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The Effect of Women Education on Waiting Time to First Pregnancy of Ever Married Women in Bangladesh: Life Table Analysis

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Abstract

Women's education is a useful indicator of their reproductive behavior. The primary goal of this study is to determine the influence of education on the time to first pregnancy among Bangladeshi women aged 15-49. Life table analysis is used to find the monthly pattern of the time to first pregnancy in different educational level. The three summary indices: Cumulative conditional probability of first pregnancy (B_x), the trimean and the interquartile range are calculated to interpret the distribution of time to first pregnancy. According to this study, uneducated women had a lengthier wait period for their first pregnancy. The mean waiting time to first pregnancy is highest among the women with no educational background.ly 86.52% of illiterate women get pregnant within five years of marriage. While 90.71%, 92.86%, and 91.67% of women from primary, secondary, and upper secondary schools became pregnant within five years of marriage, respectively. The present study reveals that level of education influences the waiting time to first pregnancy and the time to first pregnancy is higher among the women who have no educational background. A successful program should be created to enhance the literacy rate of targeted women to 100% in order to minimize the time to first pregnancy and enjoy a happy marital life.

Keywords: Time to first pregnancy; Life table analysis; trimean; women education.

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1. Introduction

Numerous social, cultural, and economic variables impact Bangladeshi fertility trends. Educational attainment influences reproductive behavior, particularly the duration of first pregnancy. Individuals with higher education levels are more likely to postpone childbirth, which typically happens owing to more time spent in school, career preparation, and greater autonomy in making reproductive decisions. On the other side, individuals with lower levels of education may begin trying to get pregnant at earlier ages, leading to shorter average waiting lengths. Furthermore, education raises awareness about fertility, healthy lifestyles, and access to reproductive healthcare, all of which impact conception timing. In this sense, education influences both the timing and circumstances under which people intend to conceive. Bangladesh has recorded adequate improvement in girl's education over the years. For example, the level of female literacy improved from approximately 30% during the early 1990s to over 70% in 2022. This was realized through projects like the Female Secondary School Assistance Project (FSSAP) and family incentives in the form of cash to send their daughters to school [1, 2].

Education may affect waiting time to pregnancy in a number of different ways. Women with more education will marry later, use birth control more, and may want to study or work before becoming pregnant [4,5]. They also have more control over deciding for themselves what happens to their bodies and their lives, e.g., when to start a family [6]. As a result, more educated women are likely to have a longer waiting time to pregnancy. Educated women tend to marry at an older age, have smaller family sizes, and are likely to use family planning [8,9]. Similar trends have been observed in South Asia as well. For example, multiple study have shown that women with secondary education delayed childbearing in several countries, including Bangladesh [10]. According to the study, education helps women become more independent and aware, which often leads them to delay having children [6].

In Bangladesh, the number of children per woman dropped sharply from 6.3 in the 1970s to about 2.0 by 2022. At the same time, efforts to improve education for girls, such as scholarships and school support programs, increased school enrollment and reduced dropout rates [1,2]. A study had reported that women who were educated up to secondary school levels had fewer chances of early marriage and more of a chance of delaying pregnancy [5]. In another study, proved that educated women used more contraception, thereby delaying the time between marriage and pregnancy [11]. However, in the majority of families, customary beliefs still limit the educational woman's choice of life.

Waiting time to pregnancy can be affected by several factors, such as a woman's age, sexual frequency, health, and wanting children at once [12]. In rural areas, the families of women typically prefer the woman to become pregnant soon after marriage, so waiting time to pregnancy will be brief. In urban societies, especially among educated women, waiting time to pregnancy is longer [12, 13].

Educated women can extend waiting time to pregnancy by a number of mechanisms. First, women marry later if they stay longer at school. Second, educated women are able to use contraception more effectively and perhaps choose to postpone conception [11]. Third, they could want fewer offspring and more birth spacing [5]. Fourth, educated women provide for themselves while outside the house, which establishes them as less dependent and

potentially more likely to delay motherhood [2]. Lastly, education increases reproductive knowledge, and that allows women to make well-educated choices [6].While various research have looked at the overall association between education and reproductive patterns, there is still a lack of information of how only education influences the waiting period for first conception. The majority studies focus solely on socioeconomic or demographic variables, failing to investigate how education interacts with factors such as reproductive knowledge, contraceptive usage, lifestyle choices, and access to fertility treatment. Addressing these gaps might lead to a more nuanced understanding of how education influences reproductive timeframes, as well as informed targeted interventions in reproductive health education and policy.

2. Data and Methodology

2.1 Data

The current study utilizes the ninth national survey of Bangladesh Demographic and Health Survey (BDHS) data conducted in 2022 representing the reproductive and health status of the country. The survey was conducted under the authority of the National Institute of Population Research and Training (NIPORT), Medical Education and Family Welfare Division, Ministry of Health and Family Welfare, and the Government of Bangladesh. A total of 30,078 ever-married women age 15–49 were sampled to collect the information. For this study, 8374 respondents were considered to estimate the time to the first pregnancy, as these individuals had all the information about nutritional status, maternity and marriage histories, socio-economic background, and decision-making autonomy. The entire dataset is divided into two subgroups named birth file (7617 respondents) and no birth file (757 respondents) for computing our target variable time to first pregnancy. Time to first pregnancy is calculated from both birth file (closed interval) and no-birth file (Open interval) and then combined both the file to status variable with values of 0 for no birth happened and 1 for at least one birth.

From the birth file, the time to first pregnancy is estimated by using the following formula

Time to first pregnancy (Closed interval) = Date of first birth (CMC) – 9(Gestation period in months) – Date of first marriage (CMC)

From no birth file, the time to first pregnancy is constructed by using two formulae considering closed interval and exposure interval (regarded as censored cases).

Date of first conception = CMC pregnancy ended – Month pregnancy ended

Time to first pregnancy (Closed interval) = Date of first conception – Date of first marriage

Exposure Interval (Open Interval) = Date of Interview (CMC) – Date of first marriage

2.2 Methodology

To get a clearer picture, we utilize a method called life table analysis. This is a method that has traditionally been used in studies of life expectancy but is increasingly being used in fertility research to look at the time

taken for women to get pregnant after marriage [7]. It enables us to see how quickly women become pregnant following marriage and compare different groups. The technique has also been used elsewhere to analyze trends in fertility [7,14]. It has been used in Bangladesh to analyze birth-to-birth or first-child-to-second child intervals but hardly any work has been done on waiting time to pregnancy [12]. In this study, we use life table analysis to establish the effect of education on waiting time to pregnancy among married women in Bangladesh.

Smith (1980) developed the methodology of building life tables from women maternity history [15]. The three summary indices are estimated to describe the results: the proportion of women having first pregnancy within six years of their marital life, the trimean and the spread of quartile of the time to first pregnancy over the six years [16]. At first, an abridge life table is constructed for the interval from marriage to first pregnancy for all ever married women.

As a women can reach interview without any pregnancy, hence the total number of women reaching interview in the interval x to x+n without conception will be presented as ${}_nC_x$ (i.e. Censored cases). Here, 'x' denotes the duration of exposure in exact month and 'n' refers to the length of duration of exposure. The number of women reaching interview in the interval x to x+n having first pregnancy is given by ${}_nE_x$. Following equation is used for calculating N_{x+n}.

$$N_{x+n} = N_x - {}_nC_x - {}_nE_x \quad \ldots\ldots\ldots\ldots \quad (1)$$

It is important to estimate the number of women exposed to risk having a conception and the figure is denoted by N^*_x. It can be calculated as

$$N^*_x = N_x - {}_nC_x \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

The proportion of women having conception partly one in the interval x to x+n among women in the previous event at the beginning of the interval is denoted by ${}_nq_x$. It is the ratio of the number of conception in the interval x to x+n and the number of women exposed to the risk of having first conception through, that is,

$${}_nq_x = {}_nE_x / N^*_x \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

The proportion of women having a conception in the interval x to x+n among all married women is denoted by ${}_nb_x$ and cumulative proportion of women having a first conception among all married women at duration x is

presented by B_x. for the category of exposure starting at duration zero, these proportions are both equal to ${}_nq_o$ as all women are in the previous event of duration zero, that is

$${}_nb_o = B_o = {}_nq_o \ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

The proportion of women having a first conception in the interval x to x+n for subsequent categories is estimated by the product of the proportion conception in the interval x to x+n among those women staying in the previous event at x, that is,

$$_nb_x = (1- B_x)\ _nq_x \text{.....(5)}$$

The cumulative proportion of women having first conception at x+n among all ever married women is obtained as the sum of the cumulative proportion having a conception of some order by duration x and the proportion of women having a conception of same order between duration x and x+n, i.e.

$$B_{x+n} = B_x + {}_nb_x \text{.....(6)}$$

B_x refers to survival function which is equivalent and complement of traditional l_x. In traditional life table, l_x is defined as the proportion of surviving up to age x.

The life table analysis of this study is used to estimate the quantum of first pregnancy B_x, which stands for cumulative proportion of women having a first pregnancy by duration of x months. Some of the other measures are also calculated and intended in terms of reproductive behavior of the ageing of the span of reproduction. The value of the time to pregnancy function six months, one, two and five years i.e. (B_6, B_{12}, B_{24} and B_{60}) have been estimated to find the suitable indicator for expressing the exact patterns of time required to pregnant. Another more sensitive measure of location, given by Tukey (1977), is called the Trimean [17]. The Trimean is a measure of center of our data. The advantage of using this measurement is that we capture information about the center in a way that is resistant to outliers. The formula for calculating Trimean is given by

$$TM = \left(\frac{\boldsymbol{Q(1)+2Q(2)+ Q(3)}}{\boldsymbol{4}} \right)$$

3. Results

Education plays a significant role of women reproductive health. The results are presented in the table shows that the waiting time to pregnancy is varied with the educational level of the respondent. The mean time to first pregnancy is higher among the women with no education (35.91 months) and lower in secondary educational background (24.34 months).

Table 1: Descriptive statistics of waiting time to pregnancy in different level of education

Highest educational level	**Time to first pregnancy**			
	Mean	**Std. Deviation**	**Number of observations**	**Percentage frequency (%)**
No education	35.9103	54.76459	1093	13.05
Primary	26.7868	32.62409	2078	24.82
Secondary	23.0321	30.97958	3899	46.56
Higher	24.3367	25.25528	1304	15.57
Total	25.8479	34.90998	8374	100

Table 2 shows an abbreviated life table for interval between marriages to first pregnancy. From this table we found B_{72} = 0.93399 which indicate that about 93.40 percent women conceive within six years of marriage. The findings from the life table reveal that only 20 percent women conceive within six months. This proportion rises

63%, 79% and 91% within two, three and five years of their first marriage. About 52% women conceive within 18 months of marital duration.

Table 2: Abridge life table for the time to first pregnancy among the ever married women in Bangladesh, 2022

Duration of exposures (months)	Number observed start (N_x)	Censored cases ($_nC_x$)	Number of terminal events (first conception), $_nE_x$	Exposed through (N^*_x)	Conditional probability of first conception (q_x)	Unconditional probability 0f first conception (b_x)	Cumulative conditional probability of first conception (B_x)
0-6	8374	180	1679	8194	0.20491	0.20491	0.20491
6-12	6515	109	1157	6406	0.18061	0.10659	0.40982
12-18	5249	65	1198	5184	0.23110	0.11175	0.51641
18-24	3986	57	906	3929	0.23059	0.08574	0.62817
24-30	3023	48	672	2975	0.22588	0.06462	0.71391
30-36	2303	35	472	2268	0.20811	0.04609	0.77853
36-42	1796	27	378	1769	0.21368	0.03747	0.82462
42-48	1391	26	300	1365	0.21978	0.03031	0.86210
48-54	1065	15	180	1050	0.17143	0.01844	0.89241
54-60	870	8	123	862	0.14269	0.01272	0.91085
60-66	739	13	99	726	0.13636	0.01042	0.92357
66-72	627	12	75	615	0.12195	0.00805	0.93399
72-78	540	8	78	532	0.14662	0.00850	0.94204
78-84	454	8	50	446	0.11211	0.00554	0.95054
84-90	396	9	47	387	0.12145	0.00533	0.95609
90-96	340	9	36	331	0.10876	0.00420	0.96142
96-102	295	7	18	288	0.06250	0.00215	0.96561
102-108	270	10	26	260	0.10000	0.00322	0.96776
108-114	234	3	19	231	0.08225	0.00239	0.97099
114-120	212	11	12	201	0.05970	0.00159	0.97337
120-126	189	2	14	187	0.07487	0.00187	0.97496
126-132	173	4	14	169	0.08284	0.00192	0.97684
132-138	155	5	11	150	0.07333	0.00156	0.97876
138-144	139	2	9	137	0.06569	0.00129	0.98031
144-150	128	4	6	124	0.04839	0.00089	0.98161
150-156	118	6	3	112	0.02679	0.00047	0.98250
156-162	109	2	6	107	0.05607	0.00096	0.98297
162-168	101	3	6	98	0.06122	0.00104	0.98300
168-174	92	1	4	91	0.04396	0.00075	0.98300
174-180	87	2	1	85	0.01176	0.00020	0.98300
180+	84	66	18	18	1.00000	0.01700	0.98300

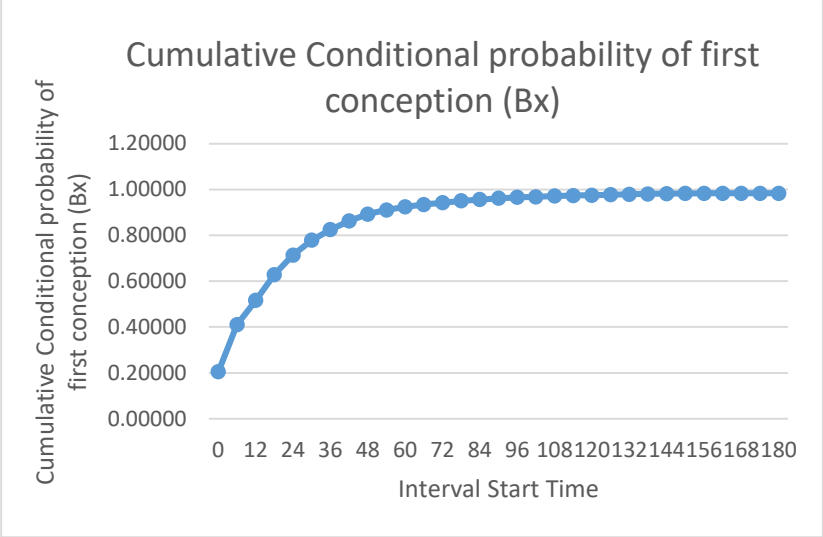

Figure 1: Cumulative proportion of women having first waiting time to pregnancy over 0 to 180 months

The cumulative proportion of having first conception by duration of exposure is shown in the above Figure 1. This figure shows that the cumulative proportion of first conception wait is rapidly increasing over 0 to 5 years and gradually increases in the later period.

Table 3: Abridge life table for the time to first pregnancy among the ever married women with different educational background in Bangladesh, 2022

Education Level	No Education		Primary Education		Secondary Education		Higher Education	Secondary
Duration of exposures (months)	Conditional probability of first conception (q_x)	Cumulative conditional probability of first conception (B_x)	Conditional probability of first conception (q_x)	Cumulative conditional probability of first conception (B_x)	Conditional probability of first conception (q_x)	Cumulative conditional probability of first conception (B_x)	Conditional probability of first conception (q_x)	Cumulative conditional probability of first conception (B_x)
0-6	0.169881	0.169881	0.193016	0.193016	0.223162	0.223162	0.199841	0.199841
6-12	0.160576	0.339762	0.179952	0.386032	0.197699	0.446324	0.150153	0.399682
12-18	0.208995	0.44578	0.252593	0.496517	0.245793	0.555785	0.17561	0.489822
18-24	0.208403	0.561609	0.216135	0.623693	0.24701	0.664970	0.231003	0.579414
24-30	0.18896	0.652971	0.228608	0.705026	0.247154	0.747726	0.203666	0.676571
30-36	0.15748	0.718546	0.194676	0.772459	0.229327	0.810076	0.229551	0.742442
36-42	0.15625	0.762869	0.21118	0.816756	0.224638	0.853631	0.257246	0.801565
42-48	0.2	0.799921	0.21164	0.855454	0.245714	0.886511	0.192708	0.852612
48-54	0.15814	0.839937	0.185185	0.886045	0.165375	0.914397	0.178808	0.881015
54-60	0.127778	0.865249	0.13278	0.907148	0.15674	0.928553	0.147541	0.902290
60-66	0.129032	0.882467	0.154589	0.919477	0.13308	0.939752	0.118812	0.916706
66-72	0.126866	0.897633	0.133721	0.931925	0.107143	0.947770	0.129412	0.926603
72-78	0.145299	0.91062	0.135135	0.941028	0.142132	0.953366	0.185714	0.936101
78-84	0.141414	0.923607	0.134921	0.948997	0.095238	0.959994	0.056604	0.947968
84-90	0.082353	0.93441	0.157407	0.955879	0.120805	0.963804	0.111111	0.950913
90-96	0.116883	0.939811	0.05618	0.962824	0.103175	0.968177	0.230769	0.956367
96-102	0	0.946846	0.085366	0.964912	0.099099	0.971460	0	0.966436
102-108	0.073529	0.946846	0.114286	0.967907	0.103093	0.974288	0.12	0.966436
108-114	0.079365	0.950755	0.129032	0.971575	0.045977	0.976939	0.105263	0.970464
114-120	0.035088	0.954663	0.075472	0.975243	0.065789	0.977999	0.066667	0.973573
120+	1	0.956254	1	0.977111	1	0.979447	1	0.975335

Table 3 is an abbreviated life table of waiting time to first pregnancy with different level of educational background. There exist a small proportion of illiterate women after six years of marital life and we found B_{72}= 0.8976 implies that about 90 percent illiterate women become pregnant within 6 years after marriage. Only 17 percent illiterate women conceive within 6 months of marital life. This proportion arises up to 34%, 56% and 72% within one, two and three years of marriage. Women with a primary educational background need less time than illiterate women to become pregnant for the first time. In this cohort, 19% women become pregnant within six years of their marital life. About 93 % women become pregnant after six years of their marital life. It can stated from the above table the time to first pregnancy is relatively shorter for the women with secondary school background than illiterate and primary school background women. In this group 22% women become pregnant

within 6 years of their marital life. The above table reveals that, almost 95% women with secondary school background become pregnant within six years of their marital life. Higher educated women are more concern about their reproductive health as it is directly associated with child health. About 20 % of the higher educated women take six months to become pregnant at first time.

Figure 2: Log survival function of waiting time to first pregnancy in different educational level of ever married women in Bangladesh

The above graph depicts that women with a secondary level of education need relatively less time to become pregnant before their first marriage. The time to the first pregnancy is relatively longer for illiterate women. Though highly educated women are cautious about their reproductive health, they take longer to become pregnant than women with primary and secondary backgrounds.

Table 4: Summary measures of the time to first pregnancy of ever married women in Bangladesh according to their level of education, 2022

Summary measurement	**Time to First conception**				
	Total women	**Illiterate**	**Primary**	**Secondary**	**Higher secondary**
B_6	0.20491	0.169881	0.193016	0.223162	0.199841
B_{12}	0.40982	0.339762	0.386032	0.446324	0.399682
B_{24}	0.62817	0.561609	0.623693	0.664970	0.676571
B_{60}	0.91085	0.865249	0.907148	0.928553	0.916706
B_{72}	0.94204	0.897633	0.931925	0.947770	0.926603
Q_1	7 months	9 months	8 months	6 months	6 months
Q_2 = Median	16 months	20 months	17 months	15 months	18 months
Q_3	32 months	41 months	34 months	28 months	33 months
Trimean (T)	17.75 months	22.5 months	19 months	16 months	18.75months
Spread (S) = Quartile range	25 months	32 months	26 months	22 months	27 months
No. of cases	=8374 (7617+757*)	=1093 (1043+50*)	=2078 (1986+92*)	=3899 (3487+412*)	=1304 (1101+203*)

***Censored cases**

The above table depicts that only 20 percent women experienced their first conception within 6 months of marital duration. The first quartile is found by linear interpolation between durations 6 to 12 months as Q_1=7 months. Similarly, Q_2= 16 months and Q_3= 32 months. The trimean is thus T= 17.75 months which is greater than the median (16) implies that the observations are not evenly distributed that indicate extreme heterogeneity present in first conception interval particularly among those who lies in the third quartile stratum. The value of spread is 25 which is also indicate that the third quartile is far away from the first quartile. It is evident from the above table the time to first pregnancy is longer for illiterate women. 25% illiterate women take about 9 months or their first pregnancy which is relatively larger than the educated women. Women with higher education also shows a lower fertility pattern than the women with secondary educational background. The trimean and spread for illiterate women is highest than the other women. The women with secondary educational background are more likely to become pregnant than the other women (B_{72}= 0.947770).

4. Discussion

This research considers the impact of women's education on waiting time to their first pregnancy in Bangladesh. The outcome indicates an interactive relationship between waiting time to pregnancy and education, with specifically short waiting time among women who attained secondary education while highly educated women and illiterate women both recorded longer waiting time before having their first child. In a study have discovered that the women with tertiary education delay childbearing as a result of late marriages and career development [18]. Research in Bangladesh has also established that educated women mostly marry late and have fewer children than their less educated counterparts [19,20]. But, contrary to these observations, our research demonstrates that highly educated women, although marrying later, typically become pregnant earlier after marriage.

The lower waiting time pregnancy among women with secondary education reflect a rightful balance between what they know about reproduction and societal expectations. These women usually have enough knowledge about reproductive health to make their own decisions about having children but are still constrained by social norms that promote having children at an early age [18]. On the contrary, more educated women, who enjoy greater access to contraception and con trol over reproduction, tend to delay childbearing for career and personal development [19,20]. Consequently, such women experience a longer waiting time to pregnancy in spite of greater reproductive awareness and medical care access [21].

Poor women might struggle to conceive because of factors beyond their control, like not being able to eat sufficient good food, lacking knowledge about reproductive health, and having poor access to healthcare facilities [22]. The more time they take to conceive is probably not a result of waiting but a consequence of social and health complications that they face [23]. This means that education allows women to be in charge of their reproduction and access important health interventions. Bongaarts (2015) pointed out that women with moderate education usually give birth earlier, but those with very low or very high education postpone giving birth for a number of social and individual reasons [19]. Caldwell (1980) explained that education helps in changing the behavior of fertility through giving people increased autonomy and maximizing the use of birth control. This, consequently, affects the timing of having children [24].

Also, the life table and survival analysis done in this study show that most Bangladeshi women give birth within the first five years of marriage irrespective of their education. These findings are in agreement with studies in other South Asian countries where early fertility is common but is determined by social, cultural, and economic factors [25, 26]. Delay in conception among highly educated women can also be attributed to rising late marriage and family planning, especially among urban and elite women in Bangladesh [27].

5. Conclusion

Women educational background is one of the most dominant factor for determining fertility pattern of a country. In Bangladesh, though the literacy rate is increasing day by but still there is a remarkable percentage of women have no educational background which is alarming for fertility pattern of the country. The results of this study find evidence that illiterate women are more susceptible to prolonged pregnancy intervals. As illiterate women are more likely to marry before reaching their reproductive age, they have low decision-making autonomy and are less aware of their nutritional status. There is a smooth distribution pattern noticed in the women of secondary educational background. The distribution of time to first pregnancy of women in Bangladesh are almost similar for primary and higher secondary educational background. Time to first pregnancy is not just a measurement of fertility behavior it is also linked with a happy conjugal life in our Bangladesh communities. So government should take necessary steps to improve women literacy rate and arrange campaign to raise aware about reproductive health behavior of the illiterate women.

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