TRIBHUVAN UNIVERSITY JOURNAL
VOL. XVI, JUNE 1993

Educational Attainment and Fertility in Nepal: An Application of Intermediate Variables Framework

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INTRODUCTION

Fertility is considered to be a major component of population change. Leibeinstein (1979) explained its variability with respect to 'basic development' of society such as increasing level of income, education and occupational status of people. In many instances, educational attainment appears to be a key variable to the inducement of lower fertility in a society. In England, as education spread, fertility declined in all groups (WB, 1984). In the context of East Asian countries, Oshima (1983) asserted that the spread of secondary education as a key variable responding to the labour force requirements of machanization and in turn a major factor exerting a downward pressure on fertility. Heer (1987) found an inverse relation between the educational attainment of all American women in 1960 ages 34-44 and the number of children ever born. In the context of Nepal, findings of the studies are not consistent - husband's education is inversely related to fertility in the Hill, while this is positively associated with fertility in the Terai (CBS, 1987).

Promotion of literacy and education prepares boys and girls for responsible productive and reproductive careers. It may be so because its role in 'increasing level of skills and knowledge as well as ability to deal with new ideas' (Caldwell, 1979) perhaps bring fertility within the sphere of conscious choice that ultimately paves way for the solution of poverty and population problems.

Intermediate Variables Framework of Fertility

There is a question as to why does fertility vary when any change in socioeconomic milieu takes place. Regarding this question, Davis/Blake (1956) are in the opinion that changes in socio-economic condition of people bring change in the values of characteristics directly associated with reproductive behavior of women. Davis/Blake's framework is generally known as Intermediate Variables

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Framwork of Fertility and consists of 11 intermediate variables related to the whole reproductive processes of mankind-marriage, conception and gestation (UN, 1973). Later on, Bongaarts (1983) in his framework generally known as Proximate Determinants of Fertility reduced those variables into seven such variables as marriage, contraception, induced abortion, postpartum infecundability, spontaneous intrauterine mortality, waiting time to conception and permanent sterility. On the basis of these explanations on fertility variation with respect of socioeconomic & itermediate variables we can conceptualize the framework as follows (fig.1).

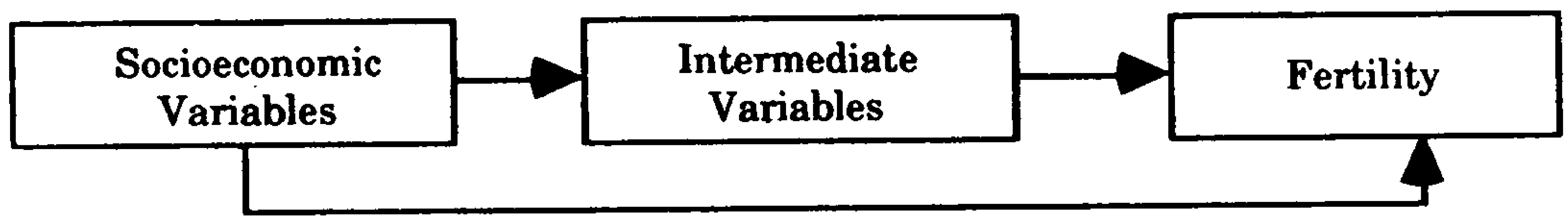


Fig. 1

According to this hypothesis, socioeconomic changes have effect on fertility through the intermediate variables (or proximate variables). This type of relationship between fertility and socioeconomic changes indicates the existence of indirect as well as direct relationship of fertility change with change in socioeconomic variables.

Research Framework

This study is a time trend analysis of fertility with its correlates. Hence, time series data are obtained from secondary sources of information for the last 13 year (1977-1989) to estimate indirect as well as direct effects of those selected correlates on fertility. This study utilizes an in-built mechanism of fertility variation described by Davis/Blake on the basic premises that effect of changes in socioeconomic (exogeneous or explanatory) variables surpasses to fertility through some intermediate variables. Multiplicity of variables is avoided in this study. So, causal links of fertility are established with limited number of related variables namely three areas of socioeconomic development of the country - educational development, development of the country - educational development, development of health, and family planning programme. Educational development of the country during the last thirteen years period is represented by the percentage of adolescents education (spread of secondary level education or more) for each year. This variable is considered to be a key and exogeneous variable to the inducement of lower fertility. Development of health, and family planning programme sectors are represented respectively by infant mortality rates (IMR) and percentage of women of reproductive ages (15-49) using contraceptives. These two variables are intermediate variables in Davis/Blake framework. Time variable is linked separately with fertility to know its effects while eliminating effects of all other variables over the period is considered.

Based on the Davis/Blake framework, a relational model can be developed across these variables to show 'assumed paths' through which effects of change in exogeneous variable surpasses to fertility (Fig. 2).

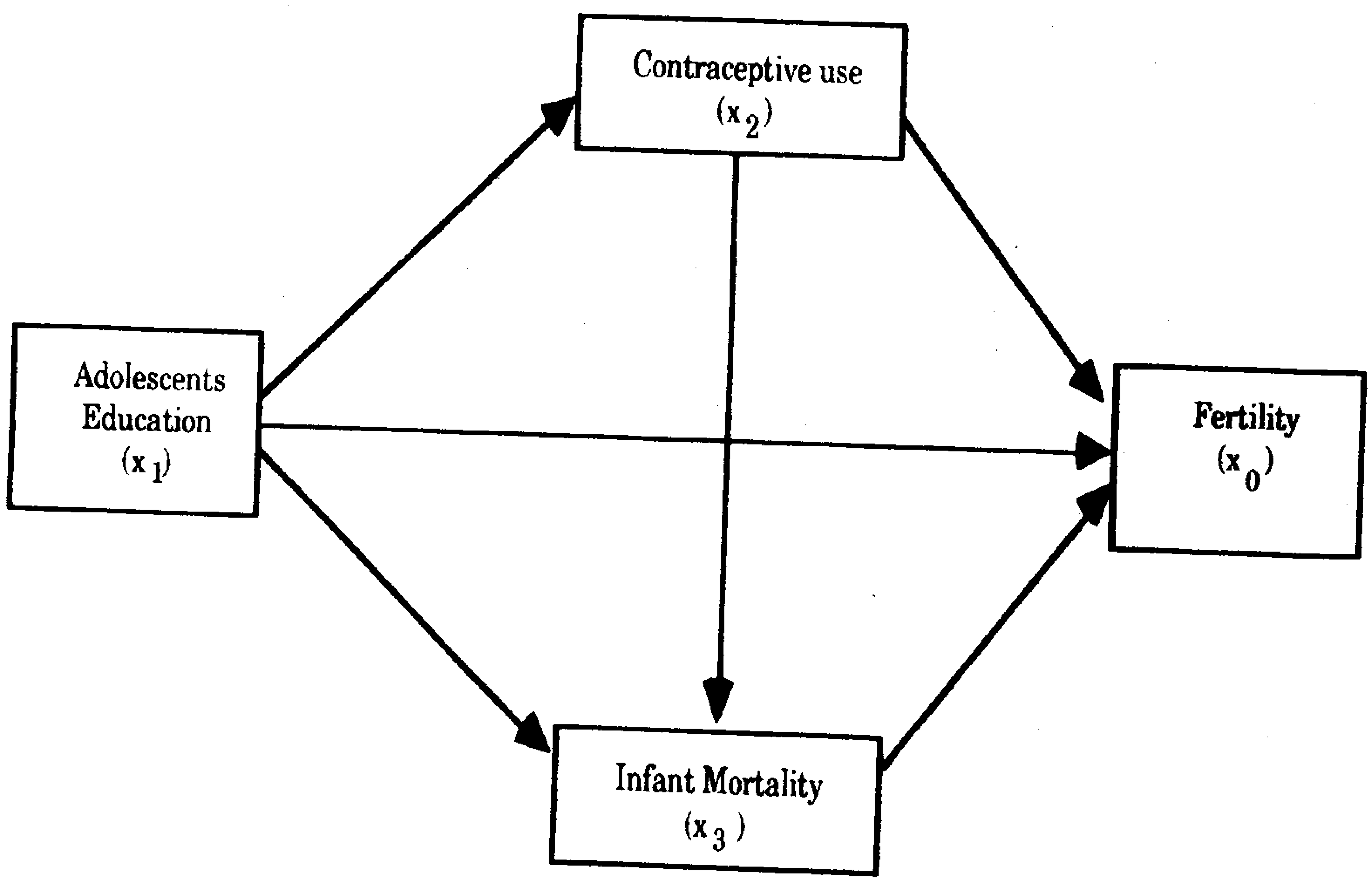


Fig. 2.

In this study, circuitous of causality is not ignored. It is assumed that all the three causal variables influence fertility directly. It is also postulated that adolescents education will be related to contraceptive use and infant mortality rates and these will affect fertility indirectly. Another possible path assumed here is that educational attainment of adolescents affects fertility indirectly even though the path between contraceptive use and infant mortality rate is not clearly determined.

Time Trend of Selected Variables

Adolescents education: Adolescent age ranges from 12 to 20 years. Up to this age, an individual in Nepal, may have completed secondary level of education or more. It can have significant effect on fertility reduction. During the 13 years period, the percentage of adolescents education has doubled from 14 percent in 1977 to 28 percent in 1989 in Nepal (Table 1).

Contraceptive use: Contraceptive use of women is generally negatively correlated with fertility. It increases with the increasing level of educational attainment. During the last thirteen years period in Nepal, this percentage increased more than 6-fold from 3 percent in 1977 to nearly 20 percent in 1989 (Table 1).

Table - 1: Fertility Change with respect to Adolescents Education, Infant Mortality, and Contraceptive Use in Nepal, 1977-1989.

Year	Total Fertility Rates (TFR) (Per woman)	Adolescents Education (AED) (in %)	Infant Mortality Rates (IMR) (per 1000 live Births)	Contraceptive Use of women (in %) (CUW)
1977	6.5	14	144	3.0
1978	6.5	14	144	4.0
1979	6.2	19	144	5.0
1980	6.1	21	150	6.0
1981	6.4	21	148	7.0
1982	6.3	21	145	7.6
1983	6.3	22	143	10.2
1984	6.3	23	135	11.8
1985	6.3	25	133	13.4
1986	5.9	25	130	15.0
1987	5.9	25	128	16.6
1988	5.8	27	126	18.2
1989	5.7	28	124	19.8

Source: World Development Report , 1979-1991.

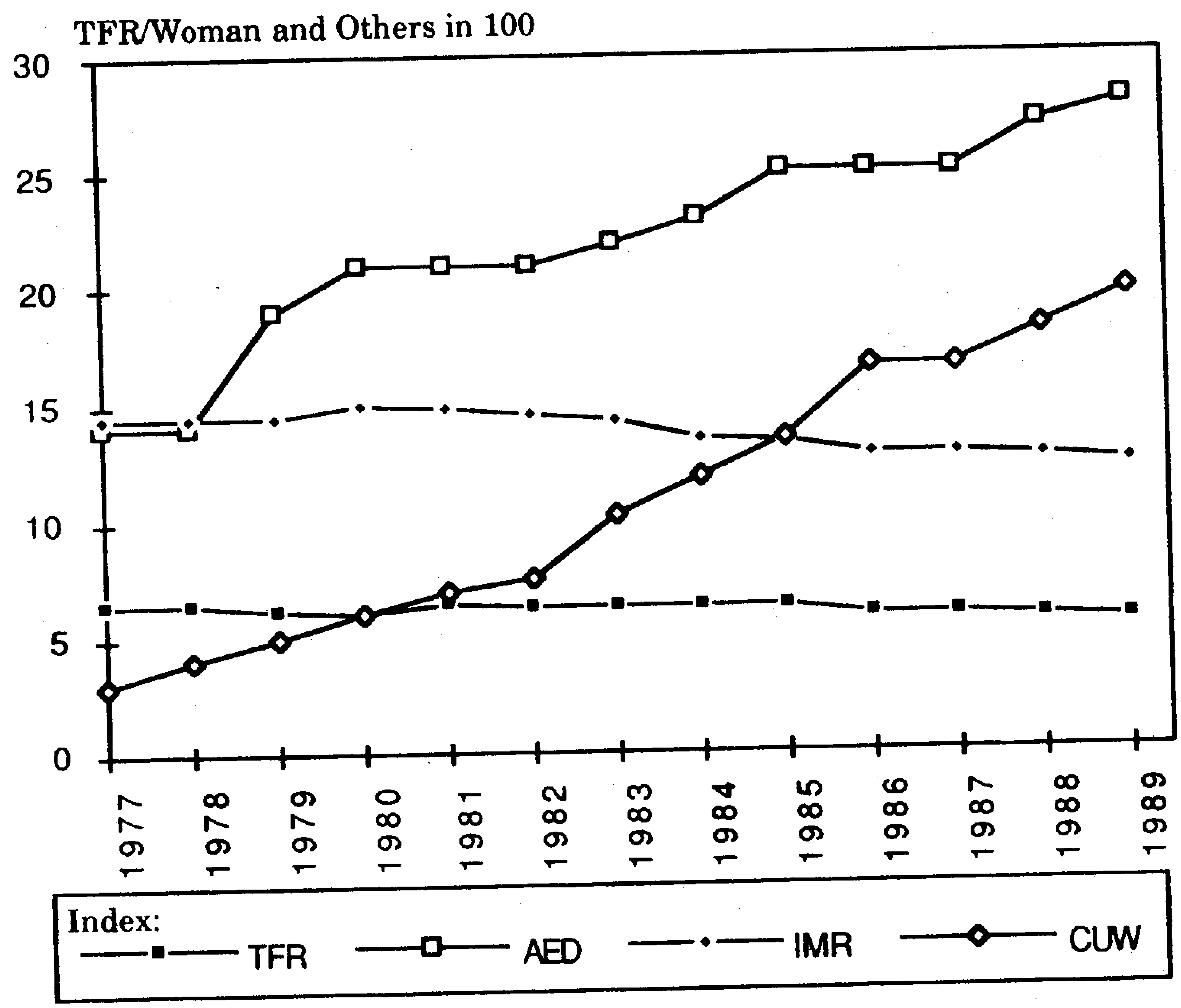
Infant mortality rates: Infant and child mortality rates are taken as one of the indicators of socioeconomic and health conditions prevailing in the country. It is measured as the number of infant deaths (deaths under one year of age) which occur in a given year divided by the total number of live births occurring in the same year (CBS, 1987). In Nepal, significant decline in infant mortality is not observed during the last thirteen years period. It declined 20 deaths per 1,000 live births from 144 in 1977 to 124 in 1989 (Table 1).

Total fertility rates: Total fertility rates indicate number of children a women likely to produce at the end of her reproductive period given the current age schedule of fertility (CBS, 1987). During the last 13 years period, it declined by 12 percent from 6.5 in 1977 to 5.7 in 1989 (Table 1).

METHODOLOGY

Recursive (saturated) path analysis model is regarded as an appropriate method of data analysis within the Davis/Blake intermediate variables framework of fertility (Kendall & O'Muircheartaigh, 1977). Path analysis model is a more explicit form of regression analysis that measures the direct influence (as path coefficient) of each causally prior variable along each assumed path and decomposes total effect into direct and indirect effect. Recursive path analysis model rules out two-way causation and gives the expected effect of a change of one standard deviation in the explanatory variable (holding other variables constant); this expected changes is expressed in terms of the standard deviation of the predicted variable (Kendall & O'Muircheartaigh, 1977). Thus, this is an additive model and assumes linear relationship between the variables.

Fig. 3 Fertility Change With Respect to Adolescents' Education, Infant Mortality, and Contraceptive Use in Nepal, 1977-1989



Source: Table 1.

This method is based on the following procedures:

(a) Estimation of zero-order correlation coefficients (r_{ij}) as total effect between the variables.

(b) Estimation of direct effect of each causally prior variable as path coefficient (p_{ij}, partial correlation coefficient) along each assumed path where path coefficient, p_{ij} equals to standardized regression coefficient, p_{ij}.

(c) Decomposition of total effect of explanatory variable(s) into direct and indirect effects on response variable(s) where total effect equals to sum of direct and indirect effects.

Estimation of Total Effect

Total effect of explanatory variable is measured in terms of Karl Pearson's zero-order correlation coefficient, r_{ij}, where first subscript identifies dependent variable and the second the variable whose effect on the variable is measured. Zero-order correlation coefficient is calculated as

$$r_{ij} = \frac{\Sigma x_i \; x_j}{\sqrt{x_i^2 \times x_j^2}}$$

where, x_i = mean deviation of dependent variable.
x_j = mean deviation of independent variable.
$x^2{}_i$ = sum of squared mean deviation of dependent variable.
$x^2{}_j$ = sum of squared mean deviation of independent variable.

Estimation of Path Coefficients

Path coefficient is measured in terms of standardized regression coefficient, beta β_{ij}, where β_{ij} is calculated as

beta (βij) = $bij \frac{Sxj}{Sxi}$
where, b_{ij} = unstandardized regression coefficient.
Sx_j = standardized deviation of independent variable.
Sx_i = standardized deviation of dependent variable.

Estimation of direct effect of each casually prior variable (as path coefficient) along each assumed path (Fig. 2) follows solution of equation-by-equation least square regression.'

$x_2 = a + \beta_{21}x1$ .... (i)
$x3 = a + \beta_{31}x_3 + \beta_{32}x_2$ .... (ii)
$xo = a + \beta_{01}x_1 + \beta_{02}x_2 + \beta_{03}x_3$ .... (iii)

where, $\beta 21$ measures the direct effect of educational attainment of adolescents on contraceptive use.

β_{31} measures the direct effect of adolescents education infant mortality rates.

β_{32} measures the direct effect of contraceptive use on infant mortality rates.

β_{01} measures the direct effect of adolescents education on fertility rates.

β_{02} measures the direct effect of contractive use on fertility rates.

β_{03} measures the direct effect of infant mortality rates on fertility rates.

Decomposition of Total Effect

Based on the relationship defined earlier in fig. 2, we obtained the values of r_{ij} which are to be decomposed into direct and indirect effects. The decomposition of total effect of educational attainment of adolescents on fertility follows the following equation.

$$r_{01} = \beta_{01} + (\beta_{02})(\beta_{21}) + (\beta_{03})(\beta_{31}) + (\beta_{03})(\beta_{32})(\beta_{32})(\beta_{21}) \text{ .... (iv)}$$

where, β_{01} is the direct effect of educational attainment.

$(\beta_{02})(\beta_{21})$ is the indirect effect of educational attainment working through its relationship with contraceptive use.

$(\beta_{03})(\beta_{31})$ is the indirect effect of educational attainment working through its relationship with infant mortality.

$(\beta_{03})(\beta_{32})(\beta_{21})$ is the indirect effect of educational attainment on fertility working through contractive use in turn working through infant mortality.

Treatment of Time Variable (t)

In this study, 3rd-order partial correlation coefficient ($r_{ot.123}$) and coefficient of partial determination ($r_{ot.123}^2$) is estimated for time variable to examine its effect on fertility over the period while effect of all other variables is eliminated. 3rd-order partial correlation coefficient is estimated on the basis of 2nd-order partial correlation coefficients.

$$r_{ot.123} = \frac{r_{ot.12} - (r_{03.12})(r_{3t.12})}{\sqrt{1-(r_{03.12})^2}\sqrt{1-(r_{3t.12})^2}}$$

In the above formula, the first two subscripts in each term refers to the variables of which correlation coefficient is to be calculated.

Data Quality

Data given in Table -1 is regressed using SPSS/PC+ computer software package to estimate the correlation as well as path coefficients. 3rd-order partial correlation coefficient is estimated manually.

Data on infant mortality rates show an irregular pattern over the period 1982 to 1984 (Fig. 3). It is not clear why it is so but one can attribute to the variation in the method of estimating infant mortality rates. Moreover, data on contraceptive use of Nepalese women were found only for two points of time, 1981 and 1986. So, data are extrapolated for the period 1977-1980 and 1982-1985 assuming 1981 as base year. 1986 is assumed to be base year while extrapolating data on contraceptive use for the period 1987-1989. Effect of these irregularities on the findings of the study is supposed to be small and minimal.

Findings

Total Effect

Total effect of adolescent education on fertility in terms of zero-order correlation coefficient, r_{01} is found to be -0.82 indicating strong negative relationship between these variables.

Estimation of Path Coefficients

Solution of the regression equations (i) (ii) and (iii) has resulted path coefficient β_{ij} along each assumed path as follows.

β_{21} = 0.93 = direct influence of adolescents education on contraceptive use.

β_{31} = 0.76 = direct influence of adolescents education on infant mortality rates.

β_{01} = -0.38 = direct influence of adolescents education on fertility.

β_{32} = -1.64 = direct influence of contraceptive use on infant mortality.

β_{02} = -0.34 = direct influence of contraceptive use on fertility.

β_{03} = 0.16 = direct influence of infant mortality rates on fertility.

The following diagram shows more explicitly the estimated path coefficients with respect of each assumed path (Fig. 4).

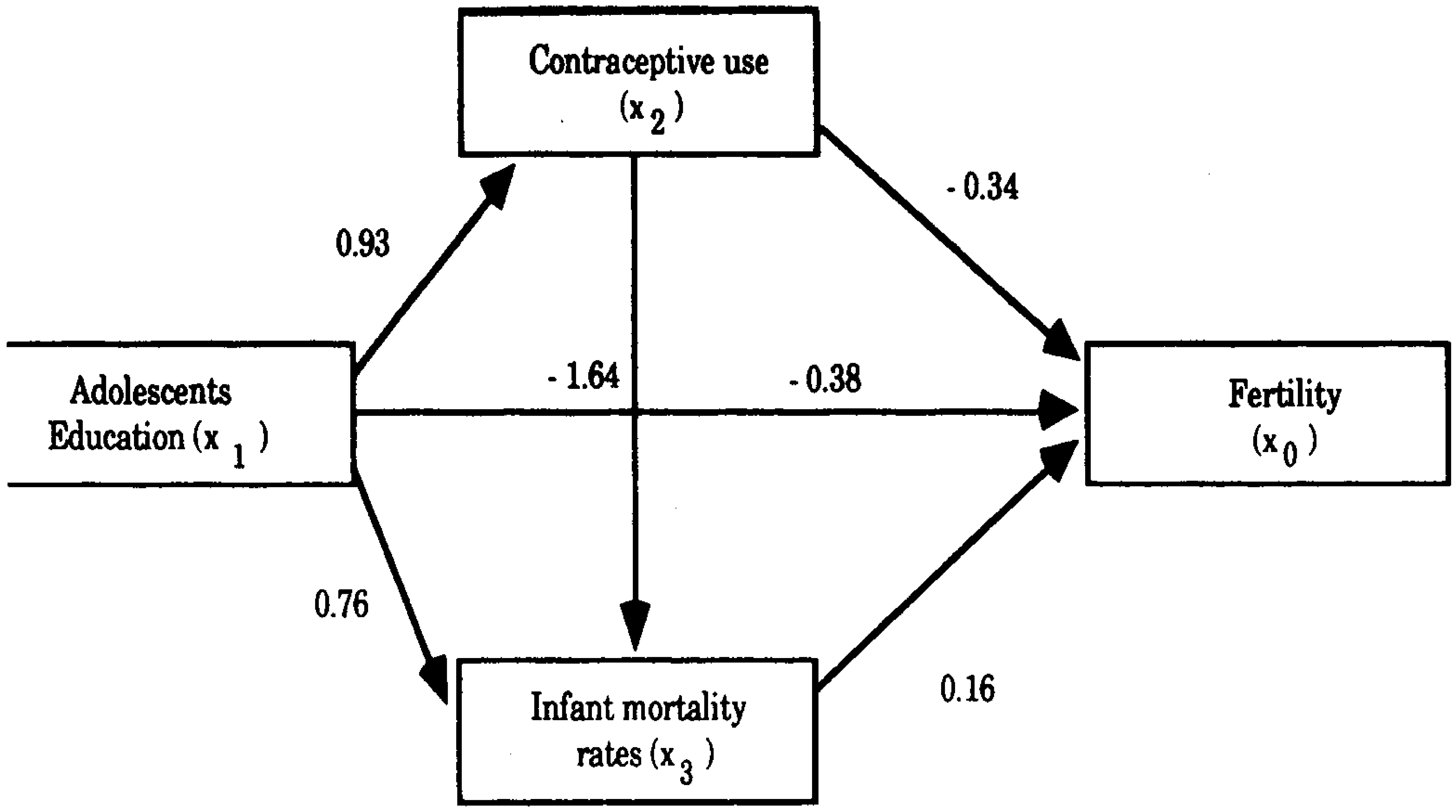


Fig. 4

Decomposition of Total Effect

β_0 = -0.38= direct effect of adolescents education on fertility.

$(\beta_{02})(\beta_{21})$ = (-0.34) (0.93) = indirect effect of adolescents education on fertility working through contraceptive use of women.

$(\beta_{03})(\beta_{31})$ = (0.16) (0.76) = indirect effect of adolescents education on fertility working through infant mortality.

$(\beta_{03})(\beta_{32})(\beta_{21})$ = (0.16) (-1.64) (0.93) = indirect effect of adolescents education on fertility working through contraceptive use in turn working through infant mortality.

Substituting the values in equation (iv) we obtain,

$-0.82 = -.038 + (-0.34)(0.93) + (0.16)(0.76) + (0.16)(-1.64)(0.93)$

Partial Correlation Coefficient

Value of partial correlation coefficient ($r_{ot.123}$) and coefficient of partial determination $(r_{ot.123})^2$ for time variable (t) is found to be 0.37 and 0.14 respectively.

CONCLUSION

This is a quantitative study on reproductive behaviour of Nepalese women in relation to a structural model involving limited number of variables. So, one should comprehend the behaviour relationship of variables within this particular framework since the inclusion of additional variables in the model may not provide the same results. If the structural model given in Fig. 2 is applied to examine the dynamics of fertility in Nepal, any change in fertility during the period must be attributed to change in percentage of adolescents education, contraceptive use of women, and infant mortality rates. Thus, within this implied framework, in Nepal, total fertility rates (TRF) would have been increased by 14 percent (value of $(rot.123)^2$ during the period, if country lacked activities relating to increasing level of adolescents education, contraceptive use of women and declining infant mortality rates. On the other hand, it is also found that these socioeconomic activities had fertility reducing effects over the period. These findings indicate that declining trend in TFR over the period was largely determined by these socioeconomic activities in the country. Direct effect of adolescents education accounted for 44 percent of the total effects on total fertility during the period and the remaining 54 percent indirectly through contraceptive use of women and infant mortality. Higher indirect effect of adolescents education is found through contractive use (73% of the total indirect effect and 39% of the total effect) compared to its effect through infant mortality (27% of the total indirect effect and 15% of the total effect).

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