schooling	0.59	0.57	0.61	0.61	(0.69)	(0.04)
Number siblings	3.90	3.86	3.98	3.97	(1.61)	(0.18)
Mom survived to 40	0.92	0.91	0.93	0.92	(1.64)	(0.83)
Dad survived to 40	0.96	0.96	0.96	0.96	(0.55)	(0.03)
Numbers brothers 15+	1.02	1.00	1.03	1.04	(0.61)	(0.18)
School Outcomes						
Literate	0.36	0.35	0.36	0.37	(0.40)	(0.74)
Enrolled in school at age 8	0.24	0.23	0.25	0.25	(1.69)	(0.19)
Years of school for enrolled	7.80	7.49	7.97	7.92	(2.83)	(0.26)
Marriage Outcomes						
Age of marriage	15.05	13.94	14.89	16.10	(8.98)**	(11.43)**
Value of dowry	7335	7225	7341	7463	(0.17)	(0.21)
No dowry	0.73	0.77	0.73	0.69	(2.22)*	(2.22)*
Arranged marriage	0.01	0.01	0.01	0.01	(0.15)	(0.19)
Spouse education level	6.51	6.50	6.60	6.45	(0.64)	(0.95)
Reproductive Outcomes						
Total pregnancies	5.82	6.20	5.77	5.55	(4.13)**	(2.16)*
Fraction pregnancies failed	0.06	0.07	0.06	0.06	(1.74)	(0.32)
Age first birth	18.34	17.66	18.40	18.84	(4.69)**	(3.14)**
First birth interval	3.97	4.42	4.02	3.50	(2.81)**	(4.08)**
Birth spacing	2.31	2.37	2.30	2.26	(1.35)	(1.21)
Liklihood prenatal care	0.23	0.18	0.25	0.26	(5.45)**	(0.92)
(first pregnancy)	0.06	0.04	0.07	0.07	(5.06)**	(0.08)
Birth attended by non-relative	0.79	0.78	0.80	0.80	(1.65)	(0.39)
(first pregnancy)	0.19	0.17	0.19	0.20	(3.47)**	(0.90)
Always wear burqa	0.20	0.21	0.19	0.18	(1.18)	(0.78)
Participate in decisions	0.88	0.86	0.89	0.88	(2.71)**	(0.96)
Never share meals	0.10	0.10	0.09	0.09	(1.42)	(0.38)
Prevented from leaving bari	0.21	0.21	0.21	0.20	(1.40)	(0.94)
Domestic violence	0.26	0.27	0.25	0.26	(0.23)	(0.70)
Obs	4661	1527	1595	1539		

Table 2b. Family Background Characteristics by Year of Menarche

Age of menarche	Mean age of marriage	Maximum age of marriage	Woman's height (cm)	Father's education	Father owns business	Father is farmer	N
11	13.98	25	149.1	2.84	0.062	0.788	75
12	14.39	26	149.6	3.06	0.075	0.791	201
13	14.33	28	149.8	2.60	0.069	0.777	696
14	15.31	28	149.7	2.71	0.065	0.777	1,092
15	16.16	31	149.7	2.37	0.080	0.800	634
16	16.88	30	149.7	2.99	0.056	0.772	285
17	17.44	31	150.2	2.88	0.073	0.773	150

Table 2c: Adult Health Conditions by Timing of Menarche

Age of menarche	Anemia	Diabetes	Arthritis	Urinary infection	Respitory	Gastritis	Other condition	Overall (1-4)	N
11-13	0.262	0.102	0.486	0.157	0.079	0.415	0.094	2.116	1,666
14	0.238	0.090	0.497	0.135	0.075	0.427	0.094	2.110	1,877
15-17	0.256	0.103	0.490	0.161	0.063	0.432	0.094	2.079	1,774

Table 3. First-stage regression: Age of first marriage

	Full sample	Ages 25-49	Ages 50-74
Age of menarche	0.670	0.694	0.600
	(0.042)**	(0.051)**	(0.076)**
Height (cm)	0.008	0.009	0.004
	(0.01)	(0.01)	(0.01)
Age	-0.061	-0.109	0.018
	(0.03)	(0.042)**	(0.06)
Value father's property	0.000	0.000	0.000
	0.00	0.00	(0.000)*
Contraceptive intervention	-4.570	-0.794	-0.775
	(2.229)*	(1.59)	(0.60)
Father business	-0.228	-0.215	-0.083
	(0.18)	(0.22)	(0.35)
Father farmer	-0.229	-0.291	-0.114
	(0.14)	(0.17)	(0.23)
Number siblings	-0.069	-0.109	0.018
	(0.033)*	(0.039)**	(0.07)
Female siblings	0.111	0.156	0.03
	(0.048)*	(0.057)**	(0.10)
Father's schooling	-0.002	-0.002	-0.014
	(0.02)	(0.02)	(0.03)
Mother's schooling	0.106	0.099	0.114
	(0.034)**	(0.039)*	(0.08)
Hindu	0.702	0.901	0.269
	(0.200)**	(0.265)**	(0.29)
Mom alive age 40	-0.214	0.409	-0.432
	(0.21)	(0.34)	(0.217)*
Dad alive age 40	0.417	0.831	0.137
	(0.25)	(0.399)*	(0.33)
Enrolled in school at 8	0.474	0.491	0.54
	(0.112)**	(0.133)**	(0.226)*
Numbers brothers 15+	0.17	0.198	0.107
	(0.037)**	(0.047)**	(0.07)
Constant	8.877	8.347	2.303
	(3.072)**	(3.056)**	(4.42)
Observations	4025	2840	1185

Note: Dependent varilable is age at marriage. Standard errors in parentheses. Robust standard errors account for sample clustering (baris and villages). Regressions also include village and 5-year age interval dummy variables.

Table 4. Effect of Marriage Age on Schooling and Literacy, Ages 25-49

Dependent Variable:	Years of School		Enrolled in school age 8		Literacy			
Universe:	*Enrolled in school at age 8*		*Full sample*		*Full sample*		*Enrolled at age 8*	
	OLS	IV	OLS	IV	OLS	IV	OLS	IV
Age of marriage	0.221	0.357	0.010	-0.002	0.011	0.026	0.020	0.051
	(7.91)**	(3.39)**	(0.003)**	(0.01)	(0.002)**	(0.010)**	(0.005)**	(0.021)*
Height (cm)	0.060	0.064	0.005	0.006	0.001	0.001	0.004	0.004
	(0.021)**	(0.022)**	(0.002)**	(0.002)**	(0.00)	(0.00)	(0.00)	(0.00)
Age	-0.156	-0.162	-0.015	-0.013	0.001	0.001	0.006	0.011
	(0.070)*	(0.077)*	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Father business	0.752	0.690	0.082	0.083	0.062	0.058	0.106	0.103
	(0.48)	(0.46)	(0.04)	(0.04)	(0.030)*	(0.03)	(0.050)*	(0.06)
Father farmer	-0.329	-0.276	0.039	0.045	0.011	0.03	0.047	0.074
	(0.27)	(0.29)	(0.03)	(0.03)	(0.02)	(0.02)	(0.05)	(0.05)
Number siblings	0.018	0.017	0.006	0.008	-0.002	-0.002	-0.001	-0.003
	(0.07)	(0.07)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Female siblings	-0.103	-0.124	0.001	-0.001	0.007	0.006	0.015	0.014
	(0.09)	(0.09)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)
Father's schooling	0.113	0.132	0.039	0.041	0.016	0.018	0.021	0.025
	(0.029)**	(0.031)**	(0.003)**	(0.004)**	(0.003)**	(0.003)**	(0.005)**	(0.005)**
Mother's schooling	0.15	0.091	0.03	0.031	0.016	0.011	0.01	0
	(0.046)**	(0.05)	(0.006)**	(0.007)**	(0.005)**	(0.01)	(0.01)	(0.01)
Hindu	-0.472	-0.636	-0.087	-0.049	0.007	-0.017	0.027	-0.013
	(0.44)	(0.44)	(0.05)	(0.05)	(0.03)	(0.03)	(0.07)	(0.07)
Mom alive age 12	0.397	0.359	0.063	0.056	-0.031	-0.026	-0.139	-0.141
	(0.46)	(0.53)	(0.06)	(0.06)	(0.03)	(0.04)	(0.08)	(0.09)
Dad alive age 12	0.424	0.45	0.062	0.098	0.014	0.005	0.063	-0.014
	(0.47)	(0.51)	(0.06)	(0.06)	(0.05)	(0.05)	(0.14)	(0.15)
Numbers brothers 15+	0.025	-0.014	0.009	0.009	0.002	0.002	0.003	0.001
	(0.08)	(0.10)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
Enrolled at age 8					0.589	0.585		
					(0.019)**	(0.021)**		

Table 5. Effect of Marriage Age on Schooling and Literacy, Ages 50-75

Dependent Variable:	Years of School		Literacy			
Universe:	*Enrolled in school at age 8*		*Full sample*		*Enrolled at age 8*	
	OLS	IV	OLS	IV	OLS	IV
Age of marriage	0.167	-1.626	0.008	-0.013	0.026	-0.195
	(0.048)**	(4.12)	(0.003)**	(0.01)	(0.010)**	(0.28)
Height (cm)	0.048	0.147	0.001	0.001	0.003	0.015
	(0.03)	(0.22)	(0.00)	(0.00)	(0.01)	(0.02)
Age	0.01	0.03	0.00	0.00	0.00	0.00
	(0.04)	(0.12)	(0.00)	(0.00)	(0.01)	(0.01)
Contraceptive program	5.021	-6.079	0.118	-0.096	-0.24	3.162
	(1.848)**	(10.62)	(0.054)*	(0.06)	(0.24)	(3.36)
Value father's land	0.000	0.000	0.000	0.000	0.000	0.000
	0.00	0.00	0.00	0.00	0.00	0.00
Father business	0.011	-1.086	-0.026	-0.029	-0.063	-0.241
	(0.60)	(3.22)	(0.04)	(0.04)	(0.12)	(0.30)
Father farmer	-0.148	-0.92	-0.015	-0.015	-0.094	-0.164
	(0.49)	(2.14)	(0.02)	(0.02)	(0.12)	(0.26)
Number siblings	-0.066	0.186	0.002	0.001	0.008	0.049
	(0.12)	(0.78)	(0.01)	(0.01)	(0.03)	(0.07)
Female siblings	-0.164	0.117	0.008	0.011	0.007	0.024
	(0.17)	(0.83)	(0.01)	(0.01)	(0.04)	(0.07)
Father's schooling	0.096	-0.036	0.012	0.011	0.029	0.018
	(0.036)**	(0.33)	(0.003)**	(0.003)**	(0.009)**	(0.02)
Mother's schooling	0.127	0.57	0.024	0.029	0.029	0.082
	(0.09)	(1.02)	(0.009)**	(0.009)**	(0.02)	(0.07)
Hindu	-0.677	-0.74	-0.028	-0.015	-0.059	-0.061
	(0.70)	(1.73)	(0.03)	(0.03)	(0.12)	(0.22)
Mom alive age 12	0.813	-2.067	0.012	0.006	0.043	-0.255
	(0.45)	(6.58)	(0.02)	(0.02)	(0.11)	(0.42)
Dad alive age 12	0.303	-1.812	-0.02	-0.015	-0.191	-0.478
	(0.77)	(5.57)	(0.02)	(0.03)	(0.18)	(0.44)
Numbers brothers 15+	-0.081	-0.046	0	0.004	0.016	0.021
	(0.13)	(0.37)	(0.01)	(0.01)	(0.03)	(0.05)
Enrolled age 8			0.455	0.467		
			(0.029)**	(0.031)**		

Table 6. Effect of Marriage Age on Reproductive Outcomes, Ages 50-75

	Total pregnancies		Stillbirths/miscarriage Fraction of pregs		Age First Birth		Stillbirths/miscarriage 1st Birth	
	OLS	IV	OLS	IV	OLS	IV	OLS	IV
Age of marriage	-0.067	-0.268	0.000	0.001	0.378	0.829	-0.002	0.005
	(0.04)	(0.136)*	(0.00)	(0.01)	(0.082)**	(0.278)**	(0.00)	(0.01)
Height (cm)	0.006	0.017	0.00	0.00	0.063	0.051	-0.002	-0.002
	(0.02)	(0.02)	(0.00)	(0.00)	(0.03)	(0.04)	(0.00)	(0.00)
Age	-4.380	0.094	0.002	0.024	-30.345	3.622	-0.002	-0.115
	(0.686)**	(1.64)	(0.02)	(0.03)	(0.737)**	(2.15)	(0.06)	(0.15)
Contraceptive	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
intervention	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Value father's land	0.380	0.270	-0.005	-0.006	0.751	0.860	-0.002	-0.018
	(0.41)	(0.41)	(0.02)	(0.02)	(0.83)	(0.88)	(0.04)	(0.04)
Father business	-0.406	-0.294	0.014	0.015	0.297	0.466	-0.045	-0.041
	(0.27)	(0.26)	(0.01)	(0.01)	(0.55)	(0.59)	(0.03)	(0.03)
Father farmer	0.078	0.067	0.002	0.002	0.233	0.235	-0.007	-0.007
	(0.08)	(0.08)	(0.00)	(0.00)	(0.16)	(0.17)	(0.01)	(0.01)
Number siblings	0.046	0.02	-0.003	-0.003	-0.157	-0.202	0	-0.002
	(0.11)	(0.11)	(0.00)	(0.00)	(0.21)	(0.22)	(0.01)	(0.01)
Female siblings	0.064	0.064	-0.004	-0.005	0.1	0.114	0.005	0.003
	(0.07)	(0.07)	(0.00)	(0.00)	(0.15)	(0.15)	(0.01)	(0.01)
Father schooling	0.005	0.014	0.002	0.002	0.08	0.073	0.009	0.009
	(0.04)	(0.04)	(0.00)	(0.00)	(0.07)	(0.07)	(0.004)*	(0.004)*
Mother schooling	-0.037	-0.028	-0.008	-0.007	-0.066	-0.068	-0.013	-0.013
	(0.09)	(0.08)	(0.003)**	(0.003)**	(0.13)	(0.14)	(0.01)	(0.01)
Hindu	-0.34	-0.099	0.015	0.016	0.402	0.334	-0.046	-0.04
	(0.40)	(0.40)	(0.02)	(0.02)	(0.68)	(0.69)	(0.04)	(0.04)
Mom alive age 12	0.001	0.001	0.079	0.082	-0.001	-0.001	-0.006	-0.004
	(0.00)	(0.00)	(0.04)	(0.05)	(0.00)	(0.00)	(0.00)	(0.00)
Dad alive age 12	-0.003	-0.001	-0.532	-0.376	0.027	0.035	0.011	0.061
	(0.02)	(0.02)	(0.95)	(0.98)	(0.05)	(0.05)	(0.02)	(0.10)
Brothers 15+	-0.135	-0.142	0.001	0.001	-0.109	-0.131	0.007	0.006
	(0.09)	(0.08)	(0.00)	(0.00)	(0.13)	(0.14)	(0.01)	(0.01)
Enrolled age 8	0.122	0.227	0.014	0.014	-0.499	-0.791	0.005	0.001
	(0.29)	(0.29)	(0.01)	(0.01)	(0.46)	(0.49)	(0.03)	(0.03)

Table 7. Effect of Marriage Age on Reproductive Outcomes, Ages 50-75

	Total pregnancies		Stillbirths/miscarriage Fraction of pregs		Age First Birth		Stillbirths/miscarriage 1st Birth	
	OLS	IV	OLS	IV	OLS	IV	OLS	IV
Age of marriage	-0.067	-0.268	0.000	0.001	0.378	0.829	-0.002	0.005
	(0.04)	(0.136)*	(0.00)	(0.01)	(0.082)**	(0.278)**	(0.00)	(0.01)
Height (cm)	0.006	0.017	0.00	0.00	0.063	0.051	-0.002	-0.002
	(0.02)	(0.02)	(0.00)	(0.00)	(0.03)	(0.04)	(0.00)	(0.00)
Age	-4.380	0.094	0.002	0.024	-30.345	3.622	-0.002	-0.115
	(0.686)**	(1.64)	(0.02)	(0.03)	(0.737)**	(2.15)	(0.06)	(0.15)
Contraceptive	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
intervention	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Value father's land	0.380	0.270	-0.005	-0.006	0.751	0.860	-0.002	-0.018
	(0.41)	(0.41)	(0.02)	(0.02)	(0.83)	(0.88)	(0.04)	(0.04)
Father business	-0.406	-0.294	0.014	0.015	0.297	0.466	-0.045	-0.041
	(0.27)	(0.26)	(0.01)	(0.01)	(0.55)	(0.59)	(0.03)	(0.03)
Father farmer	0.078	0.067	0.002	0.002	0.233	0.235	-0.007	-0.007
	(0.08)	(0.08)	(0.00)	(0.00)	(0.16)	(0.17)	(0.01)	(0.01)
Number siblings	0.046	0.02	-0.003	-0.003	-0.157	-0.202	0	-0.002
	(0.11)	(0.11)	(0.00)	(0.00)	(0.21)	(0.22)	(0.01)	(0.01)
Female siblings	0.064	0.064	-0.004	-0.005	0.1	0.114	0.005	0.003
	(0.07)	(0.07)	(0.00)	(0.00)	(0.15)	(0.15)	(0.01)	(0.01)
Father schooling	0.005	0.014	0.002	0.002	0.08	0.073	0.009	0.009
	(0.04)	(0.04)	(0.00)	(0.00)	(0.07)	(0.07)	(0.004)*	(0.004)*
Mother schooling	-0.037	-0.028	-0.008	-0.007	-0.066	-0.068	-0.013	-0.013
	(0.09)	(0.08)	(0.003)**	(0.003)**	(0.13)	(0.14)	(0.01)	(0.01)
Hindu	-0.34	-0.099	0.015	0.016	0.402	0.334	-0.046	-0.04
	(0.40)	(0.40)	(0.02)	(0.02)	(0.68)	(0.69)	(0.04)	(0.04)
Mom alive age 12	0.001	0.001	0.079	0.082	-0.001	-0.001	-0.006	-0.004
	(0.00)	(0.00)	(0.04)	(0.05)	(0.00)	(0.00)	(0.00)	(0.00)
Dad alive age 12	-0.003	-0.001	-0.532	-0.376	0.027	0.035	0.011	0.061
	(0.02)	(0.02)	(0.95)	(0.98)	(0.05)	(0.05)	(0.02)	(0.10)
Brothers 15+	-0.135	-0.142	0.001	0.001	-0.109	-0.131	0.007	0.006
	(0.09)	(0.08)	(0.00)	(0.00)	(0.13)	(0.14)	(0.01)	(0.01)
Enrolled age 8	0.122	0.227	0.014	0.014	-0.499	-0.791	0.005	0.001
	(0.29)	(0.29)	(0.01)	(0.01)	(0.46)	(0.49)	(0.03)	(0.03)

Table 8. Effect of Marriage Age on Reproductive Outcomes, Ages 25-49*

	Prenatal care		Birth attended by non-relative		Prenatal care, First birth		First birth attended by non-relative	
Age of marriage	0.033	0.022	0.017	0.025	0.014	0.010	0.013	0.010
	(0.008)**	(0.011)*	(0.01)	(0.013)*	(0.005)**	(0.005)*	(0.005)**	(0.01)
Years of Schooling		0.096		-0.05		0.036		0.038
		(0.08)		(0.09)		(0.04)		(0.05)
Height (cm)	0.000	-0.002	0.000	0.002	0.001	0.000	0.001	0.001
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Age	-0.019	-0.013	0.007	0.002	-0.013	-0.011	-0.009	-0.006
	(0.004)**	(0.01)	(0.01)	(0.01)	(0.002)**	(0.004)**	(0.003)**	(0.00)
Contraceptive intervention	-0.164	-0.494	0.154	0.329	-0.039	-0.167	0.091	-0.034
	(0.17)	(0.36)	(0.25)	(0.40)	(0.05)	(0.15)	(0.08)	(0.15)
Value father's land	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.00	0.00	0.00	0.00	(0.000)*	0.00	0.00	0.00
Father business	0.016	-0.009	-0.005	0.002	0.011	0.001	0.011	-0.011
	(0.03)	(0.05)	(0.03)	(0.04)	(0.01)	(0.02)	(0.02)	(0.02)
Father farmer	0.02	0.021	0.005	0.002	-0.01	-0.011	-0.028	-0.027
	(0.02)	(0.02)	(0.02)	(0.02)	(0.01)	(0.01)	(0.011)*	(0.013)*
Number siblings	0.003	0.002	0.006	0.005	-0.002	-0.002	-0.004	-0.004
	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)
Female siblings	0	0.008	-0.006	-0.007	0.002	0.005	0.005	0.008
	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)
Father schooling	0.002	-0.004	0.003	0.006	0.002	-0.001	0.001	-0.002
	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)
Mother schooling	0.002	-0.011	-0.005	0.003	0	-0.006	-0.002	-0.007
	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)	(0.01)	(0.00)	(0.01)
Hindu	-0.028	0.018	0.013	-0.016	0.01	0.027	0.003	0.013
	(0.03)	(0.04)	(0.03)	(0.04)	(0.02)	(0.02)	(0.02)	(0.02)
Mom alive age 12	0	-0.014	0.009	0.017	0.001	-0.006	0.001	-0.009
	(0.03)	(0.04)	(0.04)	(0.04)	(0.02)	(0.02)	(0.02)	(0.02)
Dad alive age 12	0.012	-0.004	-0.087	-0.083	0.022	0.015	-0.042	-0.055
	(0.05)	(0.05)	(0.041)*	(0.05)	(0.02)	(0.02)	(0.03)	(0.027)*
Brothers 15+	-0.003	-0.003	-0.004	-0.006	0	0.001	0.003	0.001
	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)
Enrolled age 8	0.043	-0.189	0.016	0.135	0.023	-0.064	0.023	-0.075
	(0.015)**	(0.21)	(0.02)	(0.22)	(0.008)**	(0.11)	(0.009)*	(0.11)

*Instrumental variables estimates.Marriage age and years of schooling are endogenous variables. Instrument set consists of age of menarche and age of menarche interacted with school enrollment dummy.

Table 9. Reproductive Outcomes in Contraceptive Program and Non-program areas, Ages 25-44*

	Total pregnancies		Stillbirths/miscarriage Fraction of pregs	
	OLS	IV	OLS	IV
Age of marriage	-0.14	-0.163	-0.001	-0.014
	(0.054)**	(0.070)*	(0.01)	(0.006)*
Height (cm)	-0.01	-0.008	-0.002	-0.001
	(0.01)	(0.01)	(0.001)*	(0.00)
Age	0.201	0.23	-0.011	-0.004
	(0.035)**	(0.043)**	(0.004)**	(0.00)
Value father's land	0.000	0.000	0.000	0.000
	0.00	0.00	0.00	0.00
Father business	-0.096	0.011	0.008	0.011
	(0.18)	(0.23)	(0.02)	(0.02)
Father farmer	0.321	0.087	-0.002	-0.001
	(0.125)*	(0.16)	(0.01)	(0.01)
Number siblings	0.012	0.106	-0.005	-0.001
	(0.04)	(0.045)*	(0.00)	(0.00)
Female siblings	-0.027	-0.146	0.002	-0.001
	(0.05)	(0.059)*	(0.01)	(0.01)
Father schooling	0.005	0.009	0	0.002
	(0.02)	(0.02)	(0.00)	(0.00)
Mother schooling	0	-0.05	0.001	0.002
	(0.03)	(0.03)	(0.00)	(0.00)
Hindu	-0.414	-0.009	0.005	-0.023
	(0.175)*	(0.28)	(0.02)	(0.02)
Mom alive age 40	-0.211	-0.497	-0.037	0.034
	(0.27)	(0.41)	(0.03)	(0.02)
Dad alive age 40	0.226	0.243	-0.02	0.065
	(0.33)	(0.45)	(0.04)	(0.019)**
Brothers 15+	-0.015	-0.087	0.003	-0.001
	(0.04)	(0.06)	(0.00)	(0.00)
Enrolled age 8	-0.067	-0.176	0.005	0.006
	(0.10)	(0.14)	(0.01)	(0.01)

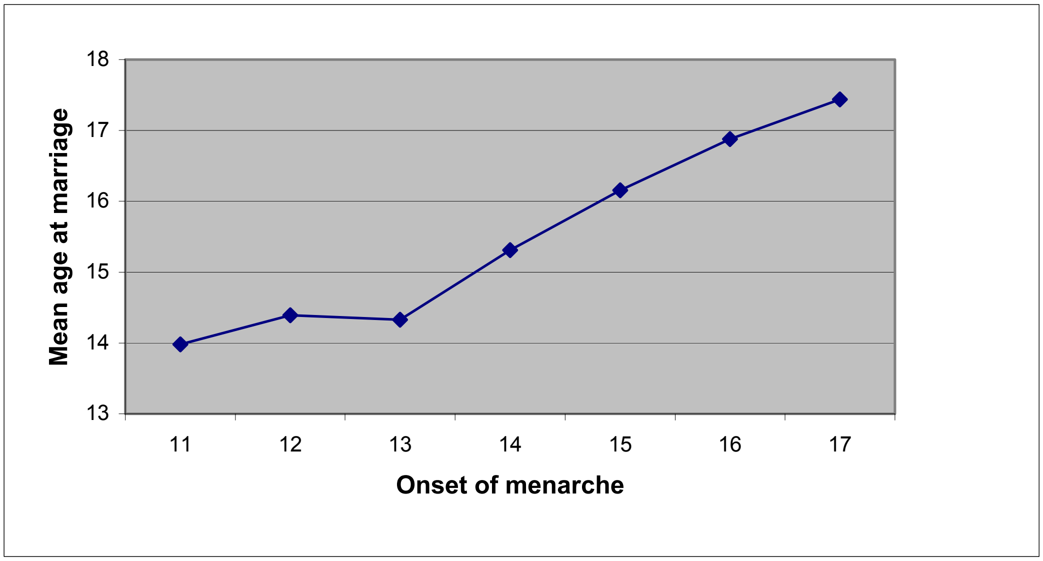
Table 10. Effect of Marriage Age on Quality of Marital Life

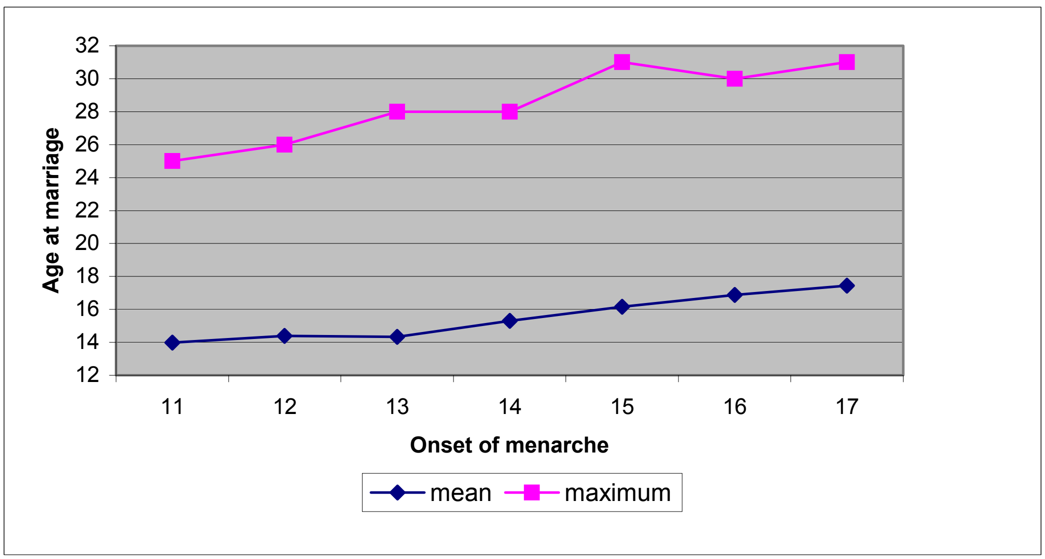
	Ages 25-49			Ages 50-76		
	Domestic violence	Burqa outside	Participate decisions	Domestic violence	Burqa outside	Participate decisions
Age of marriage	-0.004	-0.022	0.020	-0.040	-0.002	0.007
	(0.01)	(0.010)*	(0.008)*	(0.018)*	(0.03)	(0.02)
Height (cm)	0.00	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Age	0.007	0.003	0.006	0	-0.006	-0.009
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)
Contraceptive	0.192	-0.054	0.63	0.015	-0.014	-0.024
intervention	(0.050)**	(0.06)	(0.168)**	(0.03)	(0.04)	(0.02)
Value father's	0.000	0.000	0.000	0.000	0.000	0.000
property	(0.000)*	0.00	0.00	0.00	0.00	0.00
Father business	0.074	0.035	0.007	0.03	0.08	0.029
	(0.038)*	(0.04)	(0.03)	(0.07)	(0.10)	(0.04)
Father farmer	-0.045	0.003	0.028	-0.035	-0.082	0.059
	(0.03)	(0.02)	(0.02)	(0.04)	(0.06)	(0.04)
Number siblings	0.003	0.004	0.004	-0.002	-0.011	-0.006
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)
Female siblings	-0.009	0.002	-0.006	-0.002	0.011	0
	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.01)
Father schooling	-0.006	0.006	0.001	-0.006	0.009	0.003
	(0.003)*	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)
Mother schooling	-0.003	0.017	-0.004	0.007	-0.01	-0.012
	(0.01)	(0.007)**	(0.00)	(0.01)	(0.02)	(0.01)
Mom alive age 40	-0.102	0.027	-0.01	-0.065	-0.026	0.011
	(0.045)*	(0.04)	(0.03)	(0.04)	(0.06)	(0.03)
Dad alive age 40	0.008	-0.073	-0.041	0.072	-0.01	-0.021
	(0.06)	(0.06)	(0.03)	(0.05)	(0.08)	(0.04)
Numbers brothers	-0.006	-0.009	-0.007	0.002	0.049	-0.013
15+	(0.01)	(0.01)	(0.01)	(0.01)	(0.018)**	(0.01)
	-0.072	0.123	0.015	-0.028	0.137	0.039
Enrolled age 8	(0.020)**	(0.021)**	(0.02)	(0.03)	(0.057)*	(0.03)

Table 11. Marriage Market Outcomes, Ages 25-49*

	Value dowry (IV)	Spouse education (IV)	Spouse age (IV)	Spouse wealth (IV)
Age of marriage	249.4	-0.063	0.127	7,017
	(87.1)**	(0.17)	(0.49)	(7247)
Height (cm)	-0.54	0.03	-0.10	-775
	(7.7)	(0.02)	(0.06)	(990)
Age	-89.1	-0.078	-0.233	-1185
	(35.4)*	(0.08)	(0.30)	(4273)
Contraceptive intervention	-3077.4	2.061	-2.127	-14,243
	(358.1)**	(0.921)*	(2.35)	(40431)
Value father's land	0.000	0.000	0.000	0.128
	(0.00)	(0.000)*	0.00	(0.046)**
Father business	284.7	0.577	0.401	-39,801
	(330.1)	(0.47)	(1.40)	(29498)
Father farmer	-3.2	0.471	-0.354	27,174
	(121.1)	(0.42)	(1.04)	(14644)
Number siblings	21.5	-0.025	0.162	5,923
	(40.6)	(0.08)	(0.27)	(4310)
Female siblings	2.8	0.095	0.037	-4,488
	(61.0)	(0.11)	(0.39)	(6243)
Father schooling	-11.2	0.112	0.073	4,719
	(25.5)	(0.036)**	(0.12)	(2,243)*
Mother schooling	117.8	0.079	0.045	688
	(71.9)	(0.08)	(0.26)	(4768)
Hindu	-88.6	-0.073	-0.501	-20,140
	(173.9)	(0.40)	(1.62)	(22631)
Mom alive age 12	-86.0	0.571	-0.674	-38,465
	(199.0)	(0.58)	(2.28)	(31546)
Dad alive age 12	12.9	0.024	-0.058	8,258
	(41.6)	(0.10)	(0.35)	(5536)
Brothers 15+	29.0	1.805	1.279	68,034
	(126.1)	(0.285)**	(0.85)	(15,726)**
Enrolled age 8	-3.8	-0.033	0.076	-236
	(10.7)	(0.02)	(0.08)	(1265)

Figures 1a - 1b. Age of Menarche and Age of First Marriage





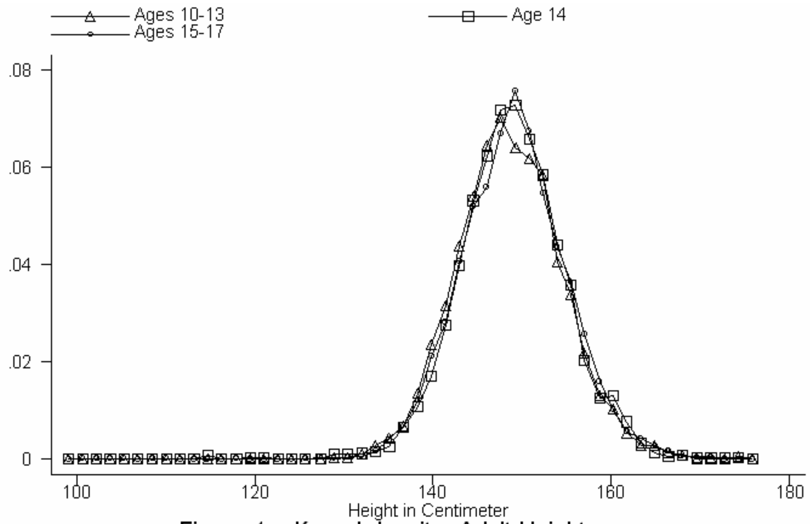


Figure 4a: Kernel density, Adult Height

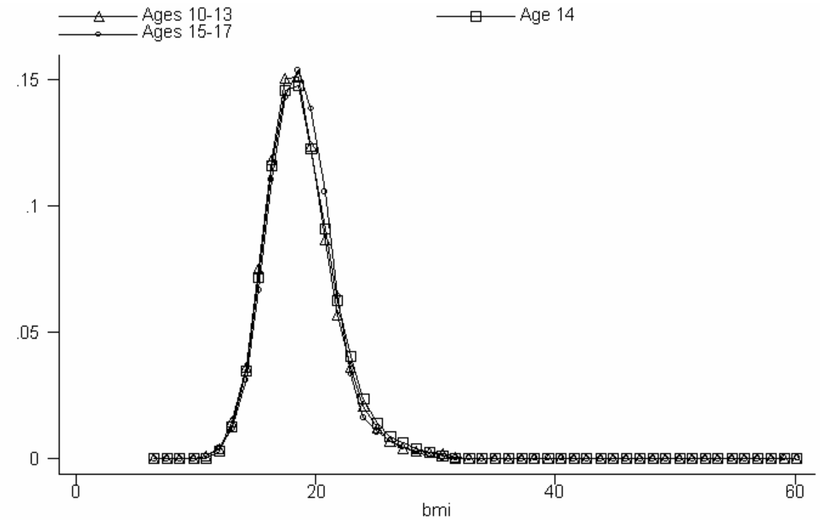


Figure 4b: Kernel density, Adult BMI

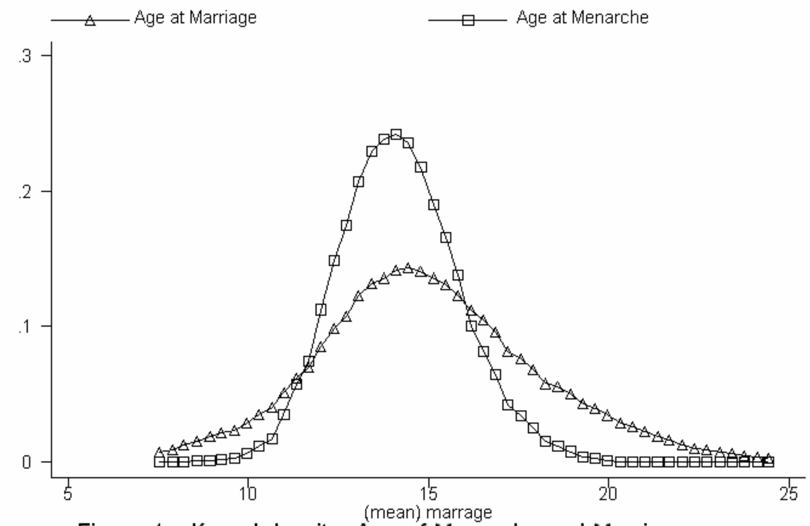


Figure 4c: Kernel density, Age of Menarche and Marriage

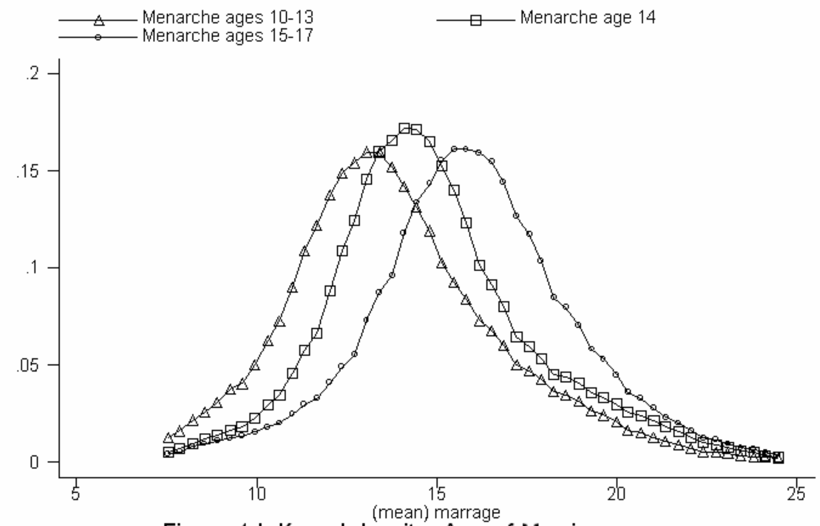


Figure 4d: Kernel density, Age of Marriage

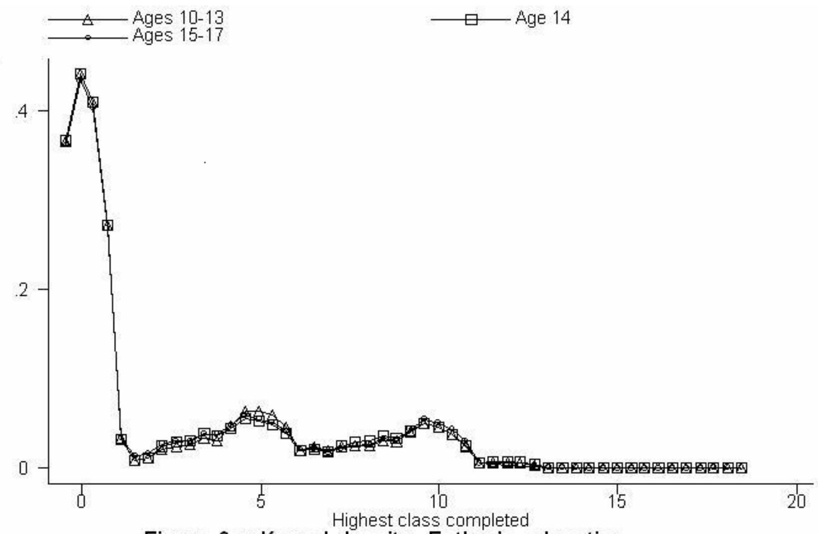


Figure 3a: Kernel density, Father's education

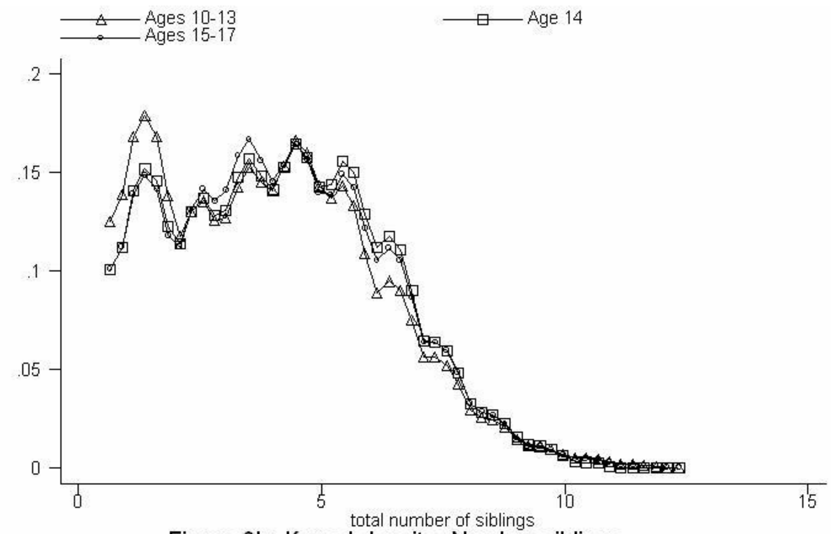


Figure 3b: Kernel density, Number siblings

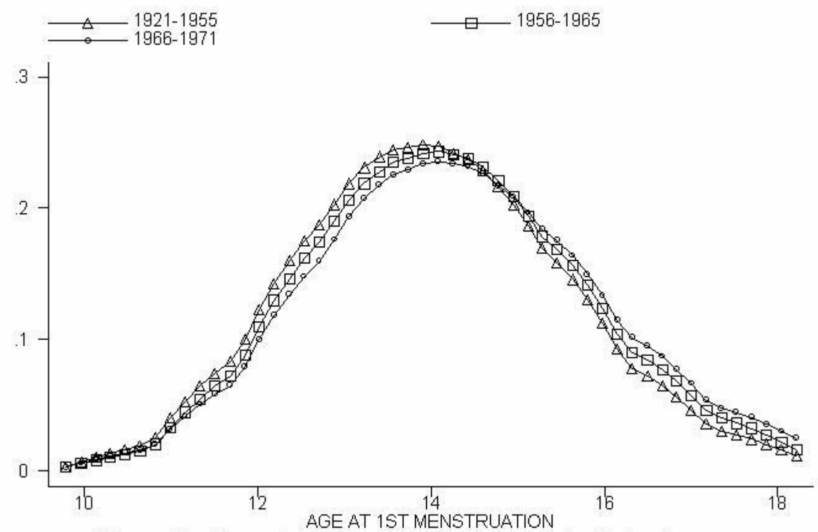


Figure 3c: Kernel density, Menarcheal Age by Cohort

Figure 4: Time trends in Menarche, Marriage and GDP