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Intermediate Variables and Fertility : A Case Study of Ghana (West Africa)

IN order that research on the determinants of fertility has both a theoretical and practical value, it is but appropriate that data are accumulated and analysed in terms of some conceptual framework. The weaknesses of many studies on fertility is that a large body of data are collected, analysed and hypotheses tested but the results are not bound together in an organised manner. The development of a suitable and acceptable theoretical model of the determinants of fertility which can guide the studies on fertility and can also serve the policy best is, however, not an easy task. A Steering Committee on the Development of the Plans for New Studies in Fertility formed in the **U.S.A.** failed to agree, even after a year of intensive work and deliberations, on an acceptable theoretical frame-work which could be used for integrating the hypotheses of future fertility surveys {Mishler and Westoff, 1961 : 7-8). An attempt will be made here to review a few theoretical models developed to explain the variations in the levels of fertility among different societies or among the various segments of the same society.

Although fertility differentials among human populations have long been studied by social scientists and biologists, Pearl (1939) did a pioneering work of providing an analytical framework for the study of the factors affecting human fertility. In his study he included both "biological and sociological" factors which affect human fertility. But Pearl was primarily concerned with *explaining Fertility differentials in the* U.S.A. *and his classification failed to* include many of the factors which affect fertility of pre-industrial populations.

In his work on culture and human fertility based on surveys and findings relevant to fertility in pre-industrial societies, Lorimer (1954) developed a "cul-

tural" theory of fertility. He defined the term "cultural values" as referring to "attitudes and interests which are, in part, engendered by a particular social structure and which in turn motivate and direct the activities of individuals who form society" (1954: 198). Among the cultural factors affecting fertility, he mentioned traditions, religion, Kinship structure, etc., and concluded that many of these cultural values are conducive to high fertility among the pre-industrial societies. Matras has pointed out that the data on which Lorimer's conclusions are based arc "neither systematic n or particulary convincing **(1973** : 138). Furthermore, Lorimer failed to use or provide any analytical framework for the systematic study of these factors. Davis and Blake also expressed the view that Lorimer failed to make clear the ways in which fertility can be affected and thus gave a confused picture as to how it is affected (1956 :213).

The most important and widely known conceptual model to account for the gross differences in fertility between different societies is that provided by Davis and Blake (1956). They attempted to formalise certain social, demographic and physiological variables through which any socio-cultural factors influencing the level of fertility must operate. Eleven such variables were identified by them and grouped under three categories corresponding to three easily identifiable stages of the reproductive process :

1 Factors affecting exposure to intercourse ("intercourse variables").
2 Factors affecting exposure to conception ("conception variables").
3 Factors affecting gestation and successful parturition ("gestation variables").

Davis and Blake called these variables "Intermediate Variables'" because they claimed that all other economic, social and cultural variables must affect fertility through these and only through these variables. They further pointed out that each of these eleven "intermediate variables" can have a negative or positive effect on fertility and the level of fertility of a population is the consequence of the joint effect of all these eleven variables. Two societies may have the same fertility level but quite different values on all or most of the "intermediate variables".

This model has been widely acclaimed by social scientists and there is no or little doubt about the exhaustiveness of this list which for more than two decades has served as an inventory of immediate determinants of fertility. However, the major drawback of the Davis and Blake framework as pointed out by Nam (1968 : 180), Tien (1968 : 138-57) and Freedman (1967 : 5-7) is that the cultural basis of the "intermediate variables" was not elaborated by the authors.

Blake (1961) tried to make use of this model in her family structure and fertility study in Jamaica but was mainly concerned with the effect of one

"intermediate variable" i.e., time lost between the unions and its effect on the reproductive behaviour of the women. Nag (1962) in his study of factors affecting human fertility in non-industrial societies drew heavily upon this framework and attempted to measure the relationship between these "intermediate variables" and fertility. But Nag's study was primarily based on anthropological data and fertility estimates in many cases were not very reliable. Yaukey (1961) applied the Davis-Blake framework in his study of fertility differentials in a cross-section of Lebanese women. Although he did not claim perfect coverage of the variables mentioned by Davis and Blake, his is the only study which included not only most of these factors but also some background characteristics of the respondents as well. Apart from these studies there has been little systematic attempt to apply this analytical framework by using all or most of these variables to explain the fertility differentials, although a number of studies in the past have taken individual "intermediate variables" such as age at marriage, use of contraception, induced abortion, foetal deaths, etc , and related them to fertility.

Hill, Stycos and Back (1959) provide an interactional approach to the study of reproductive behaviour in which the family characteristics are given importance. This conceptual model, which was developed on the basis of their study in Puerto Rico, include certain antecedent variables (demographic background factors, influence of key reference groups, general value system, informational and attitudinal variables), intervening variables (specific family size attitudes, family action possibilities such as marital happiness, husband wife communication, autonomy of wife, dominance and sexual satisfaction, etc.) which influence the use of contraception and consequently the reproductive behavior. It is thus obvious that this model makes use of only one "intermediate variable," i.e. contraception practice and is therefore not very comprehensive.

Freedman (1961-62) developed a broader model for the sociological analysis of fertility by incorporating his classification of dependent variables with the Davis-Blake scheme of "intermediate variables". His is a normative approach which goes backward from fertility to "intermediate variables" and then to norms about family size and "intermediate variables" as well as broader economic, demographic and social variables. These norms and the broader range of economic, social and demographic variables are the ultimate determinants of fertility but they act to determine the reproductive behaviour only by influencing one or more of the "intermediate variables". Freedman in his model also mentions about "environment" which affects mortality rates, norms and socio-economic structure and through this influence "intermediate variables" and then fertility. The effect of "environment" in this model, however, has not been made very explicit.

In the course of their planning for Princeton studies Mishler and Westoff (1955) developed a conceptual model for the study of fertility behaviour under which social settings are shown to influence personal pregnancy desires and

the psychological availability of contraception. These pregnancy desires and the psychological availability of contraception influence the actual practice of contraception and thereby fertility behaviour. One of the drawbacks of this model is that in this scheme equal importance is given to familial and personal variables. Furthermore, this model implies that contraceptive practice is the only immediate determinant of fertility, which remains to be substantiated.

The analytical frameworks of Davis-Blake and Freedman have been combined by Yaukey (1969) into a single model which seems to be very comprehensive for the sociological analysis of fertility (Fig. 1). In this model the variables specified by Freedman are labeled as "Class A" while the Davis-Blake list of "Intermediate Variables" are shown under "Class B" and fertility is labeled as "Class C".

Objectives of the Study

The main objective of the present exercise is to assess the relative importance of various "intermediate variables" (B) in explaining the variations in fertility (C) among the different segments of the rural Ghanaian Society.

Sources of Data

This study is entirely based on the data obtained from the Danfa Comprehensive Rural Health and Family Planning Project, Ghana (West Africa) which is a demonstration, teaching and research project developed and implemented jointly by the University of Ghana Medical School and University of California Los Angeles School of Public Health in 1970. The project is located in a zone of 10 to 50 miles northwest of Accra and covers a population of approximately 50,000.*

It was established primarily to investigate alternative health and family planning delivery system and developed an experimental research design under which the entire project region was divided into four areas on the basis of such demographic characteristics as population size, age and sex distribution. Each area consists of approximately 12,000 people and is separated from the other by geographic barriers like high hills, unbridged rivers and bush. In Area I family planning services were closely associated with comprehensive health services provided by a health centre and satellite clinic staffed by mobile teams which served outlying villages at regular intervals. In Area II, mobile family planning clinics were supported by a vigorous health education program, and in Area III family planning mobile clinics operated

*The field operations of the project officially terminated as of July 1977 but some aspects of the project are still being carried out by the Ghanaiani.

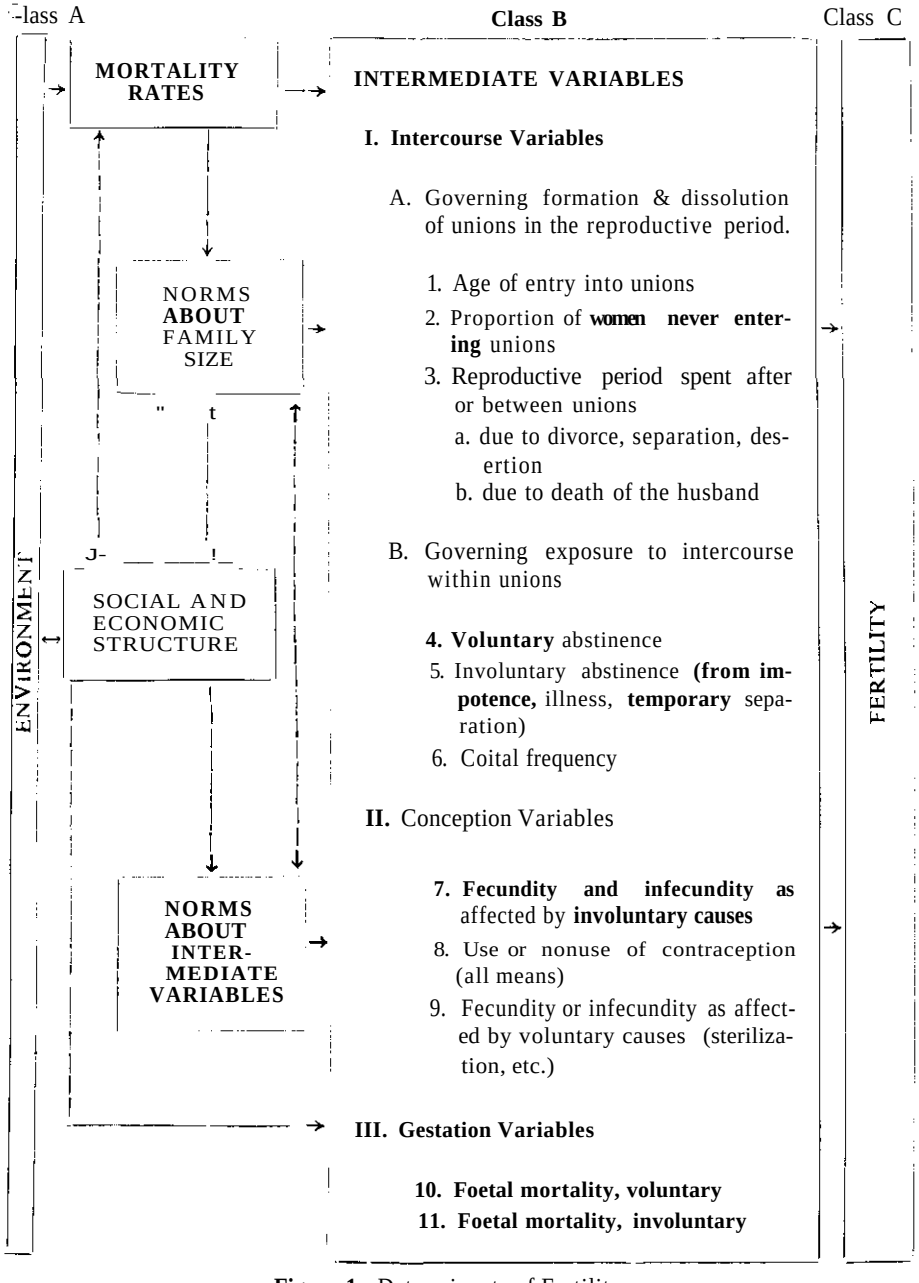

Figure 1. Determinants of Fertility.

Note : The arrows in the **diagram represent the direction in which causation is supposed to** work. Class A includes all the variables to the **left of** the "intermediate variables", those classified by Ronald Freedman. **Class B includes all of what Kingsley Davis and** Judith **Blake call "intermidiate variables". Class C refers to fertility.**

exclusively. Area IV was used as a control and no project inputs were provided there (Neumann *et al.*, 1974 : 40-50). Thus the Danfa project had a built-in family planning component which was intended to generate information needed by the Government of Ghana for the implementation of the provisions of the national population policy and to determine the most effective means of providing family planning services to the rural people who are the mainstay of the population of most developing countries including Ghana.

In order to measure the results of the alternative health and family planning delivery systems, the project undertook a series of studies on the various socio-economic, health and demographic aspects of the rural Ghanaian population on a longitudinal basis. The present analysis is limited to the data obtained primarily through the Baseline Household Registration and *Fertility* Survey.

Discussion of Variables

As mentioned in the preceeding paragraphs the present analysis will be guided by the analytical frameworks provided by Davis and Blake (1956). It is the purpose of this research to delineate the relationship between class B and class C variables. There will be no attempt to study the relationship between class A and class C variables, which has so far been the focus of many earlier studies. The type of research carried out earlier wherein the relationship between class A and class C variables has been studied does not provide clear guidelines for policy formulation and implementation. This type of analysis has been predominant mainly because the data on class A variables have been more widespread and complete than the data on class B variables. "Thus it was always the path of least resistance to develop research and theory about the relationship between class A and class C. Demographic transition theory is an example of the kind of theory that resulted" (Yaukey, 1969 : 103). Fortunately the data available from the Danfa project are amenable to the type of analysis to be carried out in this study. The variables to be included in the analysis and their definitions are discussed below:

Class C

FERTILITY. This will be measured by the number of children ever born to the woman. In order to standardize the effect of age differentials on fertility, first the age will be included in the regression equation, then the analysis will be attempted separately for three age classes, i.e.: 15-24, 25-34 and 35-44.

Class B

The variable 1 (age of entry into unions) under class B will be represented by age at first marriage which is an important variable exposing a woman to

intercourse and thereby to the risk of pregnancy, The variable 2 (proportion of women never entering unions) is not very important in the case of rural Ghana where permanent celibacy is virtually non-eKistent and every adult male or female is expected to marry sooner or later. The instability of marriages will be taken as an index of reproductive period lost and thus a proxy for variable 3 (reproductive period spent after or between unions). Marital instability will be measured by two variables ; number of marriages the woman had in the past, and if the woman is in mutual consent, friendship or consensual union, on the assumption that this type of re!ation[f]hip is less stable than other types of formal marriages. Accuiate data on the frequency of coitus and abstinence from sexual intercourse are difficult to obtain and were not collected by the Danfa Project Assuming that the frequency of coitus per woman is lower in marriages in which the husband has more than one concurrent wife and that the post-partum and other types of abstinence of long duration can be more easily observed in polygamous than in monogamous marriages, number of wives and husbands of a woman has can be a most appropriate proxy for variables 4 (voluntary abstinence) 5 (involuntary abstinence) and 6 (coital frequency) and will, therefore, be used as such in the present analysis. As regards the conception variables, data on variable 7 (fecundity or infecundity as affected by involuntary causes)—arc not available and variable 9 (fecundity or infecundity as affected by voluntary causes—sterilization, etc) is not important in the case of rural Ghana where males and females rarely undergo voluntary sterilisation. For variables (use of contraception) a dichotomous variable—whether the respondent woman had ever used contraception will be included in the analysis. The data on pregnancy wastage are available from the fertility survey of the Danfa project. Variable 10 (foetal mortality—voluntary) will be measured by the number of induced abortion? the woman had in the past while for the purpose of measuring variable II (foetal mortality—involuntary) number of miscarriages and stillbirths the woman had experienced will be added together.

Statistical Techniques Used

For examining the relationship between class C (fertility) and class B (intermediate) variables stepwise multiple regression will be used since most of our intermediate variables are numerical while some are dichotomous, for which dummies could be created. The stepwise multiple regression program of the SPSS provides the following statistics :

(a) Zero-order correlation coefficients indicating the degree of association between the dependent variables and any independent variable:

(b) the squared multiple correlation coefficient (R^3) which measures the total amount of variation in the dependent variable explained by the independent variables;

*(r) the un*standardised partial regression coefficient; (P) which indicates the amount of change in the dependent variable produced by a unit of change in any one of the independent variables when others are controlled;

(d) the standardised partial regression coefficient (Beta weight) which measures the relative importance of each independent variable in predicting the dependent variable;

(e) the standard error of {3 which measures the significance of the partial regression coefficient. In order to *be* significant each regression coefficient must be at least twice the standard error;

(/) the *F"-ratio* which measures the statistical significance of the standardised regression coefficients,

Limitations of the Study

The main limitation of the study is that we do not have information on all the intermediate variables and we have also used some proxies for certain intermediate variables which are only approximations. Thus our analysis is not claimed to be a complete application of the analytical framework.

Effect of Intermediate Variables on Fertility

For examining the simultaneous effect of various intermediate variables on fertility behaviour of the wives, multiple regression procedures were used. The variables included in this analysis are as follows :

Y = the dependent variable—number of children born alive.

X_1 = age of wife

X_2 = age at first marriage

A_3 = number of fetal deaths

X_4 = number of previous marriages

A_5 = number of current wives of husband

X_6 = family planning methods ever used : Yes = I, No = 0

X_7 = if wife is in mutual consent or friendship type of conjugal relationship Yes = 1, No = 0

The summary results of regression analysis are shown in Table 1; it indicates that all the independent variables included in the regression analysis could

TABLE 1—STEPWISE MULTIPLE REGRESSION OF NUMBER OF CHILDREN EVER BORN TO RURAL GHANAIAN WIVES WITH SELECTED INTERMEDIATE DETERMINANTS OF FERTILITY (AGES 15-44)

Summary Tables

Variable Name and Stepwise Sequence	*Unstandardised Regression Co-efficient (Beta)*	*Standard error of Beta*	*Standard regression co-efficient (Beta)*	*F-ratio*	*Level of signi-ficance*
Current Age of wife	0.289	0.010	0.776	840.25	0.000
Age at First Marriage	−0.320	0 024	−0.334	172.85	0.000
Number of fetal deaths	−0 239	0.070	−0.084	11.56	0.005
Number of previous marriages	−0.286	0.108	−0.069	7.09	0.010
Number of current wives of husbands	−0.213	0 070	−0.072	9.18	0.005
Proportion of wives ever used F. P.	0.369	0.163	0.054	5.15	0.025
Proportion of wives in Mutual Consent Unions	−0.400	0.209	−0.047	3.67	0.075
		$R^2 = 0.538$			

explain 53.8% of the total variance in our dependent variable ($R^2 = 0.538$). The largest standardised regression coefficient (0.776) obtained as a result of this analysis is that of age of wife and is highly significant ($F = 840.25$; $P = 0.000$). The sign of the beta is positive which indicates that higher the age of the wife greater her fertility performance. This result is in the expected direction.

The second largest standardised regression coefficient (- 0.334), which has a negative sign, is for age at first marriage and is also highly significant ($F = 172.85$, $P = 0\ 000$). This means that there is an inverse relationship between age at first marriage and fertility, that is, fertility of the wives who married at a younger age is significantly higher than those whose first marriage took place at a late age. The predictive power of age at marriage is slightly less than half that of age of the wife.

The standardised regression coefficient (−0.084) for number of fetal deaths though small is still statistically significant ($F = 11.56$, $P = 0.005$). The negative sign of this beta indicates that fetal mortality adversely affects the fertility performance of the wives. It has been suggested that the effect of fetal mortality on fertility is through an increase in live birth intervals. An attempt was therefore made to examine this proposition by studying the relationship between birth interval and fetal mortality. Our analysis revealed that larger the

proportion of pregnancies which resulted in fetal deaths, higher the mean birth interval. This relationship, though weak, was found to be statistically significant *(r* = 0.0939; *P* = 0.006).

Again the standardised regression coefficient (-0.069) for a number of previous marriages though small is statistically significant *(F* = 7.09; *P* = 0.010). This shows that higher the number of marriages the wife have had in the past, lower her fertility performance. It has been suggested, as indicated in earlier parts of this paper, the effect of marital instability on the fertility of women is because of considerable loss of reproductive period by wives whose marriage had been unstable. Though we do not have data on the time lost between unions, this effect was indirectly examined by analysing the relationship between number of marriages and mean live birth interval. We found a positive correlation between number of previous marriages and mean live birth interval, that is, the wives having a history of previous marriages had a larger mean birth interval as compared to those whose marriages were relatively stable. This relationship, though weak, is statistically significant *(r* = 0.0654, *P* = 0.040).

Though the contribution of polygamy to the total explained variation in fertility is marginal (standardised regression coefficient —0.072), the effect of this variable on fertility performance is nevertheless significant (F = 9,18; *P* — 0.005). Our analysis has shown that the larger the number of co-wives the lower their fertility. Fertility of polygamous wives, as mentioned earlier, is probably affected by reduced coital frequency per wife and observance of post partum abstinence for longer periods of time. Should this be correct, the birth intervals of polygamous wives would be longer as compared with the monogamous wives. In our analysis the mean birth intervals were found to be longer for polygamous wives. The correlation between birth intervals and polygamy, though not very strong, was nevertheless statistically significant (r = 0.086; P = 0.014).

Regarding the effect of contraception on fertility behaviour, the results of our analysis revealed that fertility performance of wives who had ever used contraception is higher than for those who had never used any birth control techniques. This relationship is statistically significant (F = 5.15; *P* = 0.025) though the power of this variable in predicting fertility performance of the wives is not very strong (standardised regression coefficient = 0.054). This positive relationship between contraception used and fertility is not surprising and is in fact consistent with some earlier findings. Many studies have reported that in developing countries contraception is generally sought by the couples who are mone fertile and that too after they have been burdened with a large number of children.

The standardised regression coefficient (-0.047) for type of conjugal relationship is not statistically significant. This indicates that type of conjugal relationship of the wife had no effect on her fertility performance.

In the proceeding analysis age was included in the regression equation along with other intermediate determinants of fertility and it came out to be the strongest predictor of fertility behaviour of wives. But since age contributed to most of the explained variance in fertility, its inclusion might have masked the effect of other independent variables. It would, therefore, be desirable to study the effect of various intermediate variables on the fertility of wives in different age cohorts. For this purpose all the wives in our sample have been divided into three broad age groups of *15-24, 25-34 and 35-44* and *multiple regression* has been done separately for these age groups. For these analyses the dependent variable as well as independent variables are the same as those included in the proceeding analysis except that age has been excluded from the list of independent variables. The variables involved in the analyses arc :

Y = the dependent variable—number of children born alive

X_1 = age at first marriage.

X_2—number of fetal deaths

X_3 = number of previous marriages

X_4 = number of current wives of husband

X_5 = family planning methods ever used : Yes =1, No = 0

X_6 = if wife is in mutual consent or friendship type of conjugal relationship : Yes = 1, No = 0

The results of the analysis for age group 15-24 are given in Table 2. It could be seen from this table that all the independent variables included in the equation for this age group could explain 15.6% (R^2 = 0.156) of the total variance in the fertility of wives in the age group 15-24. The largest and only significant standardised regression coefficient obtained is for age at first marriage and this obviously has a negative sign. It shows that age at marriage adversely affects the fertility of wives. The second largest standardised regression coefficient which is nearly significant (F = 3.40; P = 0.070) is for the number of current wives of the husband. This has also a negative *sign* and indicates that even in this younger age group the wives married to polygamous husbands had a lower fertility than those married monogamously though the effect is not very profound.

The summary results of multiple regression for age group 25-34 are shown in Table 3. It could be seen from this table that total variance explained by all the independent variables for this age group is 16.3% (R^2 = 0.163) and the largest standardised regression coefficient (-0.395) is for age at marriage which is highly significant (F = 69.62; P = 0.000). Thus for this age group too, the wives who married early had a higher fertility. None of the other variables

TABLE 2—STEPWISE MULTIPLE REGRESSION OF NUMBER OF CHILDREN EVER BORN TO RURAL GHANAIAN WIVES WITH SELECTED INTERMEDIATE DETERMINANTS OF FERTILITY (AGE 15-24)

Summary Table

Variable Name and Stepwise Sequence	*Unstandardised regression co-efficient (beta)*	*Standard error of beta*	*Standardised regression co-efficient (beta)*	*F-ratio*	*Level of signi-ficance*
Age at first Marriage of wife	−0.211	0.051	−0 311	17.061	0.000
Number of current wives of husband	−0.173	0.094	−0.136	3.40	0.070
Proportion of wives who have ever used F. P.	0.417	0.257	0.119	2 64	N.S
Proportion of wives in mutual consent unions	−0.327	0.288	−0.083	1.29	N.S
Number of previous marriages of wife	0.330	0.293	0.084	1 26	N.S
Number of Fetal Deaths	−0.364	−0.0138	0.198	0.03	N.S
			$R^2 = 0.156$		

TABLE 3—STEPWISE MULTIPLE REGRESSION OF NUMBER OF CHILDREN EVER BORN TO RURAL GHANAIAN WIVES WITH SELECTED INTERMEDIATE DETERMINANTS OF FERTILITY (AGE 25-34)

Summary Table

Variable name and stepwise sequence	*Unstandardised regression co-efficient (beta)*	*Standard error of beta*	*Standardised regression co-efficient (beta)*	*F-ratio*	*Level of signi-ficance*
Age at first marriage of wife	−0.287	0.034	−0.395	69.62	0.000
Proportion of wives ever used F. P.	0.332	0.237	0.065	1.96	N.S
Number of fetal deaths	−0.141	0.100	−0.067	1.98	N.S
Proportion of wives in mutual consent unions	−0.380	0.305	−0.060	1.55	N.S
Number of current wives of husband	−0.994	0.108	−0.043	0.89	N S
Number of previous marriages of wife	−0.638	0.159	−0.020	0.162	N.S
			$R^2 = 0.163$		

has been found to have a significant effect on the fertility of wives in this age group and their contribution to the total variance explained in our dependent variable is also marginal.

The results of regression analysis for age group 35-44 which are given in Table 4 also reveal that the largest standardised regression coefficient (−0.290) is for age at first marriage and this inverse relationship between age at first

TABLE 4—STEPWISE MULTIPLE REGRESSION OF NUMBER OF CHILDREN EVER BORN TO RURAL GHANAIAN WIVES WITH SELECTED INTERMEDIATE DETERMINANTS OF FERTILITY (AGE 35-44)
Summary Tables

Variable name and stepwise sequence	*Unstandardised regression coefficient (beta)*	*Standard error of beta*	*Standardised regression coefficient (beta)*	*F-ratio*	*Level of significance*
Age at first marriage of wife	−0.261	0.055	−0.290	22.85	0.000
Proportion of wives in mutual consent unions	−1.169	0.564	−0.128	4.30	0.0375
Number of current wives of husband	−0.322	0.180	−0.106	3.21	0.075
Number of fetal deaths	−0.258	0.150	−0.103	2.95	0.095
Proportion of wives ever used F. P.	0 551	0.402	0.082	1.88	N.S
Number of previous marriages of wife	−0.173	0.220	−0.048	0.62	N.S
			$R^2 = 0.130$		

marriage and fertility is highly significant ($F = 22.85$; $P = 0.000$). The second largest standardised regression coefficient (−0.128) for this age group is for type of conjugal relationship and is statistically significant ($F = 4\ 30$; $P = 0.0375$). This means that for the older wives the fertility performance of those in mutual consent or friendship type of conjugal relationship is significantly lower than those in customary type of unions. The relationship between other independent variables and fertility was not found to be significant. Furthermore, all the independent variables included in the regression were able to explain 13.0% of the variance in the fertility performance of the wives in the age group 35-44.

Conclusions

The results of the analysis show that there is a negative relationship between female age at marriage and fertility. They also reveal that marital instability depresses the level of fertility. It is shown that thj higher the number of previous marriages of (he wife, the lower the fertility. Mean live birth intervals are also higher for the wives with unstable marriages. Further, fertility of polygamous wives is significantly lower than the monogamous wives. The relationship between contraceptive practice and fertility has however been found to be positive. The fertility of those who have ever used contraceptive has been found to be higher than those who had never practised any birth control techniques. The plausible reasons for this unconventional finding have been explained. So far as the effect of foetal mortality on fertility is concerned, the data reveal an inverse relationship between number of foetal deaths and fertility, and positive relationship between foetal losses and birth intervals. It is thus evident that pregnancy wastage lowers the levels of fertility by increasing the live birth intervals.

Of all the intermediate variables, included in this analysis, the inverse relationship between age at marriage and fertility has been most pronounced and consistent.

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