Factors associated with pregnancy complications during antenatal period: an extended GEE approach

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FACTORS ASSOCIATED WITH PREGNANCY COMPLICATIONS DURING ANTENATAL PERIOD: AN EXTENDED GEE APPROACH

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ABSTRACT

The purpose of the paper is to examine the factors affecting pregnancy complications during antenatal period of mothers. The study uses data which have been repeated over time i.e., the nature of the data is longitudinal in type. Thus the generalized estimating equation (GEE) method has been employed to identify the factors associated with the pregnancy complications which constitute binary response. The study reveals important findings. Among others, education of mothers, taking special food during pregnancy and desired index pregnancy are found to be negatively associated with pregnancy related complications i.e., lower risk of complication. Patients visit to health workers during antenatal period is positively associated with identifying the causes of pregnancy related complications. Female literacy and maternal morbidity are intertwined in an inverse relationship i.e., improving the former will reduce the latter. Educated women take better care of themselves. It improves their economic power and ensures a better social and legal status. Pregnant women should take special food in order to get rid of pregnancy related complications.

Key words: GEE, Maternal morbidity, Follow-up Data.

I. INTRODUCTION

Reproductive morbidity is any morbidity or malfunction of the reproductive tract or any morbidity that is a consequence of reproductive behavior including pregnancy, abortion, childbirth or sexual behavior. Mortality tells us only a part of the story but morbidity uncovers many other aspects and tells us how pregnancy related complications affect quality of life of women. Indeed, reducing maternal morbidity can play a very significant role in lowering maternal mortality. Higher morbidity in delivery and postpartum period is the consequence of maternal morbidity in antenatal period and brings irreversible sufferings like maternal mortality. Controlling maternal morbidity in antenatal period is the key aspect that could bring happy results like lowering maternal mortality to irreducible minimum. In this paper, an attempt has been made to identify the risk factors that are responsible for maternal morbidity in antenatal period.

In 1983, an estimate of maternal mortality in Tangail was reported at 56.6 per 10,000 live births where abortion-related deaths contribute nearly 10 deaths per 10,000 live births and the major causes of maternal mortality were found to be obstructed labor, sepsis caused by improperly performed abortion, age and parity [1]. Akhter estimated the prevalence of national antenatal morbidities which are bleeding (2.7 percent), fits/convulsion (3.0 percent), oedema (22.7 percent), hypertension (3.6 percent), fever more than 3 days (16.9 percent), excessive vomiting (19.3 percent), urinary problem (29.3 percent), varicose veins (7.3 percent), hepatitis/jaundice (5.9 percent), rheumatic heart disease (5.0 percent) and malaria (3.2 percent) and tuberculosis (0.3 percent) [2]. From the study, the risk factors for antenatal morbidity are identified as maternal age, number of pregnancy, parity, heavy physical work load, socio-economic condition and education status. About 95 percent deliveries usually take place at homes and nearly 71.4 percent live births reported to have no

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antenatal care during pregnancy in Bangladesh [3]. According to the same study, only 16 percent of the deliveries received assistance from trained personnel (doctor, nurse/midwife and trained traditional birth attendant). The most common cause of maternal death at the national level was postpartum hemorrhage and eclampsia was found to be a major cause of maternal deaths in Medical College Hospitals study [4, 38]. Chen et al. in their first study estimated that the maternal mortality in rural Bangladesh was 7.1 per thousand pregnancy terminations or 7.7 per thousand live births [5]. In the second study, the maternal mortality rate was 5.2 per thousand reported pregnancy terminations or 5.7 per thousand live births. In the same study, the causes of maternal death during antenatal period are identified as eclampsia, hemorrhage, obstructed labor, ectopic pregnancy, induced abortion and indirect obstetric. In rural Bangladesh, injuries (domestic and traffic accidents, drowning and snake-bites) and violence (homicide, suicide and lethal complications of induced abortion) accounted for almost 31 percent of all deaths among women aged 15-19 years [6]. Fauveau (1993) concluded that approximately 15,000 to 30,000 cases of maternal tetanus occur each year in the world [7]. The study suggested that complete coverage of reproductive-aged women by tetanus toxoid is the most cost-effective way to eliminate maternal tetanus - the often neglected cause of maternal death. Fauveau et al. (1991) showed that maternal survival can be improved by posting midwives at village level, giving them proper training, means, supervision and back-up support [8]. Maternal mortality in Matlab, Bangladesh in 1985 was estimated at 5.5 per 1,000 live births [9,37]. It was also found that family planning program is a moderate but significant cause of reduction in maternal mortality rates. Li et al. (1996) showed that both in developing countries and the United States, over 60 percent of maternal deaths occurred in the postpartum period; nearly 45 percent of postpartum deaths occurred within 1 day of delivery, more than 65 percent within 1 week and most importantly over 80 percent within 2 weeks [10]. It was also showed that in developing countries, nearly 80 percent of postpartum deaths caused by obstetric factors occurred within 1 week. In developing countries, hemorrhage, pregnancy-induced hypertension complications and obstetric infection are the commonest causes of postpartum deaths. Measham et al. (1981) estimated a figure of 7,80,000 abortions in Bangladesh in 1978 and 7800 deaths in that year from abortion complications [11]. The study also gives the proportion of complicated abortions resulting in death which was the lowest for medically approved procedures (4.9 percent) and highest for vigorous physical activity (100 percent) and abdominal pressure (66.7 percent), although the last two together accounted for only 2.3 percent of abortion procedures. Maine et al. (1996) in their study found that the decline in maternal mortality in Matlab, Bangladesh was the result of functioning of the government hospital in Chandpur where cesarean facilities and blood transfusions were available [12]. Midwives might also have made a special contribution by providing early termination of pregnancy which is legal in Bangladesh. Rochat et al. (1981) infer that safe and effective fertility control, including abortion performed by adequately trained health workers in both in- and out-patient facilities, might be the most appropriate first step in preventing pregnancy-related deaths in Bangladesh [14]. According to Rao, anemia was responsible for 25 percent of these maternal deaths in India while eclampsia, sepsis, hemorrhage and abortion accounted for the rest [17]. In Karnataka, India, approximately 33 percent of all women reported at least one gynecological morbidity; the most common were a feeling of weakness and tiredness (suggestive of anemia); menstrual disorders; white or colored vaginal discharge (suggestive of lower reproductive tract infection); and lower abdominal pain and discharge with fever (suggestive of acute pelvic inflammatory disease) [18]. This study found that women who delivered their last child in a private institution were significantly less likely to report symptoms than those who delivered at home or in government hospital. Nonusers or users of reversible contraceptive methods were also less likely to report symptoms of morbid conditions than the sterilized women. Mcdonagh (1996) in his paper cast doubt about the effectiveness of antenatal care and suggested to develop a domiciliary midwifery service supported by appropriate local efficient obstetric service [19]. Choolani et al (1993) presented that maternal mortality levels in developed countries have reached an almost irreducible minimum and is only 1 percent of the global sum [20]. Better socio-economic conditions, better opportunities for women, better availability, distribution and utilization of resources, higher institutional deliveries and a commitment to constantly review and improve maternity services have led to this happy situation. Kulier et al. (1998) concludes that routine calcium supplementation is a promising intervention for pregnant women at risk of developing pre-eclampsia or having low calcium intake and recommend routine iron and folate supplementation during antenatal care in populations with high incidence of nutritional anemia [21]. The symptoms of emergencies in pregnancy-induced hypertension are intense headache, acute epigastric pain, sudden blurring or loss of vision or pulmonary oedema and eclampsia [22]. In a recent study, Islam et al. (1994) identified the factors affecting complications during different stages of childbearing in Bangladesh. These are antenatal visits, economic status, whether the index pregnancy was desired or not and number of pregnancies prior to the index pregnancy [23]. The study also revealed that the women who suffer from one or more of the major complications during pregnancy are expected to have a substantially higher risk of suffering from complications during postpartum period.

Longitudinal studies are eminently being undertaken in the health sciences due to their richness and flexibility in analyzing various types of data. The responses in a longitudinal study are usually positively correlated. But unfortunately longitudinal data are rarely available in developing countries and hence use of advanced statistical analysis was almost impossible. Moreover, in analyzing longitudinal data, the dependence must be taken into account to avoid misleading inferences. We choose the recently developed methodology called generalized estimating equation (GEE). This is an important and widely used approach in such analysis that does not require the complete specification of the joint distribution of repeated measurements. In addition, GEE takes the working correlation among the repeated observations into account which results in attaining more efficiency in estimating parameters of marginal models. Zeger et al. discussed the analysis of binary longitudinal data with time-independent covariates [33]. They considered extensions of logistic regression to the case where the binary outcome variable is observed repeatedly for each subject. In another paper, Linag and Zeger (1986) extended the use of generalized linear models to repeated measures data [34]. They examined the analysis based on specifications for means and variances of the observations as usual for generalized linear models, but showed how specifications for the correlation between measurements made on the same unit could be avoided by using a working correlation matrix. Liang and Zeger (1986) and Prentice (1988) have developed the moment based on GEE [30,34]. In their generalized estimating equations, both estimated the parameters associated with the expected value of an individual's vector of binary responses as well as the correlation between pairs of binary responses at pairs of times with the odds ratio. Lipsitx et al. (1991) modified the estimating equations of Prentice to estimate the odds ratios [35]. Lipsitz, Kim and Zhao (1994) extended Liang and Zeger's method to study for the correlation between repeated nominal or ordinal categorical responses [36].

II. METHODS AND MATERIALS

Methods

Generalized Estimating Equation (GEE)

Suppose we have a random sample of observations from n individuals. For each individual i, we have a vector of responses $Y_i = (Y_{i1,} \cdots, Y_{in_i})'$ and corresponding covariates $X_i = (X'_{i1}, \cdots, X'_{in_i})$, where each Y_{ij} is a scalar and X'_{ij} is a p-vector. In general, the components of Y_i are correlated but Y_i and Y_k are independent for any $i \neq k$ (conditional on the covariates). We use $D = \{(Y_1, X_1), \cdots, (Y_n, X_n)\}$ to denote the data at hand. To model the relation between the response and covariates, one can use a regression model similar to the generalized linear model, $g(\mu_i) = X_i \beta$, where $\mu_i = E(Y_i | X_i)$, g is a specified link function, and $\beta = (\beta_1, \cdots, \beta_p)'$ is a vector of unknown regression coefficients to be estimated.

The GEE approach estimates β through solving the following estimating equations (Liang and Zeger, 1986):

$$S(\beta; R, D) \equiv \sum_{i=1}^{n} D_i' V_i^{-1} (Y_i - \mu_i) = 0 \qquad (1)$$

Where $D_i = D_i(\beta) = \partial \mu_i(\beta) / \partial \beta'$ and V_i is a working covariance matrix of Y_i. V_i can be expressed in terms of a working correlation matrix

$R = R(\rho)$, $V_i = A_i^{1/2}\, R(\rho)\, A_i^{1/2}$, where A_i is a diagonal matrix with elements $\mathrm{var}(Y_{ij}) = \phi V(\mu_{ij})$, which is specified as a function of the mean μ_{ij}. The ρ may be some unknown parameters involved in the working correlation structure, which can be estimated through the method of moments or another set of estimating equations.

An attractive point of the GEE approach is that it yields a consistent estimator of $\beta, \hat{\beta}$, even when the working correlation matrix **R** is misspecified (Liang and Zeger, 1986). For instance, it is often convenient to use a working independence model where R =I. Some other popular choices include compound symmetry (CS) (i.e., exchangeable) with $R_{ij} = \rho$ for any $i \neq j$ or first-order autoregressive (AR-1) with $R_{ij} = \rho^{|i-j|}$, where R_{ij} denotes the $(i,j)^{th}$ element of R. Due to its simplicity, the working independence model is attractive. Many studies have shown that $\hat{\beta}$ obtained under the independence model is relatively efficient (Zeger, 1988; McDonald, 1993), at least when the correlation between responses is not large. Another compelling reason for using the working independence model is in partly conditional modeling of means for longitudinal data (Pepe and Anderson, 1994). However, for time-varying or cluster-specific covariates, Fitzmaurice (1995) showed that the resulting estimator from the independence model may be very inefficient; its efficiency may be as low as 60% compared with the estimator obtained by using the correct correlation structure.

Materials

Data

This study employs data from the survey on Maternal Morbidity in Bangladesh. The survey was conducted from November 1992 to December 1993 by the Bangladesh Institute for the Research for Promotion of Essential and Reproductive Health Technologies (BIRPERHT). The data were collected using both cross-sectional and prospective study designs. This study is based on the data from the prospective component of the survey. A multistage sampling design was used for collecting the data for this study. Districts were selected randomly in the first stage, one district from each Division. Then Thanas were selected randomly in the second stage, one Thana from each of the selected Districts. At the third stage, two Unions were selected randomly from each selected Thana. The subjects comprised of pregnant women with less than 6 months duration in the selected Unions. All the selected pregnant women from the selected Unions werefollowed on regular basis (roughly at an interval of 1 month) throughout the pregnancy. Again, the subjects were followed at the time of delivery for a full-term pregnancy and 90 days after delivery or 90 days after any other pregnancy outcome. A total of 1020 pregnant women were interviewed in the follow-up component of the study. The survey collected information on socio-economic and demographic characteristics, pregancy-related care and practice, morbidity during the period of follow-up as well as in the past, information concerning complications at the time of delivery and during the postpartum period, etc. Here the number of follow-ups for each individual is not equal. For the present study, the data of first four consecutive antenatal visits is considered and we have 549 such women's information for the analysis. This study makes an attempt to identify the risk factors associated with maternal morbidity in the antenatal period. To identify the morbid cases in the pregnancy period we have considered at least one of the following complications:

Antenatal complications: hemorrhage, edema, excessive vomiting, cough or fever more than three days, burning micturition, fits and convulsion. The explanatory variables considered are: age at marriage, education, economic status, gainful employment, history of miscarriage and abortion, smoking, number of pregnancies prior to the index pregnancy, special food, visit to health worker and desired/undesired pregnancy. Table 1 shows all the explanatory variables and their categories.

III. RESULTS

We have considered the first four consecutive antenatal follow-ups and get 549 women. The response variable can be defined as: Y = 1, if the woman suffers from at least one of the complicacy and 0, otherwise.

Working Independence

When the working correlation matrix is considered as a 4 x 4 identity matrix, we obtain the independence estimating equation as described previously. Table 2 represents the estimates of parameters along with their corresponding standard errors, value of Wald test, p-value and odds ratio.

From the p-values we find that the variables education, taking special food, went to health worker and whether wanted pregnancy are significant at 5 percent level. In terms of odds ratio, we can comment that women with primary or higher education, taken special food during pregnancy, went to health worker and wanted the index pregnancy respectively 0.758 times, 0.799 times, 1.922 times and 0.71 times likely to fall any of the morbid conditions (hemorrhage, edema, excessive vomiting, cough or fever more than three days, burning micturition, fits and convulsion) during pregnancy to their reference counterparts.

Exchangeable Correlation

We discussed the exchangeable correlation structure in the previous section as $R_{ij} = \rho$ for any $i \neq j$. Both the ρ and β (parameters) are estimated simultaneously using Newton-Raphson iteration procedure. Table 3 gives the estimates of parameters, using GEE assuming exchangeable correlation among the repeated observations, and the supporting information for inference.

The values of the Wald test statistic in table 3 represents the significance of education, went to health worker and wanted the index pregnancy at the 5 percent level of significance. Here went to health worker shows positive association on the other hand education and wanted pregnancy show negative association with the complications during antenatal period. From the odds ratio for wanted pregnancy (0.71) we can say that the women wanted pregnancy is 0.71 times likely to develop any of the complication during antenatal period than the women not wanted the index pregnancy.

Similarly the women with primary or higher education are 0.758 times likely to suffer from any of the complication during pregnancy than the women with no schooling. Women went to health worker are 1.92 times likely to detect any of the complications than who did not go.

Autoregressive correlation

The autoregressive correlation structure among the repeated observations is defined as $R_{ij} = \rho^{|i-j|}$. We estimated both ρ and β (parameters) simultaneously using the Newton-Raphson method of iteration. The estimated parameters using autoregressive correlation (AR-1) assumptions are presented in table 4.

From the test statistics and the corresponding p-values we see that the independent variables education, went to health worker during pregnancy and wanted index pregnancy are significant at the 5% level. The variables education and wanted index pregnancy are inversely related with maternal morbidity during pregnancy and the variable went to health worker is positively related with maternal morbidity.

Pairwise Correlation

The pairwise or unstructured correlation in the repeated responses of a single individual can be estimated as

$$\hat{R}(\rho) = \frac{1}{n}\sum_{i=1}^{n} A_i^{-1/2}(Y_i - \hat{\mu}_i)(Y_i - \hat{\mu}_i)' A_i^{-1/2}.$$

We estimated both $R(\rho)$ and β using Newton-Raphson iteration method. In table 5 we show the results obtained from that method.

From the obtained results we see that only the variables went to health worker and wanted pregnancy are significant at 5% level. Wanted index pregnancy is inversely associated and went to health worker during index pregnancy is positively associated with pregnancy related complications.

Comparison of Estimates Obtained from Different Methods

We discussed the results of estimated parameters obtained from different GEE methods for several correlation structures. We would now compare these estimates with respect to their efficiencies (see table 6).

From table 6 we see that the estimates obtained under the independence assumption of the repeated responses are most efficient among all four models. Among the exchangeable, autoregressive and pairwise correlation, the efficiency of estimates obtained assuming autoregressive correlation is higher than the others. The efficiencies of the estimates assuming exchangeable and pairwise correlation are almost same. From these results, we may conclude that for analyzing the repeated data of maternal morbidity we are to use GEE where correlation matrix can be taken as identity matrix.

We see that the variables went to health worker, wanted pregnancy are significant in all of the four models. The variable education appears significant in almost all the models except GEE using pairwise correlation. The variable special food appears significant in the most efficient GEE model for this data.

IV. CONCLUSION

An individual attacked with a particular disease passes through a series of stages. In the progression of disease, an individual starts from the normal stage to the initial stage and after passing some stages, finally reaches the ultimate stage of the disease (death or some other bad effects) or returns to the initial stage of the disease after receiving necessary treatment. In case of chronic diseases, disease status varies from time to time and covariates behave differently with the changes in disease status. Hence observation at a single time point-may be misleading about the disease status of the patient or about the disease and risk factor relationship. To overcome this problem, longitudinal investigation plays an increasingly dominant role in biomedical research. A longitudinal study implies a survey of respondents at different time-points as the individuals are observed in relation to any particular event of interest for a specified period of time. Repeated measures on the same individual results in correlated observations and this correlation should be taken into account to identify the risk factors responsible for the occurrence of disease; otherwise, the results would be misleading. In this study, we focussed on the methodology of generalized estimating equations along with common correlation structures seen in longitudinal studies. The methodology is illustrated with the help of maternal morbidity data collected by BIRPERHT during November 1992 to December 1993. We took the observations of 549 pregnant women with 4 consecutive follow-ups. We found that the different working correlation within responses results in different estimates of the parameters under consideration. We have displayed the efficiencies of the estimates obtained under different correlation assumptions and found that GEE with working independence assumption is the most efficient. For the repeated binary responses, we found the variables-education, taking special food, visit to health worker and wanted pregnancy are significant and thus have considerable effect in changing the disease status. We see that education, taking special food during pregnancy and whether the index pregnancy was wanted have negative impact with pregnancy related complications. On the other hand, those who went to health worker during pregnancy are 1.92 times more likely to detect pregnancy related complications than those who did not go to health worker. If the index pregnancy is a desired one, then it is likely that the incidence of complications would decline in antenatal period. In other words, an undesired pregnancy results in higher risk of complications during pregnancy.

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Table 1: Variables and their abbreviations and categories

Variables	*Operational definition and category*
Age at marriage	Dummy: 1 if more than 15 years, 0 if 15 years or lower*
Education	Dummy: 1 if primary or higher, 0 if never attended school*
Economic status	Dummy: 1 if average or high, 0 if below average*
Gainful employment	Dummy: 1 if yes, 0 otherwise*
History of miscarriage / abortion	Dummy: 1 if yes, 0 otherwise*
Smoking	Dummy: 1 if yes, 0 otherwise*
Number of pregnancies prior to the index pregnancy	Dummy: 1 if one or more, 0 otherwise*
Taken special food during pregnancy	Dummy: 1 if yes, 0 otherwise*
Visit to health worker	Dummy: 1 if yes, 0 otherwise*
Index pregnancy wanted or not	Dummy: 1 if yes, 0 otherwise*

Note: The asterisk indicates the reference category.

Table 2. Estimates of Parameters Obtained by Fitting GEE Assuming Working Independence within Repeated Outcomes

Variable	*Estimated Coefficient*	*Estimated St Error*	*Coef/S.E.*	*P-value*	*Odds Ratio*
Constant	0.39070	0.15369	2.54205	0.01102	1.47802
Age at Marriage	0.00700	0.09732	0.07196	0.94263	1.00702
Education	-0.27699	0.09510	-2.91246	0.00358	0.75806
Economic Status	0.05571	0.10830	0.51448	0.60691	1.05730
Gainful Employment	0.00493	0.10005	0.04929	0.96068	1.00494
History of Miscarriage / Abortion	0.11954	0.13047	0.91616	0.35958	1.12697
Smoking	0.24662	0.27097	0.91014	0.36274	1.27970
Number of Pregnancies	-0.02604	0.02304	-1.13019	0.25839	0.97429
Special Food	-0.22323	0.10237	-2.18065	0.02920	0.79992
Went to Health Worker	0.65374	0.09192	7.11157	1.147e-012	1.92272
Wanted Pregnancy	-0.34136	0.10439	-3.26988	0.00107	0.71080

Table 3. Estimates Obtained by GEE Assuming Exchangeable Correlation within Repeated Outcomes.

Variable	*Estimated Coefficient*	*Estimated St Error*	*Coef/S.E.*	*P-value*	*Odds Ratio*
Constant	0.39070	0.22870	1.70830	0.08757	1.47802
Age at Marriage	0.00700	0.14482	0.04836	0.96142	1.00702
Education	-0.27699	0.14152	-1.95722	0.05032	0.75806
Economic Status	0.05571	0.16115	0.34574	0.72953	1.05730
Gainful Employment	0.00493	0.14888	0.03312	0.97357	1.00494
History of Miscarriage or Abortion	0.11954	0.19416	0.61567	0.53810	1.12697
Smoking	0.24662	0.40322	0.61163	0.54078	1.27970
Number of Pregnancies	-0.02604	0.03429	-0.75951	0.44754	0.97429
Special Food	-0.22323	0.15233	-1.46543	0.14280	0.79992
Went to Health Worker	0.65374	0.13679	4.77910	1.7601e-006	1.92272
Wanted Pregnancy	-0.34136	0.15534	-2.19741	0.02799071	0.71080

Table 4. Estimates Obtained by GEE Assuming Autoregressive Correlation within Repeated Outcomes.

Variable	*Estimated Coefficient*	*Estimated St Error*	*Coef/S.E.*	*P-value*	*Odds Ratio*
Constant	0.35441	0.20404	1.73695	0.08239	1.42534
Age at Marriage	0.00642	0.12919	0.04972	0.96033	1.00644
Education	-0.24145	0.12631	-1.91159	0.05592	0.78548
Economic Status	0.03236	0.14386	0.22497	0.82199	1.03289
Gainful Employment	0.01340	0.13292	0.10081	0.91969	1.01349
History of Miscarriage/ Abortion	0.11338	0.17350	0.65347	0.51344	1.12005
Smoking	0.20277	0.35885	0.56507	0.57202	1.22479
Number of Pregnancies	-0.01563	0.03065	-0.51017	0.60992	0.98448
Special Food	-0.15372	0.13610	-1.12944	0.25871	0.85750
Went to Health Worker	0.64821	0.12206	5.31026	1.0946e-007	1.91212
Wanted Pregnancy	-0.30624	0.13849	-2.21118	0.02702	0.73620

Table 5. Estimates Obtained by GEE Assuming Pairwise Correlation within Repeated Outcomes.

Variable	*Estimated Coefficient*	*Estimated St Error*	*Coef/S.E.*	*P-value*	*Odds Ratio*
Constant	0.35299	0.22630	1.55983	0.11879	1.42332
Age at Marriage	0.00827	0.14323	0.05779	0.95390	1.00831
Education	-0.21737	0.14009	-1.5516	0.12075	0.80463
Economic Status	0.03847	0.15948	0.24125	0.80936	1.03922
Gainful Employment	0.00545	0.14743	0.03702	0.97046	1.00547
History of Miscarriage / Abortion	0.10588	0.19254	0.54991	0.58237	1.11169
Smoking	0.21806	0.39895	0.54660	0.58464	1.24367
Number of Pregnancies	-0.01148	0.03403	-0.33741	0.73581	0.98858
Special Food	-0.15191	0.15091	-1.00659	0.31413	0.85906
Went to Health Worker	0.64557	0.13542	4.76712	1.868e-006	1.90707
Wanted Pregnancy	-0.30912	0.15363	-2.01200	0.04421	0.73409

Table 6: Asymptotic efficiencies of the estimates obtained for different correlation structures.

Variable	*Independence*	*Exchangeable*	*Autoregressive*	*Pair-wise*
Age at Marriage	10.27486	6.90488	7.74035	6.98138
Education	10.51465	7.06602	7.91690	7.13802
Economic Status	9.23350	6.20507	6.95115	6.27010
Gainful Employment	9.99469	6.71660	7.52323	6.78270
History of Miscarriage / Abortion	7.66406	5.15038	5.76348	5.19366
Smoking	3.69035	2.47998	2.78666	2.50656
Number of Pregnancies	43.39255	29.16055	32.62579	29.38433
Special Food	9.76831	6.56448	7.34710	6.62607
Went to Health Worker	10.87819	7.31033	8.19212	7.38435
Wanted Pregnancy	9.57892	6.43720	7.22041	6.50876