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ABSTRACT

It has recently been advocated that iron supplementation begin before childbearing. A key operational issue is timely identification of females prior to pregnancy. The purpose of this study was to examine factors associated with time to first pregnancy (FP) and adolescent pregnancy (AP). A cross-sectional survey was conducted in Gazipur, Bangladesh (April-May 2006) among ever married females aged <50 y. Data on 603 females were analysed. Mean age was 32 y ± 9. Only 15% (7/47) of never pregnant females reported iron use in the past 6 mo. Mean age at marriage was 17 y ± 3 at marriage. 58% (322/556) of females were ≤ 18 y at FP. Median time from marriage to FP was 12 mo (range: 0-408). Multivariate hazard analysis found risk of pregnancy increased by 13% for every y increase in age at marriage ($p<0.0001$) and decreased by 3% for every y increase in female's current age ($p<0.0001$). Risk among medical contraceptive users was 58% of the risk among non-users ($p=0.0001$). Using multivariate logistic regression analysis the probability of an AP decreased by 3% for each y of marriage during adolescence (CI: 0.95-0.99), by 10% for every y increase in husband's age at marriage (CI: 0.87-0.94), by 68% among female wage earners compared to non-wage earners (CI: 0.16-0.64) and by 50% among medical contraceptive users compared to non-users (CI: 0.30-0.85). In this population females are married at a young age with short time to FP intervals. Periconceptional iron supplementation programs should target adolescents and newly-weds.

Keywords: birth interval, time factors, pregnancy, periconceptional, iron.

INTRODUCTION

Iron deficiency anemia in non-pregnant and pregnant females remains a problem, especially in developing countries where diet is sub-optimal and childbearing commonly occurs during adolescence (1;2). While provision of iron supplements to pregnant women is one of the most widely practised public health measures worldwide, iron supplementation during pregnancy has shown limited effectiveness in reducing adverse outcomes for the mother and her offspring (3;4). Aside from low compliance and inefficient health service delivery, it has been argued that there is insufficient time during pregnancy to improve iron status in females with pre-existing anemia and who often do not seek prenatal care until the 2nd or 3rd trimester (5). Moreover, the first trimester may be a critical period of development and growth when iron supplementation is most effective (6).

In an effort to build iron stores before pregnancy and reduce the high prevalence of anemia, it has recently been advocated that iron supplementation in developing countries begin before childbearing (7). The World Health Organization Regional Office for the Western Pacific supported pilot effectiveness projects from 1998 to 2002 in Vietnam, Philippines and Cambodia that examined the promotion and sale of weekly iron-folic acid tablets to women of reproductive age (WRA) (8). Supplements for non-pregnant females contained 60 mg of elemental iron and 3.5 mg folic acid while those for pregnant females contained 120 mg elemental iron and 3.5 mg of folic acid. In Vietnam, community mobilization and social marketing proved effective at increasing female's knowledge and attitudes about nutritional anemia (9). In the Philippines, the study provided pregnant females ($\leq$20 weeks gestations) with free iron-folic tablets at prenatal or home visits and made tablets accessible to non-pregnant females at local drugstores (7 US cents per packet) (10). After 6 weeks of intervention the community-based study found a marked improvement in serum ferritin but no significant improvement in haemoglobin levels in pregnant and non-pregnant females. Since correlation analyses showed no effect of infection on serum ferritin, the authors proposed vitamin A deficiency as a possible explanation for elevated serum ferritin concentrations in the absence of improved haemoglobin levels.

In Indonesia a study was conducted to examine a program aimed at reaching women through marriage registries to promote intake of iron and folate tablets (IFA) before pregnancy (11). One month after providing an educational intervention and access to low cost tablets, the prevalence of anemia among the newly-wed females decreased by 40%; however, there were no significant difference 3-4 months later compared to baseline. There remains uncertainty over the minimum period of supplementation before pregnancy to treat pre-existing anemia and build iron stores. A study among Indonesian adolescent females concluded that weekly supplementation with 60 mg of iron is sufficient to improve iron status after 12 weeks of weekly supplementation and maintain iron status for 6-9 months after termination of supplementation (12). However, a study in adolescent schoolgirls in Bangladesh found nearly two-thirds of girls remained anemic after 12 weeks of intermittent (twice weekly) supplementation with 30 mg of iron (13).

One of the key operational issues to programs delivering preventative iron-folic acid supplementation to women of reproductive age is timely identification of females prior to pregnancy. In Bangladesh, where the prevalence of anemia among non-pregnant females living in rural areas has increased in the last 5 years from 34% to 46% (14), no marriage registration system is in place for identifying newly-wed females. The objective of this study was to examine factors associated with time to first pregnancy and adolescent pregnancy among married females living in rural Bangladesh.

METHODS

The study is part of a larger interventional trial on periconceptional iron supplementation and was intended to gather information on sample size and putative predictors of time to FP among rural Bangladeshi females. A cross-sectional survey was conducted in Kaliganj subdistrict, Gazipur district, Bangladesh from April to May 2006. Gazipur is a city located in central Bangladesh in the Dhaka Division approximately 30 km north of Dhaka, the national capital. Subdistrict Kaliganj has been the site of previous research projects conducted by our group, where we have established strong partnerships with community leaders and members.

The sampling frame for this study used a previously established household roster of the Gazipur area. The household roster divided the area into 42 clusters of approximate equal size according to the number of households (~300 households per cluster). Based on monetary and staff resources, two clusters were randomly selected for the purposes of this study. During house-to-house visits, field interviewers screened females for eligibility. Inclusion criteria included the following: i) permanent household member (living in the household for the past 6 months); ii) ever married; iii) < 50 years old. Informed consent was obtained from females who met inclusion criteria.

Four female Bangladeshi field interviewers received intensive two day training on study protocol and questionnaire administration. Using a standardized data collection form, interviewers collected data on female and husband characteristics, marital history, reproductive history and recent iron use. The study was approved by the Research Ethics Board of the Hospital for Sick Children and by the Ethical Committee of the Bangladesh Medical Research Council.

Descriptive statistics were performed using mean (± standard deviation), median (range from 0 to 100) and proportions. Univariate analyses were conducted using the Mann-Whitney U test for non-normally distributed continuous data and chi-square tests for categorical variables (Fischer's exact test was used in cases with small cell sizes). An analysis of time trends in age at marriage and age at pregnancy was performed using female's age at survey as both a continuous variable (linear regression analysis) and ordinal variable divided into 5 year periods (analysis of variance).

Independent variables included 12 plausible risk factors: female's current age, female's age at marriage, husband's age at marriage, age at menarche, dowry, female's employment status (wage-earner v non-wage earner), husband's employment status (wage-earner v non-wage earner), female's education (illiterate v non-illiterate), husband's education (illiterate v non-illiterate), female's student status (yes v no), husband's student status (yes v no), and use of medical contraceptives (yes v no). Occupation, education, employment status and student status were asked at the time of marriage. Medical contraceptives denoted any usage from time of marriage to first pregnancy. Risk factors were examined in association with two outcomes: first pregnancy interval and adolescent pregnancy.

The dependent variable, first pregnancy interval was defined continuously as the time in months from the female's first marriage to first pregnancy. Multivariate analysis was performed using a discrete time Cox regression model and backward selection procedure. Females who had never been pregnant were censored. The second dependent variable, adolescent pregnancy was defined as a dichotomous variable according to whether or not females had their first pregnancy during adolescence (yes v no). Adolescents were defined as persons 10-19 y of age (15). For the univariate analysis, proportions and odds ratios (OR) with 95% confidence intervals are reported. Multivariate analysis used a logistic regression model and backward selection procedure. A 2-sided *P*-value of 0.05 indicated statistical significance. Statistical analyses were conducted using SAS (version 9.1; SAS Institute).

RESULTS

Of the 1450 females visit, 615 females met inclusion criteria and provided informed consent (Figure 1). After excluding 11 females, two due to incomplete data and nine due to first pregnancies in a later marriage, 603 females were included in the final analysis. The median age of females was 31 years (range: 15-49) (Table 1). The median age at marriage was 17 years (range: 11-31) for females and 26 years (range: 16-49) for husbands. Of the 603 females, 25% were illiterate, 39% were students after marriage, 8% were wage earners after marriage and 18% reported using a medical contraceptive (i.e. pill, condom) during the first pregnancy interval.

Eighty-eight percent of females (532/603) reported knowing about anemia and iron. However, only 10% of females (59/603) reported taking iron supplements in the past 6 months. Of the 47 females who had never been pregnant, 7 (9%) females reported iron use in the past 6 onths. Ten of the 15 (67%) females that were pregnant at the time of interview reported iron e in the past 6 months.

Ninety-two percent of females had been pregnant since marriage. The median age at first pregnancy was 18 years (range: 13-38) and among ever pregnant females (n=556), the median time to first pregnancy was 12 months (range: 0-408). Seven percent (37/556) of females reported their first pregnancy at the same time of marriage and 37% (195/556) reported their st pregnancy within the first 6 months of marriage. Although not reported as such due to ural taboos, some of these cases may be a result of pre-marital relations.

Compared to nulligravida females, females who had already conceived a child were significantly older at the time of survey ($p<0.0001$), younger at the time of marriage ($p=0.002$), less likely to have received any formal education ($p=0.001$), less likely to have been a student after getting married ($p=0.04$) and less likely to have taken a medical contraceptive before their first pregnancy ($p<0.0001$) (Table 1).

Females included in the analyses were born between 1986 and 1960. There were no significant time difference between age at first marriage and female's current age using linear regression analysis ($p=0.22$) or analysis of variance (Table 2). Both analysis of variance and linear regression analysis showed a statistically significant association between female's current age and age at first pregnancy ($p=0.02$). Females born between 1986 and 1991 had a significantly lower mean age at first pregnancy compared to the remaining age cohorts.

Among 556 females who had been pregnant since marriage, the cumulative proportion of females pregnant by the end of each year of marriage was 62% (n=347), 77% (n=430), 87% (n=484), 91% (n=508), 94% (n=521), 95% (n=526), 95% (n=530), 96% (n=534), 96% (n=536), 97% (n=538) from the first to tenth of year, respectively (Figure 2). The likelihood of first pregnancy after marriage increased during the first five years of marriage from 59% after one year of marriage to 74%, 83%, 88%, and 91% for the 2nd, 3rd, 4th and 5th year of marriage, respectively. After the 5th year of marriage, the risk of pregnancy plateaued; the risk increased very slightly for the next five years.

Using univariate analysis, factors significantly associated with time to first pregnancy included: female's current age ($p<0.001$), female's age at marriage ($p<0.0001$), husband's age at marriage ($p<0.0001$), female wage earners ($p=0.01$) and female illiteracy ($p=0.03$) (Table 2). Results from multivariate discrete-time hazard analysis indicate that the likelihood of pregnancy decreased by 3% for every one-year increase in female's current age ($p<0.0001$) and increased by 13% for every one-year increase in age at marriage ($p<0.0001$). Likelihood of pregnancy among medical contraceptive users was 58% of that of non-users ($p<0.0001$) (Table 4).

Of the 556 females who had been pregnant since marriage, 58% had their first pregnancy during adolescence (≤18 years) (Table 4). Univariate analyses found that adolescent pregnancy was 49% more likely among illiterate females ($p=0.05$) compared to literate females, 73% less likely among wage-earners compared to non-wage earners ($p=<0.0001$) and 40% less likely among contraceptive users compared to non-users ($p=0.03$). Median time to first pregnancy among female wage earners was 6 months (range: 0-108, n=49) compared to 4 months among non-wage earners (range: 0-408, n=553). Median time to first pregnancy among contraceptive users was 12 months (range: 0-168, n=106) compared to 12 months among non-users (range: 0-408, n=497).

Multivariate logistic regression analysis showed that the probability of an adolescent pregnancy decreased by the following factors: 3% for each year that a female was married while being an adolescent (CI: 0.95-0.99, $p=0.01$); 10% for every year increase in husband's age at marriage (CI: 0.87-0.94, $p<0.0001$); 68% among female wage earners compared to non-wage earners (CI: 0.16-0.64, $p=0.001$); and 50% among medical contraceptive users compared to non-users (CI: 0.30-0.85, $p=0.01$) (Table 6).

DISCUSSION

The results of this study suggest that strong predictors of time to first pregnancy are female's current age, female's age at marriage and use of a medical contraceptive. Adolescent pregnancies are common in this population; more than half of females had their first pregnancy before the age of 19. The probability of an adolescent pregnancy increased the fewer number of years a female spent married as an adolescent, the younger the husband's age was at marriage, and among females not earning a wage or using a medical contraceptive after marriage.

Until recently public health programs have addressed the problem of iron deficiency, particularly among women in developing countries, by providing iron supplementation as part of prenatal care. Although efficacious in controlled trials, national scale effectiveness of iron supplementation in the second and third trimesters has been disappointing. Interest in treating and preventing anemia among females, specifically adolescent girls, before they bear children has raised some interesting physiological and logistical questions. Can supplementation during adolescence build sufficient stores before pregnancy to prevent anemia? How long before pregnancy do adolescents need to take iron supplements? How can timely identification of females prior to pregnancy be achieved?

According to iron supplementation trials among adolescent girls, at least 12 weeks of daily supplementation with 60 mg of elemental Fe is required to improve iron status

(12;16-18). After termination of supplementation, one trial demonstrated that iron status shows a decline after 6 months. After 12 weeks of daily supplementation a mean ferritin concentration of 63.4 ±34.6 µg/L had declined to 40.6 ±23.9 µg/L six months after termination of supplementation, suggesting repeat supplementation would be necessary (12). As evidenced by community-based program studies, the duration of iron supplementation to reduce the prevalence of pre-existing anemia may need to be greater than 3 months because of barriers related to large-scale implementation of a prevention strategy (i.e. compliance, education and health service delivery).

Limitations of this study include possible recall bias and the use of age at marriage and not age at first sexual relationship as the starting time of exposure. Maternal recall for the majority of pregnancy events (i.e. infant birth weight, method of delivery) has been shown to be relatively accurate (19-21). Given the need to be culturally sensitive around the types of questions asked of our respondents, we felt it preferable to use age at marriage to define the time of exposure. Among fertile couples not practising contraceptive control, it is not unlikely that a significant proportion of females would become pregnant shortly after marriage. Furthermore, the number of pre-marital conceptions in this population is likely to be small because of traditional marriage systems in rural areas. Family honour is protected by ensuring daughters are married off before they can bring disgrace to the family by becoming pregnant outside of marriage (22).

The results of this study suggest that in similar communities where time to first pregnancy is common within the first few months of marriage, pre-pregnancy iron supplementation programs need to reach non-married reproductive aged females as well as newly-weds. Given that a significant proportion of females were students at the time of marriage, school-based iron supplementation programs may be operationally feasible and effective.

Efforts to prevent iron deficiency during pregnancy also need to focus on reducing adolescent pregnancies in this population. In line with previous demographic studies, a significant proportion of females marry before they reach puberty (22). In this study, the likelihood of an adolescent pregnancy increased by 10% for each year decrease in the husband's age at marriage and decreased for each year increase in the female's age at marriage. here are several possible cultural and social explanations for the decrease in risk observed for ach year a female spends married as an adolescent. Females married before or shortly after puberty are likely married off to maintain family honour and assure parents that their daughter will not become an 'old-maid' (22). Among rural people, the perception is that girls are old maids if they remain unmarried at 15 y (22). Females married during late adolescence are perceived old enough to start having children and are therefore more likely to have their first pregnancy closely after marriage.

The most obvious factor for risk of an adolescent pregnancy is marriage during adolescence. In 1984, a Bangladesh government order fixed the minimum legal age of marriage for females at 18 y (22). In light of the law, the results of this study showed no remarkable changes over the last three decades in age at first marriage or age at first pregnancy. This finding is supported by data drawn from the 1989 Bangladesh Fertility Survey (BFS), which found age at marriage in Bangladesh has risen very little in the last 70 years and that the most significant factor explaining the high incidence of early marriage is illiteracy (22). Education and enforcement of the marriage law are needed to ensure female health is prioritized.

Interestingly, adolescent pregnancies were 68% less likely among female wage earners compared to non-wage earners and 50% less likely among medical contraceptive users compared to non-users. These results have important implications for existing family planning and microfinance programs. Microfinance programs in countries such as Bangladesh have proven successful in helping vulnerable and poor females gain collateral, employment and income (23). Further research is needed to examine the impact of microfinance programs on health indicators for females and their offspring.

Since marriage registries are non-existent in Bangladesh, other methods need to be employed to reach females before pregnancy. Possible methods include using respected community members to counsel adolescent females about important health issues, adding counselling about iron and folate supplementation before pregnancy to the school curriculum, creating educational programs in the work environment and in microfinance training programs for female wage earners and extending existing family planning programs to include single adolescent females that are likely to get married at an early age and begin childbearing shortly thereafter.

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Figure 1. Recruitment

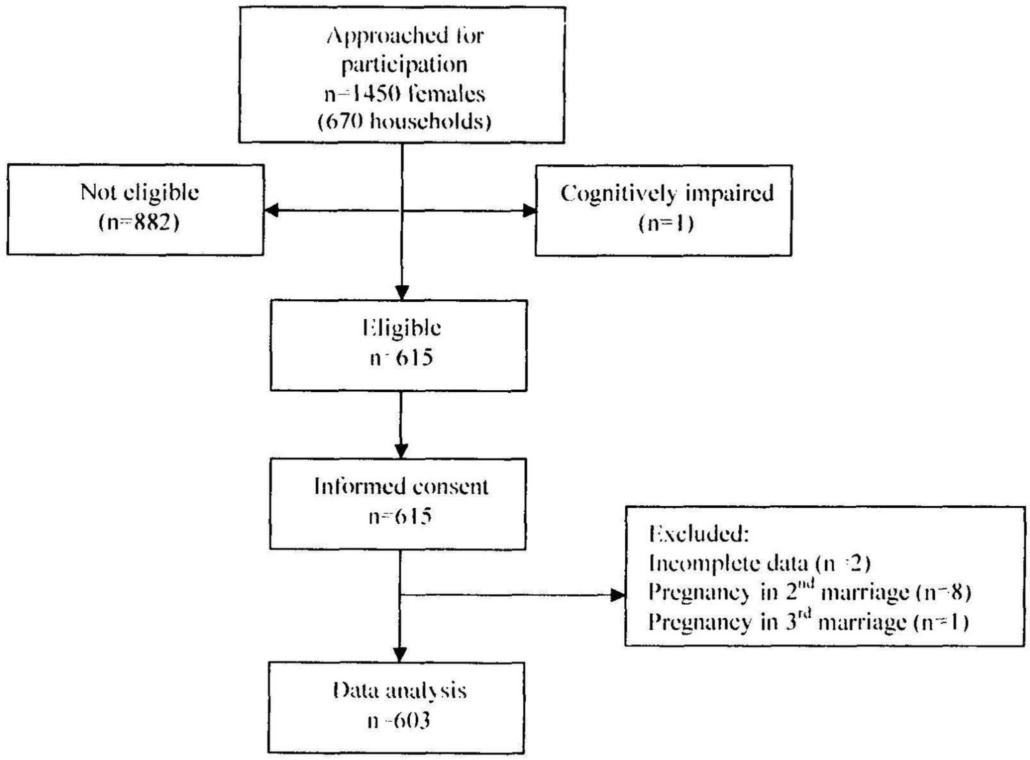

Table 1. Sample characteristics of married females living in rural Bangladesh by reproductive status (n=603)[†]

Covariates	Sample N=603	Ever been pregnant Yes (n=556)	No (n=47)	p-value*
Female's age at interview, years	31 (15-49)	32 (17-49)	21 (15-45)	<0.0001
Age at menarche, years	13 (11-17)	13 (11-17)	13 (12-15)	0.29
Female's age at marriage, years	17 (11-31)	16 (11-31)	18 (13-30)	0.002
Female married <19 years old, yes	440 (73)	413 (74)	27 (57)	0.01
Husband's age at marriage, years	26 (16-49)	26 (16-48)	25 (18-49)	0.42
Dowry, yes	150 (25)	140 (25)	10 (21)	0.55
Married before menarche, yes	17 (3)	15 (3)	2 (4)	0.54
Female illiterate, yes	151 (25)	148 (27)	3 (6)	0.0013
Husband illiterate, yes	153 (25)	146 (26)	7 (15)	0.09
Female wage earner after marriage yes	49/602 (8)	45/555 (8)	4 (9)	0.79
Husband wage earner after marriage yes	529 (88)	490 (88)	39 (83)	0.30
Female student after marriage, yes	235 (39)	210 (38)	25 (53)	0.04
Husband student after marriage, yes	33 (5)	29 (5)	4 (9)	0.31
Medical contraceptive during first pregnancy interval, yes	106 (18)	83 (15)	23 (49)	<0.0001
Iron supplements past 6 months, yes	59 (10)	52 (9)	7 (15)	0.22

† Continuous variables are reported as medians with ranges (0-100). Categorical variables are reported as proportions, n (%). The denominator is specified in cases where there is missing data.
* Continuous variables were compared using Wilcoxon test. Categorical variables were compared using the chi-square statistic. When cell sizes were <5 Fischer's Exact Test was used.

Table 2. Comparisons between age at marriage and age at first pregnancy among married females living in rural Bangladesh by age cohort, from 1957-1991.[1]

Birth cohort	Age cohort, yrs	Age at marriage Median (range: 0-100) [n]	Age at pregnancy Median (range: 0-100) [n]	Never pregnant N (%)
1991-1986	15-20	16 (13-20) [67] A	17 (14-20) [44] B	23 (49)
1981-1985	21-25	17 (13-24) [120] A	18 (14-24) [105] BA	15 (32)
1976-1980	26-30	17 (12-30) [108] A	18 (14-29) [104] A	4 (9)
1971-1975	31-35	16 (11-31) [93] A	18 (14-31) [92] A	1 (2)
1966-1970	36-40	16 (12-31) [101] A	18 (13-31) [100] A	1 (2)
1961-1965	41-45	16 (12-30) [81] A	18 (14-38) [78] A	3 (6)
1957-1960	46-49	18 (12-25) [33] A	19 (14-25) [33] A	0

[1] Analysis of variance was used to compare differences between groups. Values with the same letter are not significantly different.

Figure 2. Cumulative proportion and probability of having first pregnancy at end of each year after marriage.

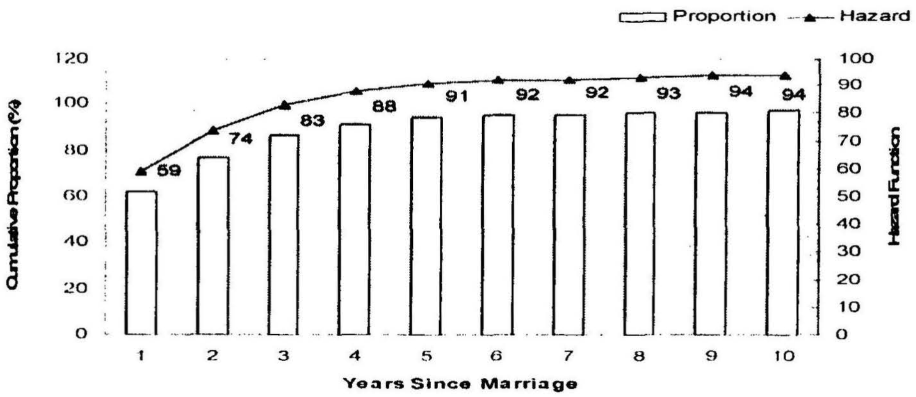

Table 3. Unadjusted hazard ratios for putative covariates of first pregnancy interval among married females living in rural Bangladesh (n=603).

Covariates	Parameter Estimate	Standard Error	Chi-square	Hazard Ratio	p-value
Female's current age	-0.02	0.01	12.27	0.98	0.001
Female's age at marriage	0.12	0.02	59.66	1.12	<0.0001
Husband's age at marriage	0.05	0.01	21.14	1.05	<0.0001
Age at menarche	-0.05	0.06	0.65	0.96	0.42
Dowry, yes	0.05	0.11	0.20	1.05	0.66
Female wage earner, yes	0.45	0.18	6.57	1.58	0.01
Husband wage earner, yes	0.22	0.14	2.34	1.25	0.13
Female illiterate, yes	-0.23	0.11	4.51	0.80	0.03
Husband illiterate, yes	-0.23	0.11	4.56	0.80	0.03
Female student, yes	0.01	0.10	0.01	1.01	0.92
Husband student, yes	-0.19	0.21	0.78	0.83	0.38
Medical contraceptive, yes	-0.21	0.13	2.56	0.81	0.11

Table 4. Results from final model using hazard regression analysis to examine covariates associated with first pregnancy interval among married females living in rural Bangladesh (n=603).

Covariates	Parameter Estimate	Standard Error	Chi-square	Hazard Ratio	p-value
Female's current age	-0.03	0.01	19.10	0.97	<0.0001
Female's age at marriage	0.12	0.02	64.36	1.13	<0.0001
Medical contraceptive	-0.54	0.14	14.59	0.58	0.0001

Table 5. Unadjusted odds ratios for putative covariates of adolescent (≤18 years old) pregnancy among married females living in rural Bangladesh (n=556).

Covariates	Adolescent pregnancy		Odds Ratio (95% CI)	p-value
	Yes n=322	No n=234		
Adolescence exposure	19 (3-35)	19 (5-37)	--	0.08
Female illiterate, yes	96 (30)	52 (22)	1.49 (1.01, 2.20)	0.05
Husband illiterate, yes	93 (29)	53 (23)	1.39 (0.94, 2.05)	0.10
Dowry, yes	84 (26)	56 (24)	1.12 (0.76, 1.66)	0.56
Female wage earner, yes	13 (4)	32 (14)	0.27 (0.14, 0.52)	<0.0001
Husband wage earner, yes	285 (89)	205 (88)	1.09 (0.65, 1.83)	0.75
Female student, yes	129 (40)	81 (35)	1.26 (0.89, 1.79)	0.19
Husband student, yes	19 (6)	10 (4)	1.41 (0.64, 3.08)	0.39
Medical contraceptive	39 (12)	44 (19)	0.60 (0.38, 0.95)	0.03
Female's current age	32 (17-49)	33 (19-49)	--	0.08

Table 6. Adjusted odds ratios for putative covariates of adolescent (≤18 years old) pregnancy among married females living in rural Bangladesh (n=556).

Covariates	Estimate (standard error)	Wald chi-square	Odds Ratio (95% confidence intervals)	p-value
Adolescence exposure	-0.03 (0.01)	6.99	0.97 (0.95, 0.99)	0.01
Husband's age at marriage	-0.10 (0.02)	22.45	0.90 (0.87, 0.94)	<0.0001
Female wage earner	-1.14 (0.35)	10.47	0.32 (0.16, 0.64)	0.001
Medical contraceptive	-0.69 (0.27)	6.66	0.50 (0.30, 0.85)	0.01

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