DEDUCTION OF CORRELATED VARIABLES AS THE DETERMINANTS OF CONTRACEPTIVE USE IN BANGLADESH: AN APPLICATION OF FACTOR ANALYSIS

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Abstract- Bangladesh is facing various problems for high and rapid population growth. The high population growth is a great obstacle to the socio-economic progress of the country. The government has given importance to reduce the rapid growth of population and employing all its efforts for the success of population control and family planning program. This paper has been made an attempt to investigate the determinants of contraceptive use in Bangladesh adopting factor analysis and logistic regression model using the nationwide Bangladesh Demographic and Health Survey data. Specifically, factor analysis is performed as a data reduction technique to extract a small number of factors instead of a large number of correlated variables and then multiple logistic regression method is applied to identify the significant determinants of contraceptive use. The factor analysis extracted two factors viz., current status of marriage, age, & birth (F_1)- consisted of the variables respondent's age, partner's age, marital duration, and number of living children; and inception status of marriage & birth (F_2)- consisted of the variables age at marriage and age at 1st birth. These two factors were used in the subsequent analysis instead of the six demographic variables. The logistic regression analysis indicates that region, type of place of residence, religion, respondent's working status, partner's occupation, exposure to media, involvement with NGO, source of FP, 'current status of marriage, age, & birth' and 'inception status of marriage, & birth' have had significant influence on contraceptive use in Bangladesh.

Keywords- Contraceptive use, Data reduction, Factor Analysis,

I. INTRODUCTION

A substantial increase in population growth all over the world has drawn attention of demographer, policy makers and other social scientists over the last few decades. In 1950 the size of the world population was 2.5 billion (Bongaarts and Bulatao, 1999), which increased to 6.4 billion in 2004 (US Census Bureau). Such a rapid growth of population throughout the world has increased concern of all because of its intricate relationship with socio-economic development of a society or country. Almost all the developing countries are confronted with unchangeable condition like huge population, a limited amount of arable land and natural resources, low level of literacy, a large percentage of unskilled/ dependent manpower (Islam, 2001).

Bangladesh is most densely populated country with more than 900 people per square kilometer (BBS, 2003) that makes it the 9th most populas country in the world. At the beginning of the twenty century the population of this country was only 30 million with growth rate of less than 1 per cent per annum, while it increased about 140 million at the beginning of twenty first century with current growth rate of about 1.5 percent per annum (Bairagi and Datta, 2000; BBS, 2003).

Bangladesh has a glorious history of reducing total fertility rate. The total fertility rate declined sharply from 6.3 to 3.0 during 1971-2004 (Islam and Islam, 1993, Micheal et al 2006). It is evident that contraceptive play a vital role in controlling a fast growing population. The contraceptive prevalence rate in Bangladesh has steadily grown from 8% to 58% during 1975 to 2004 for currently married women (Ministry of Health and Family Welfare, 1978; UNPD, 2005). Several studies have also shown that the only factor contributing much to the recent fertility decline in Bangladesh is the increasing use of contraception (Cleland et al., 1994; Amin et al., 1994; Raeside and Khan, 1997, 1998). Though the use of contraception increase considerably over the past few decades, however, it is not sufficient to reach the Millennium Development Goals regarding replacement level of fertility. This is in fact because the individual's tastes, interests, behaviors, etc. differ from one unit to another within each level and due to variability among various socioeconomic factors like religion, culture, income, place of residence, education, occupation, mass media, administrative and social facilities, and so on. To make the contraceptive use sustainable and to make effort to reach the replacement level of fertility, it is necessary to investigate the factors that influence the contraceptive use. It is observed that several variables are interrelated with each other and thus it is necessary to utilize the multivariate technique to minimizing the number of correlated variables. The objective of the study is to identify the determinants of contraceptive use in Bangladesh by reducing the correlated variables from several individual and other socio-economic characteristics.

II. DATA AND METHODOLOGY

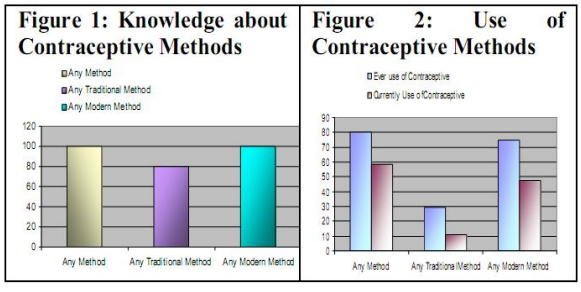
This study utilizes the data of 11,440 ever-married women in the age group 10-49 extracted from nationally-representative Bangladesh Demographic and Health Survey (BDHS) 2004. The BDHS was

designed to collect data on fertility, family planning, infant and child mortality, and maternal and child health as a part of the worldwide Demographic and Health Surveys program. The details about BDHS-2004 can be seen in NIPORT et al. (2005).

The determinants of contraceptive use can be identified by using logistic regression model since the dependent variable is dichotomous. Due to the inclusion of a large number of covariates in an analysis the multicollinarity problem may arise. Therefore, it will be convenient, if we reduce the large number of covariates into a smaller number of manageable levels. To meet the purpose factor analysis is carried out to reduce the selected correlated variables into a few factors. The factor analysis will obviously help to reduce the multicollinearity problem in developing the multiple logistic regression model. Thus, the study investigates the determinants of contraceptive use in Bangladesh adopting factor analysis and logistic regression model. Specifically, factor analysis is performed as a data reduction technique to extract a small number of factors instead of a large number of correlated variables and then multiple logistic regression method is applied to identify the significant determinants of contraceptive use. The factor analysis is performed using the principal component method with varimax rotation to facilitate interpretability of the factors.

III. RESULTS AND DISCUSSION

Knowledge of ever-married women regarding the family planning methods is widespread in Bangladesh and all the respondents have knowledge of at least one modern method of family planning, though 80% have knowledge on any traditional method (Figure 1). The use of contraceptive was much higher: about 58% currently married women are the current user of any contraceptive method and about 47% are the user of any modern method (Figure 2).



3.1 Factor Analysis

Since the variables in factor analysis need to be appropriately measured on an interval or ratio scale hence respondent's age, partner's age, age at marriage, age of respondent at 1st birth, marital duration and number of living children are selected for factor analysis. The factors are extracted by principal component analysis with varimax rotation method. On the basis of the value of the eigen value and percentage of variation, Table 2 leads that first two factors accounted for 84% of the total variation. Factors 3 through 6 have eigen values less than 1, and therefore explain only 16% of the total variation. Therefore, the first two factors are retained; the other factors are not included in the model.

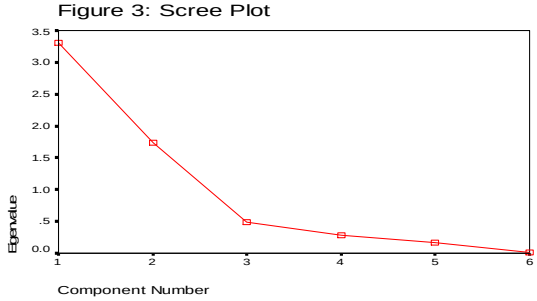
Table 2: Total Variance Explained

Component	Eigen values	Percentage of Variance	Cumulative percentage
1	3.31	55.12	55.12
2	1.74	28.99	84.11
3	0.49	8.13	92.24
4	0.28	4.70	96.94
5	0.17	2.83	99.78
6	0.01	0.22	100.0
KMO		0.58	
Bartlett's Test of Sphericity		Approx. Chi-Square	71838.77
		Sig.	0.00

Extraction Method: Principal Component Analysis.

A graphical method, scree test, is also used for determining the number of factors. The eigen values are plotted in the sequence of principal factors. The number of factors is chosen where the plot levels off to a linear decreasing pattern. The figure below also suggests that the first two factors are responsible for most of the variation.

Figure 3: Scree Plot



The communalities (Table 3) for the variables respondent's age and marital duration are fairly high (.953 and .934 respectively), indicates that about 95 percent variation of respondent's age and 93% variation of the marital duration are explained by the two factors. That is to say, most of the variances for these two variables are accounted for by the two factors. The proportion of variance explained by the factors is minimum (63 percent) for number of living children.

The factor loadings in the component matrix (Table 3) are correlations of the variables with the factors. The factor loadings those are greater than 0.50 (ignoring the sign) are retained. These large and moderate loadings indicate how the variables are related to the factors.

In addition it is seen that among the 95 percent variation of respondent's age explained by these two factors (F1 and F2), factor F_1 alone explained 93.89 ($969^2 \times 100$) percent variation. Similarly about 82, 92 and 57 percent variation of partner's age, marital duration and number of living children respectively are explained by factor F_1. Again factor F_2 explains 86 and 82 percent variation of age at first birth and

age at marriage respectively. Therefore the variables respondent's age, partner's age, marital duration, and number of living children are related strongly to factor F_1 and thus instead of using four variables we can use F_1 as manifest variable. Similarly, we can say that factor F_2 can be extracted instead of variables age at 1st birth and age at marriage.

Table 3. Factor loadings and communality values, Rotated Component Matrix

Variables	Factor		Communality Value
	F_1	F_2	
Respondent's age	0.969		0.953
Partner's age	0.910		0.830
Age at marriage		0.907	0.840
Age at 1st birth		0.927	0.861
Marital duration	0.958		0.933
Number of living children	0.756		0.628

Therefore factor F_1 correlates with the current status of marriage, age, & birth and factor F_2 correlates with the inception status of marriage & birth. The factor scores are the values of the variables current status of marriage, age, & birth and inception status of marriage & birth for each of the individual. We use the regression method to the factor scores.

3.2 Determinants of Contraceptive Use: Using Logistic Regression Model

Using factor analysis we extracted two factors and the factor scores are used in logistic regression analysis instead of six demographic variables. Since the factor scores are continuous in nature we categorized them using the sense that lower the value of the factors the lower the value of the variables, which are shown in Appendix Tables 1 and 2. The tables display the mean value of the variables at the different categories of the factor scores. For example the respondent's mean age were found 23.81, 38.10, and 47.34 when factor F_1 categorized as -1.98 to 0, 0 to 2, and 2 to 3.0 respectively (Appendix Table 1). Again the mean age at marriage and mean age at 1st birth were about 15 and 17 respectively when factor F_2 take the value -1.99 to 4 and mean value of these two variables were 27 and 30 respectively when factor F_2 takes value 4 to 8.52 (Appendix Tables 2).

Table 4 shows the estimated regression coefficients along with the standard error and odds ratio from the logistic regression model of contraceptive use. The results indicate that all the covariates included in the model (region, type of place of residence, religion, respondent's working status, educational attainment, wealth index, partner's occupation, exposure to media, involvement with NGO, source of FP, current status of marriage, age, & birth and inception status of marriage & birth') had significant effect on contraceptive use except educational attainment and wealth index. The variation of impacts of selected covariates on contraceptive use in terms of relative risks is discussed below:

The location/region plays a dominant role in contraceptive use (Omar et al., 2007). The result of the logistic regression model indicates a very significant variation in the likelihood of contraceptive use by region (Table 4), may be because of the difference of culture, taste, religious faith and socio-economic condition. The findings indicate that the likelihood of contraceptive use was 1.72 times more in Rajshahi division than Dhaka division, followed by Khulna division (1.3 times). Sylhet division has the worst performance in contraceptive use as the odds ratio was found only 0.35 in comparison with Dhaka division. Chittagong and Barisal divisions also show the lower performance of contraceptive use than Dhaka division, but significantly higher than the Sylhet division. Earlier studies also documented the low use of contraceptive in Chittagong division, which was inclusive of Sylhet division (Rashid and Ali, 1993). The widespread religious ideologies against contraceptive use (Sabina, 1999), lower involvement with NGO, poor access to work outside may be the reasons which leads the Sylhet division as a lowest user of contraceptive method. On the other hand highest number of women engaged in outside work, larger number of women involves with NGO and access to media may be the reasons that make the Rajshahi the highest user of contraceptive method.

The analysis shows that place of residence plays an important role in current use of contraceptive methods. Compare to rural areas the likelihood of using contraceptive method was significantly higher in urban areas (20% more). Urban women may be more likely to use modern methods than rural women because of greater access to modern methods in urban areas. Other reasons may be the desire for smaller families among urban couples (Hamill et al., 1990) and lower educational levels in rural women (Gajanayake, 1989).

Religion is another important factor that works alone in predicting women's perception of fertility regulation. Muslim women are comparatively less likely to regulate their fertility than the non-Muslim women (Kalam and Khan, 2002). The results indicate that Muslim women were significantly 30 percent less likely to use contraceptive than the non-Muslim. Higher level of education of women has been found to be associated with greater acceptance of contraceptive use (Ullah & Chakrborty, 1993; Khan, 1997; Raeside and Khan, 1997). It appears from the results of logistic regression analysis that the risk of contraceptive use did not vary significantly according to the educational attainment of the women. Female autonomy is another vital factor in increasing the contraceptive prevalence rate.

The findings reveal that respondents' working status is strong covariates of contraceptive use. The risk of contraceptive use is 1.2 times greater among the working women than the women who did not work outside. Kalam and Khan (2002) documented that woman who are working regularly or seasonally are more widely practicing contraception than women who are not working. The results of Table 4 depicts

that the women whose husband were engaged in job/service had 48% more likely to use contraception than the women whose husband was manual worker. In addition, the women whose husband did not do any work had 9 percent less risk to use contraception than reference category. Wealth index plays an important role in determining the economic and livelihood condition of a household. The results indicate that wealth index did not put any significant impact on the use of contraception. Exposure to media is appeared to be a strong predictor of contraceptive use. The odds ratios were obtained 1.3, 1.4, and 1.4 for the women who had access to one media, two media, and three media respectively than those who do not had access to any media. Membership with NGO is a positively associated with contraceptive use (Mohsena and Kamal, 2007). The risk of contraceptive use was found 40% higher among the women who were the member of any NGO than those who did not involve with any NGO. The risk of contraceptive use was found to vary significantly according to the source of family planning methods. The women who collect the family planning method from NGO/private family planning clinic/private doctor had 72 percent more likely to use contraception than those who had collects from public sectors (mainly hospital, government health centre/clinics, field worker).

Factor F_1, current status of marriage, age, & birth obtained from the factor analysis is appeared to be a strong predictor of contraceptive use. The women with factor score -1.975 to 0 were 2.94 times more likely to use contraceptive method than the reference category. That is women whose average of age, partner's age, marital duration, and number of living children are 24 years, 32 years, 2 years, and 2 respectively are 2.9 times more likely to use contraceptive method than those women whose average of age, partner's age, marital duration and number of living children are 38 years, 48 years, 5 years and 4 respectively. On the other hand, the risk of contraceptive use was found 4.6 times higher for the women with factor score 0-2 than reference category.

The factor F_2, inception status of marriage & birth is another significant indicator of contraceptive use. It is found that the respondents with factor scores 1.99 to 4 had 2.03 times more likely to use contraceptive method than those of with factor score 4 to 8.52. That is to say women with mean age at marriage and mean age at 1st birth 15 and 17 years respectively had two times more likely to use contraceptive method than those whose mean age at marriage was 27 and mean age at 1st birth was 30 respectively.

Table 4: Determinants of Contraceptive Use by Multiple Logistic Regression Model

Covariates/Predictors	Coefficient (β)	S.E (β)	P-value	Relative risk
Region				
Barishal	-0.12	0.097	0.200	0.88
Chittagong	-0.46	0.065	0.000	0.63
Rajshahi	0.54	0.063	0.000	1.72
Khulna	0.26	0.077	0.001	1.29
Sylhet	-1.05	0.101	0.000	0.35
Dhaka (R)	-	-	-	1.00
Type of place of residence				
Urban	0.18	0.061	0.003	1.20
Rural (R)	-	-	-	1.00
Religion				
Muslim	-0.36	0.080	0.000	0.70
Non Muslim (R)	-	-	-	1.000
Educational attainment				
Attain primary or secondary	0.05	0.053	0.350	0.95
Higher	0.11	0.136	0.410	1.12
No education (R)	-	-	-	1.00
Respondent's working status				
Working	0.20	0.058	0.001	1.22
Not working (R)	-	-	-	1.00
Partner's occupation				
Not working	-0.10	0.151	0.531	0.91
Prof., tech., manager	0.39	0.141	0.006	1.48
Agriculture	0.43	0.056	0.000	1.54
Other	0.47	0.061	0.000	1.60
Manual worker (R)	-	-	-	1.00
Wealth index				
Poor	-0.06	0.061	0.358	0.95
Middle	-0.04	0.066	0.519	0.96
Rich (R)	-	-	-	1.00
Exposure to media				
1media	0.26	0.059	0.000	1.30
2 media	0.36	0.064	0.000	1.43

3 media	0.37	0.105	0.000	1.44
No media (R)	-	-	-	1.00
Involvement with NGO				
Belong to NGO	0.32	0.051	0.000	1.38
Do not belong to NGO (R)	-	-	-	1.00
Source of FP				
NGO and Private	0.54	0.054	0.000	1.72
Other(Shop, friend, relative, etc)	-0.22	0.097	0.026	0.81
Public (R)	-	-	-	1.00
Current status of marriage, age & birth				
-1.98 to 0	1.08	0.165	0.000	2.95
0 to 2	1.52	0.164	0.000	4.59
2 to 3.0 (R)	-	-	-	1.00
Inception status of marriage & birth				
-1.99 to 4	0.707	0.288	0.014	2.03
4 to 8.52 (R)	-	-	-	1.00
Constant	-1.321	0.347	0.000	
(R) reference category;				

CONCLUSIONS AND RECOMMENDATIONS

The factor analysis is performed as a data reduction technique to extract a small number of factors instead of a large number of correlated variables to identify the significant determinants of contraceptive use. The factor analysis extracted two factors viz., current status of marriage, age, & birth (F_1) - consisted of the variables respondent's age, partner's age, marital duration, and number of living children; and inception status of marriage & birth (F_2)- consisted of the variables age at marriage and age at 1st birth. These two factors were used in the multiple logistic regression model instead of the six demographic variables. The logistic regression analysis indicates that region, type of place of residence, religion, respondent's working status, partner's occupation, exposure to media, involvement with NGO, source of FP, 'current status of marriage, age, & birth' and 'inception status of marriage & birth' have had significant influence on contraceptive use in Bangladesh.The methodologies used in this study may open new avenue for the researchers regarding the application of factor analysis in the demographic issues. The findings of this study may help the policy makers to address the issues where intervention is necessary in order to increase in contraceptive use and hence to gain success in family planning programs to reduce the population growth rate in Bangladesh.

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Appendix

Appendix Table 1: The mean value of the variables at the different categories of the factor F_1

Factor	Variable*			
Current status of marriage, age, & birth	Respondent's age	Partner's age	Marital duration	Number of living children
-1.975 to 0	23.81 (4.35)	32.83 (5.69)	2.27 (.92)	1.90 (.93)
0 to 2	38.10 (5.43)	48.37 (7.64)	5.22 (1.15)	3.85 (1.55)
2 to 3.003	47.34 (1.64)	63.13 (7.67)	6.97 (.27)	6.98 (1.69)

* The values within the parenthesis displaying the standard deviations.

Appendix Table 2: The mean value of the variables at the different categories of the factor F_2

Factor	Variables*	
Inception status of marriage & birth	Age at marriage	Age at 1st birth
-1.989 to 4	14.65 (2.30)	17.19 (2.84)
4 to 8.521	26.89 (3.71)	30.17 (3.81)

* The values within the parenthesis displaying the standard deviations

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