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Research Article

Structural Linkages between Fertility, Infant Mortality, Contraception and MCH Care in AHS States of India

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Abstract

The study highlights inter linkages amongst district level fertility, infant mortality, contraception, MCH care and marriage age patterns in nine states viz. Uttar Pradesh, Madhya Pradesh, Bihar, Rajasthan, Jharkahand, Uttarakhand, Chattisgarh, Odisha and Assam; where district level Annual Health Survey was conducted in 2010-11. This study formulates a recursive model to highlight the structural linkages between marriage age patterns, usage of contraception, antenatal and delivery care, infant mortality and fertility as endogenous and twelve selected socioeconomic variables as predetermined variables. The parametric estimates of the recursive structural system are based on data from 284 districts of the 9 AHS states. The elicited parametric estimates are utilized to elicit the partial and total effects of exogenous or predetermined variables on the endogenous variables in the system. The study highlights strong inter linkages between fertility, infant mortality, MCH care, contraception, and marriage age patterns. The elicited parametric estimates facilitate prioritization of alternate determinants of fertility, infant mortality contraception and MCH care utilization. The study highlights that infant mortality, usage of modern contraceptives and institutional delivery care depict relatively much stronger inhibitive impact on fertility. Further, female literacy and employment, children's school enrolments, provisioning of Janani Suraksha Yojana, children's immunization, improved sanitation conditions like in-house availability of toilet facility and safe drinking water and exclusive breastfeeding for six months depict higher total effects on fertility and its crucial proximate determinants in the eight demographically backward states. Thus, holistic approach necessitates focused attention on strongly interconnected proximate determinants and socioeconomic development process to accelerate the process of fertility and mortality reduction in these demographically backward states of India.

Introduction

Theoretical and empirical literature highlights strong structural linkages between fertility, infant-mortality, contraception usage, marriage-age patterns, breastfeeding practices, MCH care utilizations, socioeconomic development and environmental factors. The strengths and directional effects and linkages among the factors are discerned to vary under alternate scenarios and combination of factors. Empirical studies have also highlighted the impact of utilization of quality reproductive and child healthcare comprising of obstetric care like antenatal, delivery and postnatal, children's immunization, and family welfare on fertility and mortality.

The Annual Health Survey (AHS) was conceived in a meeting of National Commission on Population chaired by the Hon'ble Prime Minister in 2005 to facilitate comprehensive district profiles of key benchmark indictors to effectively monitor the performance of key health initiatives under National Rural Health Mission launched in 2005 and which became completely operational in 2007. Thus, profiling of districts at regular intervals would provide effective monitoring tools and suggest intervening health corrections to bring out best of results under NRHM. To begin with, it was decided to conduct benchmark survey in the eight demographically backward AHS states. The benchmark

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indicators for 284 districts stretched over nine states viz. Bihar, Uttar Pradesh, Madhya Pradesh, Rajasthan, Uttarakhand, Chattisgarh, Odisha and Assam, hereafter called as AHS states, has provided comprehensive district health profile on key parameters like fertility, infant mortality, access and utilization of maternal, child health, and family planning services, prevalence of disabilities, acute and chronic illnesses, sanitation conditions, etc. for the districts in the AHS states. The survey data or comprehensive district profiles of the benchmark indicators provide an opportunity to highlight the structural linkages between key demographic parameters and utilization of RCH care and socioeconomic and sanitation parameters in the AHS states.

Objectives

This study intends to highlight the structural linkages between fertility, proximate determinants of fertility, RCH care utilization, and socioeconomic development factors in the AHS states of India. For the purpose the factorial investigations would be employed to have semi-quantitative insights into the linkages, which in turn would facilitate formulation of the structural system to highlight exact estimates of partial and total effects of different predetermined or exogenous on the endogenous variables.

The parametric estimates of the structural model would highlight the strength of linkages and would also facilitate prioritization of the RCH-care utilization and socioeconomic and cultural factors towards containment of fertility and utilization of RCH care in these high fertility and demographically backward AHS states. The structural estimates and the effects would facilitate a prioritization of the alternate RCH components and demographic factors to be focused upon towards a cost effective achievement of the population policy objectives.

Database and Methodology

The benchmark key indicators characterizing demographic, RCH care utilization, morbidity and chronic illness, socioeconomic and sanitation profiles of 284 districts stretched over nine AHS states have been selected for the study. The abbreviated names and details of the 18 selected variables for the study are provided in Appendix 1. The basic descriptive statistics of the eighteen selected variables under the purview of the presented study is provided in Appendix 2. The inter linkages are highlighted through factorial investigations. Formulation of the structural model and thereby parametric estimates are elicited using the multivariate technique. The semi-quantitative insights into the linkages among the key indicators are elicited using the Factor Analytical technique. The factorial investigations would facilitate formulation of the structural system. The parameterization of the structural system would also facilitate prioritization of the alternate factors for key endogenous factors and thereby help in eliciting partial and total effects of the exogenous variables on the endogenous variables in the system.

Factor Analysis

Factor analysis reveals strong inter linkages between fertility, infant mortality, MCH care utilization, contraception, and marriage age.

Factor analysis has elicited 6 factors based on the Kaiser criterion of Eigen values greater than unity (Harman, 1978). The Varimax Rotated Factor structure of the 16 selected variables under purview of the present study is provided in the following Table 1. Perusal of Table-1 reveals that fertility, infant mortality, institutional deliveries, antenatal care utilization and marriage age patterns is strongly interconnected. The factor loadings on the first factor are relatively much higher. The direction of linkages is also consistent with the general expectations. Districts with higher fertility have higher infant mortality, lower institutional deliveries, lower utilization of antenatal care, lower usage of modern contraceptives, and higher age at marriage patterns.

Further perusal of the Table reveals that women's empowerment enabling factors like female education and work participation depict negative association with fertility and positive association with institutional deliveries and antenatal care utilization, and positive association with higher age at marriage and usage of modern contraceptives.

Table 1: Varimax rotated factor structure for the 18 selected variables

Factor Loadings, Communalities and Eigen Values							
Variables (Abbreviations)	**Factors**						**Communalities**
	F1	**F2**	**F3**	**F4**	**F5**	**F6**	
TFR	**-0.640**	**-0.436**	**-0.282**	**-0.183**	**0.128**	**0.119**	0.743
IMR	-0.268	-0.229	**-0.645**	0.237	-0.177	0.171	0.657
TINSD	0.244	0.123	0.094	**0.778**	0.251	-0.030	0.752
TANCCOM	0.377	**0.763**	0.082	0.126	0.058	0.109	0.763
TMOD	0.227	**0.345**	**0.324**	**0.558**	0.290	-0.201	0.711
TMFLT18	**-0.735**	-0.096	0.187	0.027	0.269	-0.107	0.669
TFELR	**0.856**	0.043	0.245	0.122	-0.031	0.143	0.831
TCSCER	0.161	-0.228	**0.712**	0.042	-0.164	0.291	0.698
TFWPR	-0.204	**0.769**	-0.093	0.308	0.007	0.043	0.738
THWTF	0.**733**	-0.210	0.183	0.053	0.216	-0.119	0.678
THSDW	-0.036	**-0.781**	0.050	0.271	0.177	-0.070	0.723
THWE	**0.640**	-0.009	0.260	-0.028	0.408	-0.152	0.667
TJSY	-0.092	-0.112	-0.149	**0.823**	-0.107	0.146	0.753
TCFIMM	0.168	0.122	**0.627**	0.236	-0.247	-0.262	0.621
TCSDIA	-0.084	0.071	**-0.378**	0.165	**0.588**	0.321	0.631
TCSARI	0.031	0.223	-0.010	0.042	0.047	**0.842**	0.764
TCBFE6M	-0.092	**0.554**	0.429	-0.031	-0.058	0.220	0.552
TSR	-0.031	0.142	0.061	-0.067	**-0.807**	0.037	0.681
Eigen Values	3.077	2.677	2.075	1.978	1.617	1.208	

Similarly other crucial factors like children's complete immunization depict strong and negative association with infant mortality rate. Also we find higher extent of exclusive breastfeeding for 6 months depict negative association with fertility. Thus, most of the socioeconomic, environmental and program factors depict expected directions of associations with fertility, infant mortality, RCH care utilization, marriage age patterns, and other variables under study through factorial investigations. The semi-quantitative insights into the inter linkages facilitate formulation of the structural model in the following section.

Recursive Structural Model

The recursive model depicts the formulation of the structural equations in which endogenous variables are ordered in such a way that the first endogenous variable has only predetermined or exogenous variables on the right hand side; the second equation contains predetermined variables and the first endogenous variable in the right-hand side; and so on. The special feature of the recursive system facilitates an estimation of equations one at a time by OLS without a simultaneous-equation bias. Furthermore, the OLS estimates of the structural coefficients are unbiased and consistent.

The structural relations in the recursive system can be formulated as follows:

$$Y1 = f(X\,1, X\,2, X\,3, \ldots X\,k; u1)$$
$$Y2 = f(X\,1, X\,2, X\,3, \ldots X\,k; Y1; u2)$$
$$Y3 = f(X\,1, X\,2, X\,3, \ldots X\,k; Y1, Y2; u3)$$
……
…… ,

and so on.

The random variables are assumed to be independent. The special features of a recursive model are that its equations may be estimated one at a time by the OLS estimation technique obviating the simultaneous-equations bias. Assuming that there are G-endogenous variables and k-exogenous variables in the model, the structural form of the recursive model would be as follows:

Functional form of the structural equations under the Recursive Structural Model would be as follows:

$$Y_1 = \Upsilon_{11} X_1 + \Upsilon_{12} X_2 + ..+ \Upsilon_{1k} X_k + u_1$$
$$Y_2 = \Upsilon_{21} X_1 + \Upsilon_{22} X_2 + . .+ \Upsilon_{2k} X_k + \beta_{21} Y_1 + u_2$$
$$Y_3 = \Upsilon_{31} X_1 + \Upsilon_{32} X_2 + ..+ \Upsilon_{3k} X_k + \beta_{31} Y_1 + \beta_{32} Y_2 + u_{3,}$$
.
.
$$Y_G = \Upsilon_{G1} X_1 + \Upsilon_{G2} X_2 + ... + \Upsilon_{Gk} X_k + \beta_{G1} Y_1 + \beta_{G2} Y_2 + \ldots \beta_{G-1} Y_{G-1} + u_{G.}$$

The recursive system being triangular in the sense that the coefficients of the endogenous variables (the β's) form a triangular array; the main diagonal of the array of ß's contains units, and no coefficients appear above the main diagonal. The array of structural parameters can be rewritten in matrix form as follows:

$$ß_{GxG}\, Y_{Gx1} = \Gamma_{Gxk}\, X_{kx1} + U_{Gx1}.$$

The estimated structural parameters can be elicited by application of OLS to each equation yielding unbiased and consistent estimates of the structural parameters ß and Γ.
The reduced form parameters Й can be elicited using the estimated structural parameters of the recursive system as follows:

$$Й = ß^{-1}_{GxG} * \Gamma_{Gxk.}$$

The reduced-form parameters measure the total effect, direct plus indirect of a change in the predetermined variable on the endogenous variable, after taking account of the interdependence among the jointly dependent endogenous variables, while a structural coefficient indicates only the direct effect (Koutsoyiannis, 1977).

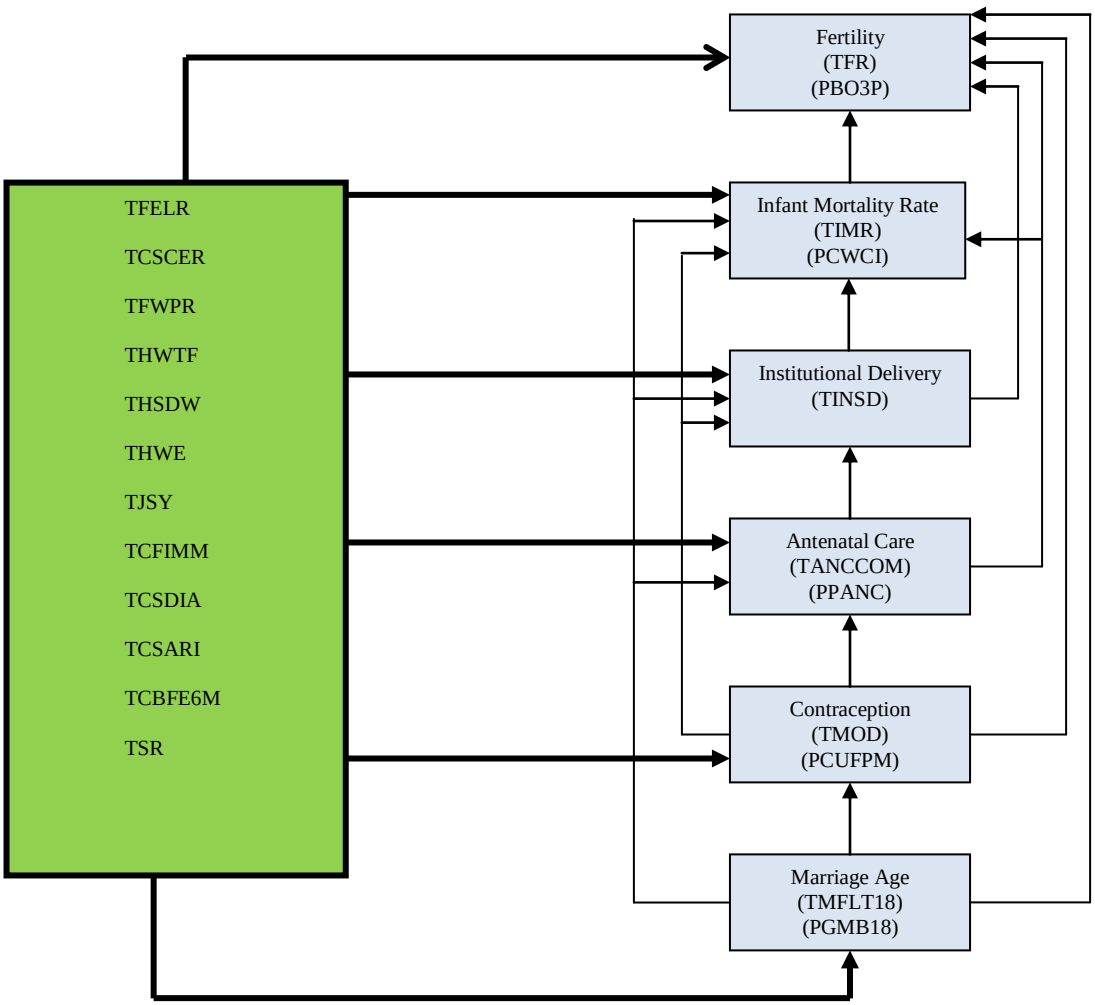
Recursive Structural Model Formulation

Six equation recursive structural models for the present study are formulated with six endogenous variables and twelve predetermined or exogenous variables under the purview of the present study. The flow chart clearly reflects that fertility (TFR) has five endogenous predictors (five arrows from the five smaller rectangular boxes) and all the twelve exogenous variables (arrow from bigger rectangular box). Furthermore, infant mortality rate (IMR) has four endogenous variables and twelve exogenous variables as predictors. Likewise, the lowermost small rectangular box depicts that marriage age (TMFB18) has only all the twelve exogenous and none of the endogenous variables as predictors. Thus, the first structural relation depicts that marriage age patterns namely, percent girls married below the age of 18 years (TMFLT18) providing extent of girls getting married at younger ages i.e. below 18, the legal age at marriage, is predicted by the twelve socioeconomic, program and sanitation factors under the purview of the present study. The second structural relation depicts that usage of contraception characterized by percent couples using modern family planning methods (TMOD) are determined by all the twelve predetermined variables alongwith first endogenous variable viz.TMFB18.

The third structural relation which depicts the extent of utilization of antenatal care characterized by percent pregnancies in which the complete antenatal care was utilized (TANCCOM) is determined by all the twelve exogenous variables alongwith marriage age patterns (TMFB18) and usage of contraception (TMOD). The fourth structural relation that depicts the extent of institutional deliveries characterized by percent deliveries in health institutions (TINSD) being determined by all the predetermined variables along with marriage age patterns, contraception usage and extent of

utilization of antenatal care. The fifth structural relation depicts that infant mortality rate (IMR) gets determined by all the predetermined variables alongwith four of the endogenous variables viz. TMFB18, TMOD, TANCCOM, and TINCD. The sixth structural relation depicts fertility characterized by total fertility rate (TFR) being a function of all the five endogenous variables viz. TMFB18, TMOD, TANCCOM, TINCD, and IMR; in the system and all the twelve predetermined variables.

Fig.1: Flow diagram for the integrated fertility, infant mortality, RCH care utilization and marriage age recursive structural model



Parametric estimates of the structural model

Women's age at marriage (TMFLT18) is discerned to be significantly influenced by women's empowerment enabling factors like female education (TFELR) and school enrolment ratios (TCSCER). Perusal of Table 2 reveals significant inhibiting impact of the two exogenous variables in lowering age at marriage. Alternatively, districts with a higher female literacy, school enrolment ratios and work participation depict higher marriage age patterns among girls. It is of interest to note that higher female-male sex ratio (TSR) is also depicting significant and inhibitive effect on age at marriage of girls. Usage of modern methods of contraception (TMOD) seems to be significantly affected by female literacy (TFELR), school enrolment ratios (TCSCER) and female work participation rate (TWPR). Further, we find that districts depicting higher percentage of mothers who availed financial assistance for delivery care (TJSY) also depict higher usage of modern methods of contraception. Possibly, grass root health functionaries who motivate mothers for institutional

deliveries and availing of financial assistance may also be counseling others for usage of modern methods of contraception.

Utilization of complete antenatal care (TANCCOM) among women who experienced live birth during the reference period of three years prior to the survey is discerned to be significantly impacted positively by the age at marriage and usage of modern methods of contraception. Alternatively, districts depicting higher age marriage i.e. with lower percent of marriages below 18, and higher usage of modern contraception methods depict significantly higher utilization of complete antenatal care. Among predetermined variables we find female work participation as well higher percent of mother availing financial assistance under JSY also depict significantly higher utilization of the antenatal care. It is of interest to note that the women's empowerment enabling factors depict a relatively stronger impact on the antenatal care utilization Also we find that percent of mothers who exclusive breastfeed their newborn children for six months are also discerned to have significantly higher utilization of the antenatal care. Possibly, districts with active participation of grass root health workers also depict higher extent of counseling to pregnant women for availing antenatal and institutional delivery care.

Table 2: Parametric Estimates of the Recursive System's Structural Relations

Endogenous or dependent variables						
Predictor Variable	TMFLT18	TMOD	TANCCOM	TINSD	IMR	TFR
(Constant)	50.037*	4.675*	-14.431*	-81.956*	77.521*	6.572*
IMR						0.011*
TINSD					-0.157*	-0.007*
TANCCOM				0.240	0.064	-0.009***
TMOD			0.090*	0.523*	-0.205*	-0.008*
TMFLT18		-0.004	-0.090*	-0.261*	0.232*	0.001
TFELR	-0.654*	0.208**	0.071	0.674*	-0.219***	-0.021*
TCSCER	-0.180**	0.377*	-0.012	0.024	-0.128	0.002
TFWPR	-0.005	0.389*	0.100**	0.030	0.164*	0.001
THWTF	0.000	0.078	-0.016	-0.249*	-0.076	-0.007*
THSDW	-0.002	-0.008	-0.093*	0.070**	0.126*	-0.007*
THWE	0.014	0.046	0.268*	0.573*	-0.258*	-0.002
TJSY	0.048	0.143**	0.074*	0.774*	0.032	-0.005
TCFIMM	0.036	0.206*	-0.028	-0.165*	-0.168*	0.002
TCSDIA	0.000	0.389	0.098	0.194	0.034***	0.009
TCSARI	0.041	-0.259*	0.018	-0.254*	0.075***	0.006
TCBFE6M	-0.021	-0.003	0.105*	0.053	-0.164*	0.001
TSR	-0.019**	-0.045*	0.010**	0.001	0.016	-0.002*
R-Square	0.564	0.667	0.800	0.786	0.635	0.838

*, ** & *** denotes level of significance at 1%, 5% and 10%

Crucial determinants of infant mortality are institutional deliveries, children's immunization and exclusive breastfeeding for six months

Institutional deliveries (TINSD) are significantly higher among women using modern methods of contraception as well as having higher marriage-age patterns. Again we find female literacy depicts significant and positive impact on institutional delivery-care utilization. Provisioning of financial assistance under Janani Suraksha Yojana has significantly improved institutional deliveries in the AHS states. It is of interest to note that even improvement in infrastructural facilities like availability of electricity and safe drinking water also depicts significant and positive impact on the institutional deliveries.

Infant mortality rate (IMR) is discerned to be significantly affected by lower in districts with higher usage of modern methods of contraception and higher age at marriage. Similarly, higher usage of antenatal care also depicts significant impact in lowering infant mortality rate in the AHS states. Thus, higher institutional deliveries and higher usage of modern methods of contraception facilitates lowered infant mortality. Increased age at marriage also facilitates significant decline in infant mortality. Coming to predetermined variables we find that female literacy depicts significant negative impact on infant mortality. Theoretically, children's immunization is supposed to predominantly impact post neonatal component of infant mortality and thus depicts significant impact on infant mortality rate in the AHS states. However, children's complete immunization is also discerned to have significant impact in lowering infant mortality. Thus, higher utilization of antenatal care and children's immunization seems to be predominantly responsible for lowering infant mortality rate in the AHS states.

Total fertility rate (TFR) is significantly affected by other four out of other five endogenous variables viz. infant mortality rate, institutional deliveries, antenatal care, and usage of modern methods of contraception. The directional effects of all the four significant endogenous variables are consistent with the general expectations. Such as infant mortality depicts positive and utilization of obstetric care and modern methods of contraception depict negative impact on fertility. Coming to exogenous variables we find that female literacy, availability of infrastructural facilities like safe drinking water and toilet facility, possibly characterizing higher economic status, depict significant and negative impact on fertility. Again we find that higher female-male sex ratio depicts significant but negative impact on fertility in the AHS states.

Prioritization of factors affecting fertility revealed by standardized coefficients we find infant mortality rate, institutional deliveries and usage of modern methods of contraception need focused attention towards curtailment of fertility in the AHS states (Appendix 3). Among exogenous variables we find that female literacy, provisioning of safe drinking water and toilet facility within house-premises need to be focused towards fertility reduction. Further, infant mortality reduction necessitates higher extent of institutional deliveries, children's immunization and higher extent of exclusive breastfeeding practices for six months of the newborn children. Institutional deliveries and utilization of complete antenatal care are discerned to be higher among women marrying late and using modern method of contraception. It is of interest to note that most of the endogenous variables are discerned to reinforce each other and strongly interconnected.

Infant mortality reduction, usage of modern contraceptives, female literacy and employment, and improved sanitation conditions depict relatively much stronger inhibitive impact on fertility.

Partial and total effects of the predetermined variables on the endogenous variables

The direct or partial effects of the predetermined variables have been highlighted earlier while discussing the parametric estimates of the structural system in the earlier section. Furthermore, the total effects of the predetermined variables elicited through estimated reduced form parameters are presented in the following Table 3.

Marriage age patterns (TMFLT18) being the first structural relation in the recursive model would obviously depict partial and total effects that are exactly the same. Coming to total effects of predetermined variables on usage of contraception we find that most of the partial effects get compounded as indirect effects routed through marriage age patterns get compounded with the direct effects on usage of contraception. However, the changes are not substantial as marriage age patterns donot depict any significant impact on contraception usage. The total effect of female literacy on utilization of antenatal care (TANCCOM) gets compounded and becomes significantly higher (0.149) compared with its partial effect (0.071), as its indirect effects routed through marriage age and especially contraception usage, which bear a significant effect on antenatal care. Similarly, we find that total impact of female work participation (0.135) turns out to be much higher compared to its direct effect (0.100), as it had significant impacts on age at marriage as well as usage of contraception, which get compounded while depicting total effect on utilization of antenatal care.

Table 3: Partial and total effects of the predetermined on the endogenous variables in the recursive system model

Partial and Total Effects of Predictor Variables on Six Endogenous Variables							
Exogenous Variable	Effects	TMF-LT18	TMOD	TANC-COM	TINSD	IMR	TFR
TFELR	P	**-0.654**	**0.208**	**0.071**	**0.674**	**-0.219**	**-0.021**
	T	**-0.654**	**0.211**	0.149	0.991	-0.560	-0.038
TCSCER	P	**-0.180**	**0.377**	**-0.012**	**0.024**	**-0.128**	**0.002**
	T	**-0.180**	**0.378**	0.038	0.278	-0.288	**-0.007**
TFWPR	P	**-0.005**	**0.389**	**0.100**	**0.030**	**0.164**	**0.001**
	T	**-0.005**	**0.389**	0.135	0.267	-0.278	**-0.008**
THWTF	P	**0.000**	**0.078**	**-0.016**	**-0.249**	**-0.076**	**-0.007**
	T	**0.000**	**0.078**	**-0.009**	**0.288**	-0.138	**-0.011**
THSDW	P	**-0.002**	**-0.008**	**-0.093**	**0.070**	**0.126**	**-0.007**
	T	**-0.002**	**-0.008**	**-0.094**	**0.044**	**0.114**	**-0.009**
THWE	P	**0.014**	**0.046**	**0.268**	**0.573**	**-0.258**	**-0.002**
	T	**0.014**	**0.046**	**0.271**	**0.658**	**-0.350**	**-0.013**
TJSY	P	**0.048**	**0.143**	**0.074**	**0.774**	**0.032**	**-0.005**
	T	**0.048**	**0.143**	**0.083**	**0.856**	-0.115	-0.014
TCFIMM	P	**0.036**	**0.206**	**-0.028**	**-0.165**	**-0.168**	**0.002**
	T	**0.036**	**0.206**	**-0.013**	**0.260**	-0.244	**-0.004**
TCSDIA	P	**0.000**	**0.389**	**0.098**	**0.194**	**0.034**	**0.009**
	T	**0.000**	**0.389**	**0.133**	0.429	-0.105	**0.001**
TCSARI	P	**0.041**	**-0.259**	**0.018**	**-0.254**	**0.075**	**0.006**
	T	**0.041**	**-0.259**	**-0.009**	-0.402	0.200	**0.013**
TCBFE6M	P	**-0.021**	**-0.003**	**0.105**	**0.053**	**-0.164**	**0.001**
	T	**-0.021**	**-0.003**	**0.107**	**0.083**	**-0.174**	**-0.002**
TSR	P	**-0.019**	**-0.045**	**0.010**	**0.001**	**0.016**	**-0.002**
	T	**-0.019**	**-0.045**	**0.008**	**-0.016**	**0.024**	**-0.001**

P: Partial Effects; T: Total Effects

Coming to total effects on institutional delivery (TINSD) we find that the total impact of female literacy turns out to be substantially higher (0.991) compared with its direct effect (0.674). Furthermore, the significant direct effects of school enrolment ratios, female work participation rate, incidence of diarrhea and acute respiratory infections get compounded and thus total effects are substantially higher than their direct effects. Total effects of female literacy (-0.560), school enrolment ratios (-0.288) and female work participation rate (-0.278) are substantially higher than their direct effects on infant mortality rate. Further we find that total impact of *Janani Suraksha Yojana* (JSY), and children's immunization is much higher on infant mortality rate compared with their direct effects. Still further we find that total effects of incidence of diarrhea and acute respiratory infections also turn out to be substantially higher compared with their direct effects on infant mortality.

Coming to fertility (TFR) we find that the total inhibitive effect of female education (-0.058) is substantially higher than its direct effect (-0.021). Furthermore, women's employment also depicts a much higher inhibitive total impact (-0.008) compared with its direct effect (-0.001). It is again because of the fact that female work participation rate had significant effect on usage of contraction and obstetric care and which in turn depict significant impact on total fertility. Thus, the total effect of female work participation gets compounded compared to its direct effect on fertility.

Summary and concluding remarks

The recursive model comprising six structural linkages integrating fertility, infant mortality, obstetric care utilization, contraception usage and marriage age patterns as endogenous and twelve predetermined or exogenous variables comprising female literacy and work participation, children's

school enrolments, immunization, incidence of diarrhea and acute respiratory infections, infrastructural characteristics, etc. Strong inter-linkages between fertility, infant mortality, usage of contraception, antenatal and delivery care and marriage age patterns got evidenced through factorial investigations and which facilitated formulation of the recursive structural model with six endogenous and twelve exogenous variables.

The relative significance of infant mortality reduction, widespread utilization of institutional delivery care, and usage of modern methods of contraception towards fertility reduction in the AHS states gets depicted by the standardized regression coefficients. Out of predetermined variables we find female literacy, infrastructural variables like availability of safe drinking water and toilet facility within house-premises, possibly characterizing economic status or living standards, depict significant impact on fertility reduction. Thus the holistic approach towards fertility reduction necessitate focused attention on reduction in infant mortality, increased usage of modern contraceptives, and utilization of obstetric care, especially institutional delivery care. Female education and children's school enrolments apart from being women empowerment enabling factors also depict widespread impact on the demographic parameters like infant mortality and fertility.

Women's empowerment enabling factors, especially female education and employment, are discerned to play an important role towards utilization of the RCH quality care package in India. These have all pervasive effects on the promotion of higher marriage age patterns, usage of modern contraception, and utilization of antenatal and delivery care. Women's empowerment was also placed in the center stage in the International Conference on Population and Development held in Cairo in 1994, after which paradigm shifts in India's population policy also got documented in the National Population Policy. Thus, women's empowerment can facilitate a wider usage of RCH quality care and also fertility reduction.

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Appendices

Appendix Table 1: Description of the Selected Variables under Study for AHS States

Abbreviated Name	Description of the Variable
TFR	Total Fertility Rate
IMR	Infant Mortality Rate
TINSD	Total Percent of Institutional Deliveries
TANCCOM	Total Percent Mothers Who Received Completer Antenatal Care
TMOD	Total Modern Methods of Contraception sage
TMFLT18	Total Percent Marriages among Females below 18 Years during Last 3 Years
TFELR	Total Female Literacy rate
TCSCER	Total Percent Children Currently Attending School
TFWPR	Total Female Work Participation Rate
THWTF	Total Percent Households Having Toilet Facility
THSDW	Total Percent Households Having Safe Drinking Water Facility
THWE	Total Percent Households with Electricity
TJSY	Total Percent Mothers Availed Janani Suraksha Yojana
TCFIMM	Total Percent Children Aged 12-23 Months Fully Immunized
TCSDIA	Total Percent Children Suffering from Diarrhoea
TCSARI	Total Percent Children Suffering from ARI
TCBFE6M	Total Percent Children Breastfed Exclusively for 6 Months
TSR	Total Sex Ratio (Women to Men)
Valid Cases	284

Appendix table 2: Descriptive statistics of the 18 selected variables for 282 districts in 8 annual health surveyed states, India

Variable	Minimum	Maximum	Mean	Standard Deviation
TFR	1.70	5.90	3.20	0.71
IMR	19.00	103.00	60.51	13.90
TINSD	16.80	92.50	56.19	18.49
TANCCOM	0.60	36.00	9.72	7.45
TMOD	7.60	75.60	42.84	13.40
TMFLT18	0.50	53.90	13.18	10.29
TFELR	36.90	84.90	61.93	9.56
TCSCER	10.30	98.10	87.01	6.80
TFWPR	0.00	65.20	18.30	14.45
THWTF	8.80	95.30	34.88	20.88
THSDW	2.60	100.00	73.21	30.87
THWI	4.30	58.60	18.33	10.30
TJSY	32.60	98.00	86.08	10.57
TCFIMM	11.90	93.20	57.97	17.73
TCSDIA	1.90	38.10	12.09	5.63
TCSARI	1.00	59.60	13.27	8.68
TCBFE6M	1.20	78.70	28.87	16.43
TSR	818.00	1220.00	951.88	66.15
Valid Cases	284			

Appendix Table 3: Standardized Coefficients (β's) of the Recursive Structural Model

Standardized Coefficients (βs) of the Recursive System Model						
	TMFLT18	**TMOD**	**TANCCOM**	**TINSD**	**IMR**	**TFR**
IMR						**0.209**
TINSD					**-0.210**	**-0.194**
TANCCOM				0.097	0.035	-0.095
TMOD			0.162	0.379	**-0.198**	**-0.147**
TMFLT18		-0.003	-0.125	-0.145	0.172	0.022
TFELR	**-0.608**	0.148	0.091	**0.348**	-0.151	**-0.276**
TCSCER	0.119	0.191	-0.011	0.009	-0.063	0.016
TFWPR	-0.007	0.**419**	0.193	0.024	0.171	0.011
THWTF	-0.001	0.122	-0.045	-0.281	-0.115	-0.201
THSDW	-0.005	-0.019	-0.386	0.118	**-0.279**	**-0.315**
THWI	0.013	0.035	**0.369**	0.317	-0.190	-0.025
TJSY	0.049	0.113	0.105	0.442	0.024	-0.067
TCFIMM	0.063	0.272	-0.066	-0.157	**-0.214**	0.040
TCSDIA	0.000	0.162	0.074	0.059	0.014	0.068
TCSARI	0.035	-0.168	0.021	-0.119	0.047	0.070
TCBFE6M	-0.033	-0.003	0.230	0.047	**-0.193**	0.015
TSR	-0.122	**-0.223**	0.090	0.004	0.078	**-0.218**