Identification of Fertility Enhancing and Inhibiting Factors: A Study on Married Adolescents in Bangladesh

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Received: August 16, 2010 Accepted: November 5, 2010 doi:10.5539/ass.v7n5p191

Abstract

Fertility is associated with complex biological process of women life through the transition of pregnancy and birth. Some socio-demographic variables are hypothesized to affect the level of fertility, many of those factors enhance fertility where as some other inhibit the fertility. Our aim in this study is to reveal the most influential fertility inhibiting and enhancing factors for married adolescents. The intuition behind this is to explore the interaction of both enhancing and inhibiting factors on the level of adolescent fertility. In this sequel, a hypothesized framework based on proximate covariates is used to describe the theoretical relationship among the covariates and factor analysis is applied to identify the dominant fertility enhancing and inhibiting factors. Among all proximate covariates highest level of education is speculated as the most influential fertility inhibiting factor for adolescents.

Keywords: Adolescent motherhood, Age at marriage, Dominant covariates, Early childbearing, Fertility inhibiting and fertility enhancing factors

1. Introduction

Childbearing in human population is a complex phenomenon and practice of childbearing depends on many covariates. Moreover, a number of physiological, behavioral, psychological, socio-economic and demographic factors regulate childbearing practices in human population (Bongaarts 1978, 1982; Bongaarts and Potter 1983).

Early marriage and childbearing are very common in Bangladesh. Nearly half of the adolescent girls (15–19 years) in Bangladesh are married, and nearly 57% become mothers before the age of 19 years (UN, 2005). Schuler et al. (2006) explored the norm, belief and socio-cultural strategies associated with the early marriage and childbearing. Education is found to be very important socio-economic factor that possesses strongest effect in delaying first birth during adolescence and a one-year increase in age at marriage decreases the chance of teenage first birth by 10% or more in Bangladesh (Nahar and Min, 2008).

Both the age at marriage and first birth may be affected by the parents, that is, generation effect may strongly influence the age at marriage and first birth. Bates et al. (2007) conducted a survey in six villages in Bangladesh and have found strong association between female education in one generation and the timing of marriage and childbearing in the next generation. Education level of mothers and mothers-in-law are also found significantly associated with the age at marriage of daughters and age at first birth of daughters-in-law respectively. Haque and Sayem (2009) carried out a survey on married rural women aged 15 to 29 and explored that more than 72% women gave first birth before 20 years of age with mean age at first birth 18.74 years. Though they strongly recommended increasing the age at first birth to reduce high fertility, however, the intuition behind this is not very clear as many of the covariates like age at marriage, education level, contraceptive use, etc., are correlated with the age at first birth.

Islam and Islam (1993) examined factors affecting fertility by using the Bangladesh Fertility Survey Data in 1989 by quantifying fertility-inhibiting effects through Bongaarts' proximate determinants model. Later, many authors dug-out the DHS data sets to explore the socio-economic determinants of childbearing of Bangladeshi women. A recent good study on identification of key factors of childbearing pattern in Bangladesh is conducted by Asaduzzaman and Khan (2009) where they explored education level and age at first marriage as main causes of high fertility in Bangladesh. Though many authors studied the factors associated with the fertility behavior of

Bangladeshi women, however, a little is known in the context of early childbearing and on-time childbearing. Our aim in this study is to find two orthogonal subsets of fertility enhancing and inhibiting covariates for adolescents (early childbearing) as well as that for on-time child bearing (women aged 20-35). Assuming the on-time childbearing as control group we verify the differential effects of both subset of covariates (enhancing and inhibiting factors) on early childbearing. In section 2, we briefly discuss about the availability of data and methods employed to extract dominant factors. Section 3 is devoted to study the transition of adolescent fertility over the cohort that is useful to depict the proportion of adolescent motherhood for some other age-groups, for example, to know the proportion of adolescent motherhood for women who are in 45-49 age group. An intuitive empirical analysis along with a hypothesized model is presented in section 4 to find the fertility enhancing and enhancing factors as well as their effect on early childbearing are studied.

2. Data and analytical methods

The data for this study is obtained from Bangladesh Demographic and Health Survey (BDHS) 2007 which is a nationally representative survey was conducted under the authority of the National Institute for Population, Research and Training (NIPORT) of the Ministry of Health and Welfare, Bangladesh. The present study is based on 10996 ever married women aged 15-49 years. Information on marital status, age at first marriage, and fertility behavior was gathered with some demographic and socio-economic characteristics on the basis of respondents' reports.

In order to determine the latent dominant factors that affect adolescent fertility, linear regression analysis and principle component regression analysis are undertaken and factor analysis recoursing principal component extraction method with varimax rotation is used to identify the socio-demographic covariates by exploring the correlation matrix of proximate variables.

3. Proportion of adolescent motherhood in different cohorts

We consider different group of women as a single cohort and the oldest cohort represents the first generation. Now we want to observe the generation effect of the adolescent motherhood ratio. Simply we can estimate the proportion of mothers giving first birth before 20 years of age for each cohort/generation and explore the change of the proportion of a woman being mother before 20 years of age. Thus the generation effect of adolescent motherhood is the study of change of proportion of being a mother at their adolescent age for different generations/age groups. For example, many women of age group 40-44 years gave their first birth before 20 years of age and the proportion of adolescent motherhood for that age group or generation is the number of women gave first birth before 20 years and total number of women within this age group, that is, the proportion to be calculated for this age group is 963/1218=0.7906 (column 5, Table 1). Similarly, we can compute the proportion for all the age groups and can compare how the proportion changes over time.

From BDHS 2007 data we found 1348 adolescent women and 753 live births before the age of 20 year among those adolescents. However, many of them are just got married and they have a long way to go through out the adolescent age. An adolescent may be married at 15 years of age and interviewed without any birth at the time of interview, but may give birth before 20 years. Thus we need to adjust the proportion of adolescent motherhood for the present generation (age group 15-19). To do this we compute the proportion of adolescent mothers for each single year from 15-19 and project the proportion for each single year, that is, we compute the projected proportion of being a mother for each of single years and finally take the average to find the projected proportion of adolescent motherhood for present generation. Proportion of mother giving first birth before 20 years of age has been displayed in column 5 of Table 1. For single year 15, this proportion is 0.2754 and that for 19 years is 0.7037. So the rate of transition from one single year to another single year is (0.7037 – 0.2754)/5= 0.0857 and the projected proportion corresponding to the single year group 15 is 0.2754 + 5(0.0857) = 0.7039. Similarly, for the single year age group 16, this proportion would be 0.3892 + 4(0.0857) = 0.7320. Finally, the projected proportion for this age group (15-19) is the average of all the projected proportions which is 0.7602 (column 7, Table 1).

4. Extraction and assessment of dominant factors

4.1 Hypothetical framework of proximate covariates

In our society, childbearing starts immediately after marriage. Age at first marriage or age of first intercourse is one of the major covariates which influence teenage motherhood directly. Besides this, reduced fecundability, secondary sterility, child survival and childlessness, fertility intension or fertility desire, abortion and contraceptive use also influence childbearing practice. Set of such variables influencing childbearing practice may be subdivided into fertility enhancing and fertility inhibiting factors. Two proximate variables, child death and desire for more children, have some sort of fertility enhancing effect while age at first marriage, ever use of contraception, breastfeeding status, and induced abortion have fertility inhibiting effect. Consequently, some socio-demographic covariates such as highest level of education and working status may influence the proximate variables, which in turn may play important role in shaping the adolescent fertility pattern of Bangladeshi women. But these socio-demographic variables might have very low impact on fertility compared to the proximate variables. Thus the relationship of covariates related to the early motherhood can be expressed by the hypothesized framework displayed in figure 1.

Data on abortion, coital frequency and fecundability are not available. Since fertility rate is a function of children ever born (CEB), so we use data on children ever born, age at first marriage (AFM), ever use of contraception (EUC), desire for more children (DMC), number of children died (NCD), currently breastfeeding (CBF) and highest level of education (HLE). In the next section, we aim to extract dominant factors that form two set of covariates S_1 and S_2.

4.2 Extraction of dominant factors

Both socio-demographic and proximate covariates may affect the fertility pattern. However, the strength and direction of all covariates for fertility regulation are not same. Thus our first step is to search for dominant factor and the second step is to find the direction of (enhancing or inhibiting characteristics) of covariates from that dominant factor. To extract the dominant factor we use factor analysis based on principal components and to extract the direction of covariates we use principal component regression. Thus we construct correlation matrix and perform factor extraction by principle component method with varimax rotation. The correlation matrix and results for factor analysis for six proximate variables viz. AFM, EUC, NCD, DMC, CBS and HLE are produced in Table 2 and Table 3. Due to the large sample size (N>10000) the correlation coefficients are found small in magnitude but statistically significant at 5% level (Table 2).

The factor analysis extracted initially five factors corresponding to six eigenvalues. Table 3 incorporates eigenvalues, percentage of variation explained by each eigenvalue and the cumulative percentage of variation explained by those eigenvalues. Science there are six proximate variables, factor analysis extracted initially six factors corresponding to six eigenvalues. Proportion of variation explained by a factor is its eigenvalue divided by the sum of all eigenvalues. The factor analysis arranges the latent roots by diminishing order that facilitates identification of the dominant structural factors. It is observed that the first factor (F_1) with the highest eigenvalue of 1.824 explains slightly more than 30 percent of total variation and the second factor (F_2) with eigenvalue 1.154 explains more than 19 percent of total variation in the socio-demographic covariates among the women aged 15-49 years. However, the eigenvalue corresponding to third factor (F_3) is 0.998 which is very close to 1 and explains more than 16 percent of total variation. Thus we extract the first three factors which are explaining more than 66 percent of total variation of the covariates (Table 3).

Evidently, F_1 is the most dominant factor, F_2 is the second dominant factor and F_3 is the third dominant factor that represents the effect of proximate covariates. Now we explore the factor loadings associated with three different factors for six different covariates. We consider factor loadings greater than 0.5 and cross-loading (loadings with negative value) less than -0.4 (Johnson and Wichern, 2002) to explain the relationship between the covariates and factors. We see that the factor loadings of F_1 are greater than 0.5 for covariates AFM and HLE and that of F_2 is for EUC and DMC. We found only one covariate CBS having factor loadings greater than 0.5 for F_3. Consequently, two cross-loadings for F_1 is obtained for DMC and NDC. Although AFM and HLE are positively related to the first factor, MC and NDC are negatively associated with the most dominant or strongest factor. So far, we have explored the relationship of covariates with the strongest and dominant factors. Thus we may apply principal component regression to depict the direction (inhibiting and enhancing characteristics) of covariates to affect the fertility (children ever born) of mothers aged 15-49 years. We compute factor scores for three dominant factors and then fit regression model which yields

$$CEB = 2.785 - 1.253F_1 + 0.5F_2 - 0.376F_3$$
$$R^2 = 0.466$$

All coefficients are found to be highly significant where the first and third factors have negative (inhibiting) effect and the second factor has positive (enhancing) effect on CEB. Since AFM and HLE are positively associated with the first factor (F_1) so the increase of AFM and HLE increases F_1 which in turn reduces the CEB. Thus AFM and HLE are fertility inhibiting covariates. Similarly, for the negative coefficient of F_3 and positive association between F_3 and CBS, we may say that the covariate CBS has some sort of fertility inhibiting effect. Due to the cross-loading corresponding to DMC and NDC we may explore the negative association with the first factor. Thus as the DMC and NDC increases so the F_1 decreases and CEB increases due to the negative coefficient, that is, these two covariates are fertility enhancing covariates. As DMC and EUC are positively associated with the second factor which has positive coefficient in the regression model, we may affirm the fertility enhancing behavior of DMC. However, ever use of contraception is quite contradictory which may be due to the fact that a woman might have used any kind of contraceptive method at any stage of reproductive span and there might have very small variation for (small variance) this covariate over the whole population and by the explanation of Bongaarts (1978) we may term this factor also as fertility inhibiting. Lastly, CBS is positively associated with the third factor and is negatively affecting (inhibiting) the CEB. Thus we have found the fertility enhancing or inhibiting effect of covariates on CEB and can form two different sets, that is, S_1={AFM, HLE, CBS} and S_2={DMC, NDC}. Therefore, our hypothetical framework is well-defined for these sets of covariates.

4.3 Assessment of dominant covariates

Since our aim in this study is to explore the most dominant fertility enhancing or inhibiting factor for adolescent mothers, so we set up adolescent mothers of ages 15-19 as target group and mothers of ages 20-34 as control group. The reason behind the selection of 20-34 age group as control group is that mothers of this age group are assumed to be in on-time and less risk fertility group. To fit multiple linear regression models we consider the women ages below 20 years and ages of 20 to 34 years as a control group for comparing the effect of proximate variables among the fertility of adolescent women and adult women. The fitted model for the control group, i.e. the fertility among those women whose ages are between 20 to 35 years is

$$\begin{aligned} CEB &= \underset{(0.000)}{2.014} - \underset{(0.000)}{0.074AFM} - \underset{(0.000)}{0.279EUC} + \underset{(0.000)}{1.115NCD} + \underset{(0.000)}{0.325DMC} - \underset{(0.000)}{0.413CBF} - \underset{(0.000)}{0.260HLE} \\ R^2 &= 0.546 \end{aligned}$$

Above fitted regression models divulges that in case of on-time fertility group (control group) the number of children died and desire for more children has fertility enhancing effect while the age at first marriage, ever use of contraception and currently breastfeeding have fertility inhibiting effect. All these variables explain more than 52 percent of total variations in fertility. Thus the set of enhancing and inhibiting factors are identified for the control group and we would like to investigate any difference with that of target group (adolescent mothers). The fitted regression model for adolescents is

$$\begin{aligned} CEB &= \underset{(0.000)}{1.177} - \underset{(0.000)}{0.075AFM} - \underset{(0.900)}{0.009EUC} + \underset{(0.000)}{0.706NCD} + \underset{(0.000)}{0.124DMC} + \underset{(0.000)}{0.262CBF} - \underset{(0.000)}{0.053HLE} \\ R^2 &= 0.433 \end{aligned}$$

From the above model, we find only two fertility inhibiting factor for adolescents which are age at first marriage and highest level of education. On the other hand, ever use of contraceptive is still negative but with insignificant effect. For the control group, all fertility inhibiting covariates were significant but for adolescent EUC is insignificant. Thus adolescent mothers are less likely to use any kind of contraceptive methods compared to the control group. The strongest factor (F_1) is negatively related to the children ever born (a measure and function of fertility) and highly positive (>0.7) loadings ensure that two variables { AFM, HLE} have higher level of inhibiting effect on fertility. Thus the most dominant fertility inhibiting factor for adolescents is the highest level of education and second strongest inhibiting factor is age at first marriage. Therefore, level of education may be inclined with some degree of awareness of adolescent pregnancy and thus contributing as most dominant fertility inhibiting factor.

5. Conclusion and recommendation

Adolescent pregnancy is a major concern in Bangladesh that is also associated with the millennium development goal. Pregnancy during adolescence may cause serious health complications and may cause of maternal death. Our empirical study encompasses theoretical insights through a hypothetical model and verifies the hypothetical model by a very popular statistical method to extract fertility enhancing and inhibiting factors along with their strengths. Consequently, comparative study between the target group and control group enables us to find the factor that is differently affecting the target group. Though the rate of early marriage is very high in Bangladesh, this is not the root cause of adolescent motherhood. Rather our study shows that the level of education is much stronger than the age at marriage. Thus increasing awareness level by educating them or even by counseling through social activities would be a good way to restrain even married adolescents from early childbearing.

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Table 1. Proportion of mothers giving first birth at adolescent age

Age of respondent	Number of women	First marriage < 18 yrs	Mothers gave first birth before 20 yrs	Proportion of first birth before 20 yrs	Projected Proportion of first birth before 20 yrs
15	138	138	38	0.2754	0.7039
16	185	185	72	0.3892	0.7320
17	260	260	137	0.5269	0.7840
18	387	387	240	0.6201	0.7915
19	378	363	266	0.7037	0.7894
15-19	1348	1333	753	-	**0.7602**
20-24	2174	1846	1678	0.7718	
25-29	1935	1604	1470	0.7597	
30-34	1661	1396	1252	0.7538	
35-39	1596	1374	1201	0.7525	
40-44	1218	1094	963	0.7906	
45-49	1064	994	848	0.7969	
Total	10996	9643	8165	-	

This table computes the proportion of mothers giving birth at their adolescent age as well as the projected proportion for mothers still in the adolescent age-group.

Table 2. Correlation matrix

Proximate Variables	AFM	EUC	NDC	DMC	CBS	HLE
AFM	1.000					
EUC	-0.042	1.000				
NDC	-0.168	-0.070	1.000			
DMC	-0.217	0.213	0.205	1.000		
CBS	0.045	0.013	-0.096	-0.109	1.000	
HLE	0.402	0.144	-0.277	-0.280	0.081	1.000

All the correlation coefficients are significant at 5% level

Table 3. Eigen values and percentage of variations explained by factors

Factors	Eigen Values	Percentage of Variation	Cumulative Percentage	Factor Loadings			
				Proximate variables	F_1	F_2	F_3
1	1.824	30.407	30.407	AFM	0.719	-0.154	-.127
2	1.154	19.236	49.643	EUC	0.155	0.892	0.075
3	.998	16.632	66.275	DMC	-0.457	0.599	-0.209
4	.830	13.831	80.106	NCD	-0.557	-0.103	-0.311
5	.671	11.184	91.289	CBS	-0.021	-0.039	0.942
6	.523	8.711	100.000	HLE	0.820	0.048	0.011

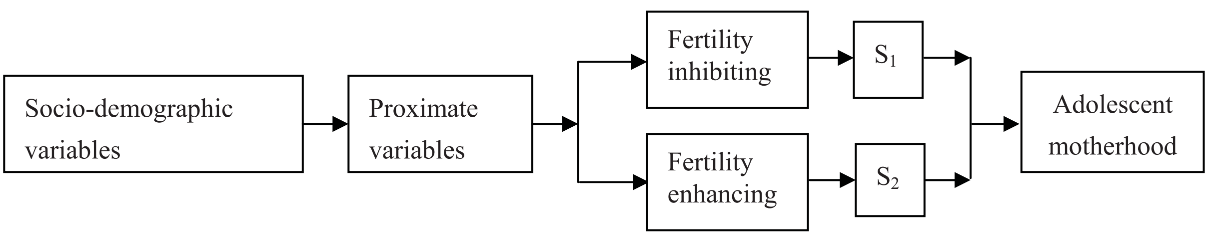

Figure 1. Hypothetical framework of proximate covariates