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Influence of Socio-Demographic Variables on Fertility in Bangladesh: Application of Path Model Analysis

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Abstract: This study seeks to examine the effects of some selected socio-economic and demographic variables on fertility using a well-known multivariate technique named path model analysis. The data are from 2004 Bangladesh Demographic and Health Survey (BDHS). This study argues that for both cohorts (i.e., aged below 30 years and aged 30+ years) women's education, age at first marriage and length of breast feeding are found to have significant direct negative effects, while the place of residence and the number of dead children have significant direct positive effects on the number of children ever born. Fetal loss appears to have a significant direct positive effect on fertility in Bangladesh. Based on the finding of this study, it may be suggested that attention should be focused on the need for providing educational facilities in particularly among women in rural areas in order to decline the level of fertility in Bangladesh.

Key words: Socio-economic variables, demographic variables, fetal loss, children ever born, path model analysis, Bangladesh

INTRODUCTION

The recent decline in fertility has created much interest among researchers, policy makers and academicians because such dramatic change in fertility has occurred in Bangladesh without a substantial improvement in socio-economic status, health condition and other factors needed usually for fertility decline. The specific nature of the determinants of fertility is intricate and complex. While, fertility behavior influences population growth, which has consequences towards pressure on resources, employment situation, health and other social facilities and savings and investment, in turn, such consequences have great bearing on the socio-economic variables that affect fertility behavior. Socio-economic factors are in turn affected by the demographic factors. These factors directly and indirectly affect the interaction processes. Socio-economic variables cannot directly influence fertility but must act on fertility through their effect on one or more of the intervening variables.

The mechanism of factors affecting fertility is that intermediate variables influence fertility directly, while socio-economic and environmental variables affect fertility indirectly through intermediate variables (Davis and Blake, 1956; Bongaarts, 1978; Bongaarts *et al*., 1984). This study is an initial framework for the classification of variables to be analyzed using the path analytical approach. One of the difficulties in such an analysis is that the independent variables affecting fertility are often inter-correlated to such an extent that if statistical control were introduced for one of the variables, the influence of the other variable, on fertility would be substantially altered. That's why this study is carried out to examine the direct and indirect and joint effects of selected socio-economic and demographic factors on fertility employing the technique of path analysis.

MATERIALS AND METHODS

The data used in this study are from the 2004 Bangladesh Demographic and Health Survey (BDHS, 2004), which was conducted under the authority of the National Institute of Population Research and Training (NIPORT) during the period January 1-25 May 2004. A stratified sample design was used for the survey.

In the BDHS (2004), data a number of socio-economic, demographic and cultural variables are available. Among them, eight variables have been taken into consideration in this study in order to examine a correlation matrix and to construct a path model. Table 1 gives a detailed description of the variables. Wife's education and place of residence are considered as the socio-economic and background variables, while the demographic as well as intermediate variables regarded in this study are current age, age at first marriage, contraceptive use, duration of breast-feeding and fetal loss or children dead. Finally, the number of children ever born to each women is used here as a measure of fertility.

Table 1: Description of variables

Variable name	Abbreviation	Causal order number	Measurement
Child-hood place of residence	PR	1	1 = Urban* 2 = Rural*
Current age of wife	AGE	2	Single year
Wife's education	EDU	3	0 = No schooling* 1 = Incomplete primary* 2 = Primary and above*
Proportion of dead children	D	4	Proportion dead children
Age at first marriage	AFM	5	Completed years
Length of breast-feeding	LBF	6	Completed months
Contraceptive use	CON	7	1 = Ever use* 2 = Never use*
Children ever born	CEB	8	Number of live births

*Indicates dummy variables

It has been assumed here that these selected variables affect fertility behavior of women according to the theoretical framework of Bongaarts *et al*. (1984).

Descriptive analysis: It is well documented that the current age of women has a high correlation with their fertility and fertility variations may be observed due to characteristics of women between the two age cohorts such as below 30 and 30-49 years of women (Islam and Khan, 1995). Figure 1 reveals that fertility increases with higher order cohorts of women. On the other hand, split data for women aged below 30 years and for women 30 years and older show different types of distribution. Figure 2 shows, a skewed distribution; however, Fig. 3 shows more or less symmetric distribution. The average parity is seen to be merely two per woman aged below 30 years, whereas it is about five per woman aged 30 years or older (Table 2). Thus, the correlation and the path model analysis have been applied separately for two age cohorts of women:

- The cohort aged below 30 years at the time of interview (younger cohort)
- The cohort aged 30+ years at the time of interview (older cohort)

Table 2 presents the means (X) and Standard Deviation (SD) of the variables included in this study for the two age cohorts of women.

Correlation analysis: In order to examine the quantitative relationship between socio-economic and demographic variables and cumulative fertility, at first we construct a correlation matrix. The correlation coefficient measures the degree of closeness of the linear relationship between two variables. When two variables are seen to be correlated, it is tempting to infer a cause and effect relationship between them. But, it must be remembered that such measures tell us nothing about the causality (Liberatraum, 1983).

Table 2: Number of women (N), mean (X) and Standard Deviation (SD) of variables

	Women aged below 30 years			Women aged 30+ years		
Variables	N	X	SD	N	X	SD
AGE	5964	22.313	4.369	5476	38.042	5.640
PR	5964	1.714	0.452	5476	1.688	0.464
EDU	5964	1.096	0.893	5476	0.793	0.891
D	5964	0.180	0.448	5476	0.657	0.778
AFM	5964	15.147	2.773	5476	14.815	3.307
LBF	3966	19.880	15.070	1400	24.580	16.430
CON	5964	0.733	0.442	5476	0.766	0.423
CEB	5964	1.723	1.349	5476	4.475	2.338

Fig. 1: Distribution of women according to age cohort of women, Bangladesh, 2004

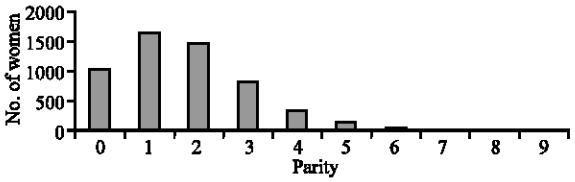

Fig. 2: Distribution of women aged below 30 years, Bangladesh, 2004

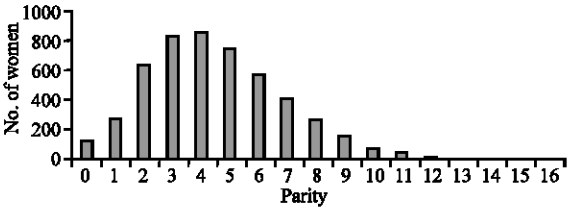

Fig. 3: Distribution of women aged 30-49, Bangladesh, 2004

Table 3: Zero order correlation coefficients of ever married women under 30 years

Coefficients	PR	AGE	EDU	D	AFM	LBF	CON	CEB
PR	1.00	-0.073**	-0.156**	0.058**	-0.169**	0.016	-0.110**	0.089**
AGE		1.000	-0.120**	0.203**	0.227**	0.186**	0.220**	0.603**
EDU			1.000	-0.188**	0.283**	-0.04**	0.151**	-0.286**
D				1.000	-0.119**	-0.069**	-0.035**	0.489**
AFM					1.000	-0.071**	0.010	-0.286**
LBF						1.000	0.221**	-0.286**
CON							1.000	0.212**
CEB								1.000

Table 4: Zero order correlation coefficients of ever married women aged 30 years and above

Coefficients	PR	AGE	EDU	D	AFM	LBF	CON	CEB
PR	1.00	0.043**	-0.257**	0.134**	-0.176**	0.023	-0.094**	0.173**
AGE		1.000	-0.108**	0.235**	-0.138**	0.135**	-0.153**	0.381**
EDU			1.000	-0.240**	0.305**	-0.007	0.227**	-0.229**
D				1.000	-0.193**	-0.024	-0.103**	0.591**
AFM					1.000	-0.054*	0.082**	-0.301**
LBF						1.000	0.107**	-0.023
CON							1.000	0.041**
CEB								1.000

Table 3 and 4 depicts, the simple zero order correlation coefficients matrix for all the variables used in the analysis for two age cohort 10-29 and 30-49 years, respectively. According to the Table 3, the strongest significant relationship are observed between AGE and CEB, AGE and AFM, AGE and D, AGE and CON, EDU and AFM, EDU and CEB, D and CEB, AFM and CEB, LBF and CON and CON and CEB with the r-values of 0.603, 0.227, 0.203, 0.220, 0.283, -0.286, 0.489, -0.286, 0.221 and 0.212, respectively. The stronger significant relationship are observed between AGE and EDU, AGE and LBF, PR and EDU, PR and AFM, PR and CON, EDU and D, EDU and CON, D and AFM with the r-values of -0.120, 0.186, -0.156, -0.169, -0.110, -0.188, 0.151 and -0.119, respectively. And the weak relationships are observed between AGE and PR, PR and D, PR and LBF, PR and CEB, EDU and LBF, D and LBF, D and CON, AFM and LBF, AFM and CON, LBF and CEB with the r-values of -0.073, 0.058, 0.013, 0.089, -0.049, -0.069, -0.035, -0.071, 0.010 and -0.038, respectively. All the relationships are significant for the one-tailed t-test at 0.01 and 0.05 level of significance, with the exception of PR and LBF and AFM and CON, respectively.

Table 4, shows the strong significant relationship are seen to be between AGE and CEB, AGE and D, PR and EDU, EDU and D, EDU and AFM, EDU and CON, EDU and CEB, D and CEB, AFM and CEB with the r-values of 0.381, 0.235, -0.257, -0.240, 0.305, 0.227, -0.229, 0.591 and -0.301, respectively. And weak relationships are observed between AGE and PR, PR and LBF, EDU and LBF, D and LBF, LBF and CEB and CON and CEB. All the relationships are significant for the one tailed t-test at 0.01 and 0.05 level of significance, with the exception of the weak relationships.

The various relationships examined in this study are, in fact, quite complex and as a result, path model will be applied to identify more precisely the underlying empirical causation. Since, in any situation where a multivariate problem is encountered, the method of analysis should proceed from simple to complex in an orderly manner.

Path analysis: Path analysis helps in estimating the magnitude of the linkage between interrelated variables and provides information about the underlying causal process. However, the fundamental task here is to construct a path diagram in which direction (indicated by arrowheads) should be causally meaningful. This study employs a recursive path model relating to population and development variables. The path diagrams represent the hypothetical causal model of relationships between fertility and some of its determinants. The assumptions that underlie the application of path analysis are:

The relations among the variables in the model are linear, additive and causal. Consequently, curvilinear, multiplicative, or interaction relations are excluded.

Each residual is not correlated with the explanatory variables that precede it in the model.

There is one-way causal flow in the system. That is, the reciprocal causation between variables is not considered.

Given the above assumptions, the method of path analysis reduces the system to one or more multiple linear regression analysis. By the help of reduced multiple linear regression analysis, the path coefficients are estimated. Path coefficients are the standardized regression coefficients in a system of linear regression equations, indicating the direct effects of an independent variable

on the dependent variable. To estimate the total effect and indirect effect, we use Alwin and Hauser's (1975) method. The residual path co-efficient can also be estimated from the regression equation as square root of ($1-R^2$), where R^2 (unadjusted) is the multiple correlation coefficient (square) of the regression equation.

In the path diagram, the causal links among the variables are assumed to be a conceptual framework conceived in advanced. The path diagram is developed based on a conceptual framework used in a study of determinants of fertility by Pathak and Murthy (1985).

According to the causal ordering of the variable we have denoted the factors as follows:

X_1 = Childhood place of residence
X_2 = Women's current age
X_3 = Education
X_4 = Proportion dead children
X_5 = Age at first marriage
X_6 = Length of breastfeeding
X_7 = Contraceptive use
X_8 = Children ever born (dependent variable)

This model is a recursive path model, in which each variable is assumed to be dependent upon all prior causal variables. Under additional assumptions of linearity and additivity the system of equation are as follows:

$$X_3 = P_{31}X_2 + e_1$$
$$X_4 = P_{41}X_1 + P_{42}X_2 + P_{43}X_3 + e_2$$
$$X_5 = P_{51}X_1 + P_{52}X_2 + P_{53}X_3 + e_3$$
$$X_6 = P_{61}X_1 + P_{62}X_2 + P_{63}X_3 + P_{64}X_4 + P_{65}X_5 + e_4$$
$$X_7 = P_{71}X_1 + P_{72}X_2 + P_{73}X_3 + P_{74}X_4 + P_{75}X_5 + P_{76}X_6 + e_5$$
$$X_8 = P_{81}X_1 + P_{82}X_2 + P_{83}X_3 + P_{84}X_4 + P_{85}X_5 + P_{86}X_6 + P_{87}X_7 + e_6$$

where, e_1, e_2, e_3, e_4, e_5, e_6 are random disturbance terms.

This system of equations which is known as structural equations give us estimates of path coefficients and represent the weight attached to each link in the causal chains.

RESULTS AND DISCUSSION

Under the assumption of causal ordering, presented earlier, a set of recursive regression equations were fitted. Utilizing these equations the standardized β-coefficient (Path coefficient) and the residual path coefficients are estimated. All together, the path model has 26 paths for two cohorts of women. The t-test is used to identifythe estimated path coefficients that are significant. Various path coefficients are shown in Fig. 4 for the cohorts of women aged below 30 years and in Fig. 5 for the cohorts of women aged 30 years and older. Out of 26 hypothesized paths, 24 and 18 paths are found to be statistically significant for the younger and older cohorts, respectively. The discussion that follows on direct and indirect effects is based on these significant coefficients only. It is worth mentioning here that the elimination of the non-significant paths has only a small effect on the power of explanation of the model. Coefficient of determination (R^2) of the regression equations in respect of the corresponding dependent variables are presented in Table 5 for two age cohorts.

Table 5: R^2 of corresponding dependent variables

Dependent variable	Coefficient of determination(R^2)	
	Aged below 30 years	Aged 30 and above years
CEB	0.671	0.549
CON	0.113	0.084
LBF	0.072	0.025
AFM	0.172	0.126
D	0.074	0.119
EDU	0.023	0.066

It is important to note that for the ever-married women, the total set of independent variables linked by the causal relationship explain 67.1% ($R^2 = 0.671$) for aged below 30 years and 54.9% ($R^2 = 0.549$)for aged 30 and older of the variance in cumulative fertility (CEB) followed by about 17 and 11.3% for aged below 30 years of the variance in Age at First Marriage (AFM) and Contraceptive (CON) and also followed by 12.6 and 11.9% for aged 30 and older of the variance in age at first marriage and number of Dead children (D), respectively. The other independent variables like LBF, EDU explained lower proportions of the variance.

The direct, indirect and total effects of each of the selected explanatory variables are presented in Table 6 and 7 for the cohort aged <30 years and in Table 8 and 9 for the cohort aged 30 years and older. For both the cohorts, women's education, age at first marriage and length of breastfeeding are found to have significant direct negative effects while, the place of residence and the number of dead children has a significant direct positive effect on the number of children ever born. Compared with the younger cohort, both the direct influence of age at marriage and duration of breastfeeding on fertility are observed to be higher for the older cohorts but the direct influence of women's education on fertility are observed to be higher for the younger cohorts than older cohorts. The direct influence of the number of dead children on the number of children ever born is found to be higher and significant for women aged 30 years and older than for those aged below 30 years; however, their

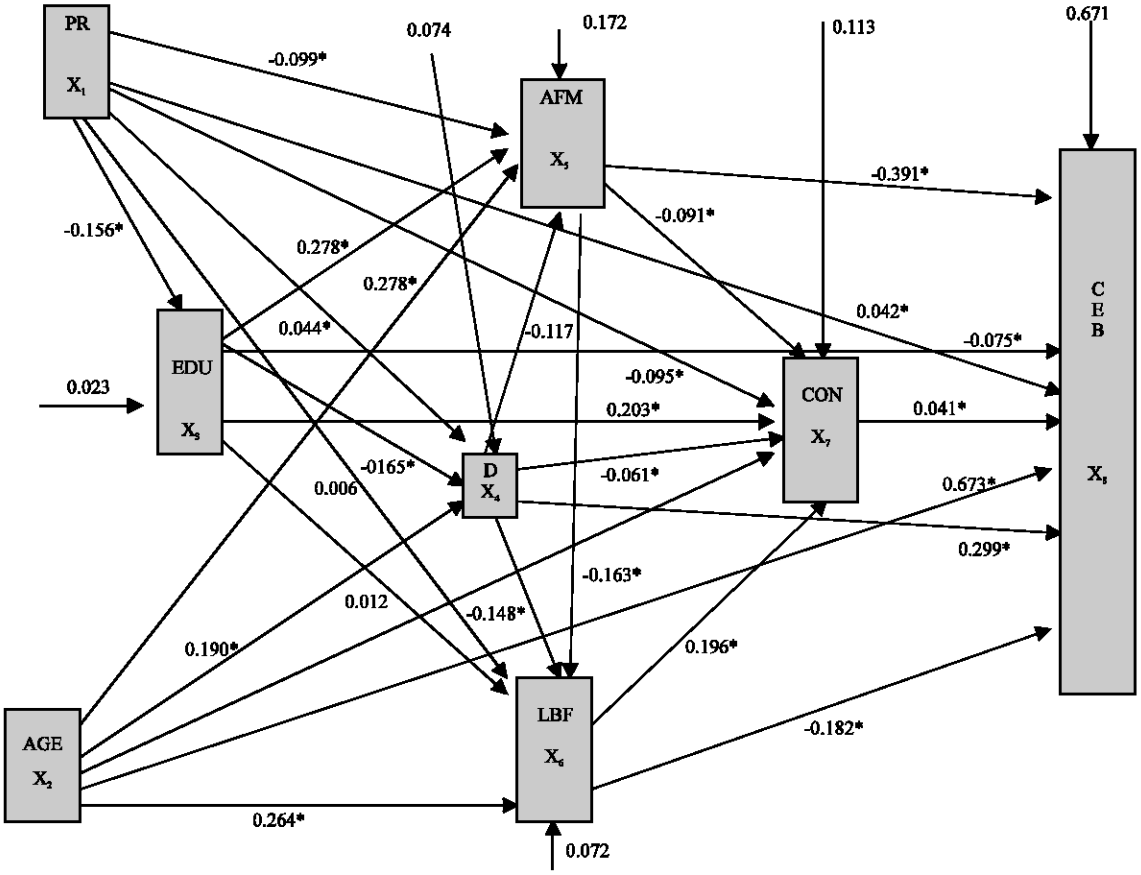

Fig. 4: Path diagram showing the influence of various factors on fertility for women aged below 30 years, Bangladesh 2004. *Denotes significant path co-efficient; PR: Childhood Place of Residence, AGE: Current Age of wife, EDU: Wife's Education , D: Proportion Dead children, AFM: Age at First Marriage, LBF: Length of Breast-Feeding, CON: Contraceptive use and CEB: Children Ever Born

Table 6: Effects of variables used in the path model for explaining fertility of ever married women (under 30 years)

Endogenous variable	Exogenous variable	Direct effect	Indirect effect via					Total effect	Total association
			X_3	X_4	X_5	X_6	X_7		
X_8	X_1	0.673	-0.011	0.015	0.033	0.014	-0.004	0.089	0.089
	X_2	0.042		0.066	-0.093	-0.065	0.005	0.586	0.603
	X_3	-0.075		-0.343	0.193	0.016	0.009	-0.200	-0.286
	X_4	0.299			0.039	0.010	-0.003	0.345	0.489
	X_5	-0.391				0.059	-0.004	-0.336	-0.256
	X_6	-0.182					0.008	-0.174	-0.038
	X_7	0.041						0.041	0.212

Table 7: Percentage of the total absolute effect on fertility through endogenous variable of ever married women (under 30 years)

Endogenous variable	Exogenous variable	Percentage of indirect effect through					Direct effect
		X_3	X_4	X_5	X_6	X_7	
X_8	X_1	1.46	2.00	4.400	1.860	0.530	89.700
	X_2		24.35	34.317	23.985	0.829	15.490
	X_3		53.93	34.317	2.510	1.415	11.737
	X_4			30.346	2.850	0.854	85.190
	X_5			11.110	12.990	0.880	86.120
	X_6					4.210	95.790
	X_7						100.000

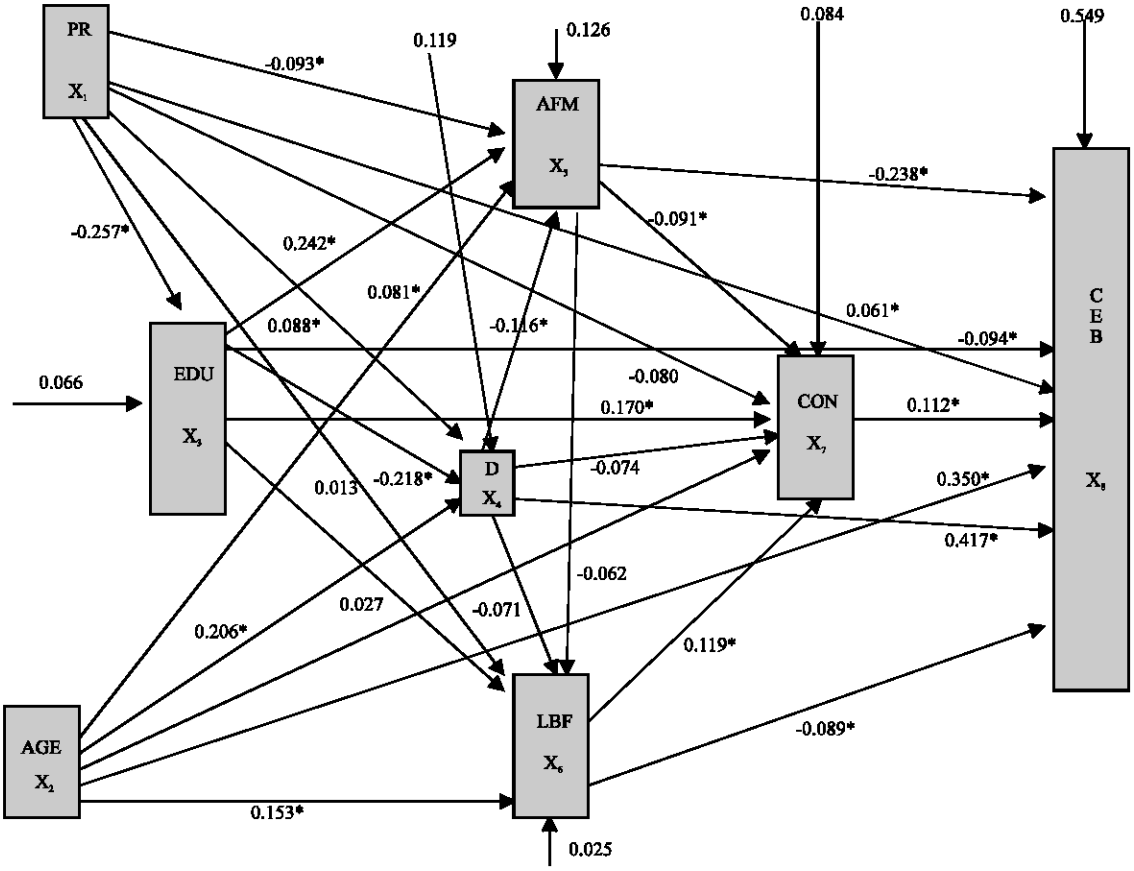

Fig. 5: Path diagram showing the influence of various factors on fertility for women aged 30+ years, Bangladesh 2004. *Denotes significant path co-efficient; PR: Childhood Place of Residence, AGE: Current Age of wife, EDU: Wife's Education , D: Proportion Dead children, AFM: Age at First Marriage, LBF: Length of Breast-Feeding, CON: Contraceptive use and CEB: Children Ever Born

Table 8: Effects of variables used in the path model for explaining fertility of ever-married women (30+ years)

Endogenous variable	Exogenous variable	Direct effect	Indirect effect via					Total effect	Total association	Non-causal Effect (NE)
			X_3	X_4	X_5	X_6	X_7			
X_8	X_1	0.350	-0.186	0.286	0.009	0.001	-0.009	0.173	0.381	0.208
	X_2	0.061		-0.142	0.019	-0.076	-0.008	0.116	0.173	0.057
	X_3	-0.094		-0.107	-0.032	0.055	0.019	-0.160	-0.229	-0.069
	X_4	0.417			0.000	0.053	-0.006	0.491	0.591	0.100
	X_5	-0.238				0.002	0.002	-0.155	-0.301	-0.146
	X_6	-0.089				0.013	0.013	-0.070	-0.023	0.047
	X_7	0.112						0.108	0.041	-0.067

Table 9: Percentage of the total absolute effect on fertility through endogenous variable of ever married women (30+ years)

Endogenous variable	Exogenous variable	Percentage of indirect effect through					Direct effect
		X_3	X_4	X_5	X_6	X_7	
X_8	X_1	22.116	34.007	1.07	0.118	1.070	41.617
	X_2		46.41	6.21	24.800	2.614	19.935
	X_3		34.85	10.40	17.900	6.190	30.618
	X_4			6.00	11.100	1.260	87.605
	X_5				0.826	0.826	98.340
	X_6				11.300	11.300	77.390
	X_7						100.000

signs are in expected directions. Total effects of women's education, age at first marriage and length of breastfeeding are negative while, place of residence, number of dead children and contraception are positive for both cohorts. This indicates that woman with more education have fewer children ever born to them as compared with those having less education, whereas rural women have more children ever born to them as compared with urban counterparts. It is observed that current age of female (X_2) is positively related to fertility for two age cohorts. Its indirect effect on fertility (X_8) through proportion of dead children (X_4) and contraceptive use (X_7) is positive for age under 30 years and through age at first marriage (X_5) is positive for age cohort 30 years and older.

For age cohort below 30 years (Table 6), place of residence (X_1) has total positive effect 0.089 on fertility (X_8), of which about 2% is mediated through proportion of dead children, 1.86% is mediated through length of breastfeeding and 4.4% is mediated through age at first marriage in the same direction, about 1.46 and 0.53% are mediated through women's education and contraceptive use respectively, in the opposition direction. Women's current age has total positive effect 0.586 on fertility of which 24.35 and 0.829% are mediated through proportion of dead children and contraceptive use respectively, in the same direction, 34.3 and 23.99% are mediated through age at first marriage and length of breastfeeding, respectively in the opposite direction. Women's education has total negative effect -0.200 on children ever born or fertility of which 53.93% is mediated through proportion of dead children in the same direction, while 30.4, 2.51 and 0.85% are mediated through age at first marriage, length of breastfeeding and contraceptive use, respectively in the opposition direction. Proportion of dead children has 0.345 positive total effect on fertility of which 11.11 and 2.85% are mediated through age at first marriage and length of breastfeeding, respectively in the same direction, while 0.85% is mediated through contraceptive use in the opposition direction. Age at first marriage has -0.336 negative total effect of which 0.88% is mediated through contraceptive use in the same direction while, 12.99% is mediated through length of breastfeeding in the opposite direction. Length of breastfeeding has -0.174 negative total effect of which 4.21% is mediated through contraceptive use in the opposite direction.

On the other hand, for age cohort 30 years and older (Table 8), place of residence (X_1) has total positive effect 0.173 on fertility, of which about 34, 1 and 0.118% are mediated through proportion of dead children, age at first marriage and length of breastfeeding, respectively in the same direction while 22.11% is mediated through women's education in the opposite direction. Women's current age has 0.116 positive total effects on fertility of which 6.21% is mediated through age at first marriage in the same direction while 46.4, 24.8 and 2.6% are mediated through proportion of dead children, length of breastfeeding and contraceptive use, respectively in the opposite direction. Women's education has -0.160 negative total effects of which 34.85 and 10.4% are mediated through proportion of dead children and age at first marriage respectively in the same direction while 17.9 and 6.19% are mediated through length of breastfeeding and contraceptive use respectively in the opposite direction. Proportion of dead children has 0.491 total positive effect of which 11.1% is mediated through length of breastfeeding in the same direction and 1.26% is mediated through contraceptive use in the opposite direction. Age at first marriage has -0.155 negative total effect on fertility of which 0.826% is mediated through both length of breastfeeding and contraceptive use in the opposite direction. Length of breastfeeding has -0.070 total effect of which 11.3% is mediated through both length of breastfeeding and contraceptive use in the positive direction.

Place of residence shows fertility increasing effect through age at first marriage because age at marriage in the rural areas of Bangladesh is very low and early female marriage results in large families. Place of residence shows fertility decreasing effect through women's education for two age cohort.

CONCLUSION AND RECOMMENDATIONS

For both cohorts, women's education, age at first marriage and length of breastfeeding are found to have significant direct negative effects while, the place of residence and the number of dead children have significant direct positive effects on the number of children ever born. Thus, raising the age at marriage by implementing a minimum-age marriage law is likely to lower fertility on a national scale. Encouraging women to breastfeed their children for a relatively longer duration may also contribute to a reduction of fertility. Fetal loss appears to have a significant direct positive effect on fertility in Bangladesh, which means that mothers who have experienced children dead are found to have higher fertility. Mothers always try to replace their dead child as early as possible. Such behavior is a result of social fear about the survival of children.

The total effect of female education on fertility is found to be negative influence on fertility. Education may provide better employment opportunities outside the home and age at marriage can be raised by providing education to females, especially at the secondary and higher levels.

Thus, some policies can be drawn from this study as they relate to the achievement of further fertility decline are as follows. There is need to:

- Campaign for a further increase in the age at marriage of women, especially in rural areas
- Encourage efforts to increase the quality and the quantity of contraceptive use to achieve higher use-effectiveness that will lead to a greater contribution to fertility decline
- Provide a method mix that meets the varied needs of couples
- Increase programme efforts to maintain current performance levels
- Ensure the commitment of additional resources to maintain current programme momentum

More notably, attention should be focused on the need for providing educational facilities, particularly, among women in rural areas in order to depress the level of fertility in Bangladesh.

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