Framing Correlates of Stillbirths in India:
A Path Analysis Approach

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Despite further improvement in maternal and child health care services, stalling of infant and child mortality rate over the period in most of the developing countries including India has paved the way for research in the area of child survival in perinatal or neonatal period. Since stillbirths contribute a significant portion in the component of perinatal mortality, investigating the magnitude of its plausible determinants would be desirable from the policy point of view. The present study has made an approach to review the trends of stillbirths in India with a view to explain the factors determining the state-wise differentials in the stillbirth rate. The data from Sample Registration System (SRS) and 3 rounds of NFHS has been used for the analysis. The results show that household environmental standard seems to lay positive impact in regulating the occurrence of stillbirths in India.

Key words: stillbirths, late fetal deaths, perinatal mortality, path analysis approach, household environmental standard

1. Introduction

Stillbirths or late fetal deaths refer to deaths prior to the complete expulsion or extraction from their mother of a product of conception, after 28 weeks' of pregnancy (gestation); the death is indicated by the fact that after such separation, the fetus does not breathe or show any other evidence of life, such as beating of the heart, pulsation of the umbilical cord, or definite movement of voluntary muscles[1].

Stillbirth is a valuable health status indicator. A high stillbirth rate implicates maternal health and physique as a primary factor in mortality (and fertility). This is its utility for historical research on procreation. Where death occurs in utero the environment is mediated by the mother's body, which is the fetal lifeline and a means of environmental insulation. The female body is the instrument of human procreation, and stillbirth is a good indicator of its capacity, its vitality. Since female physique reflects material conditions and the distribution of subsistence between the sexes, stillbirth is also an important potential indicator of inequality between them. In fact, the frequency of late fetal death usually only enters demographic analysis as a glitch, where its possible confusion with live born death inflates an estimate of infant mortality (Hart, 1998).

The exclusion of stillbirth hampers demographic analysis, underestimates progress in newborn vitality, and over-privileges post-natal causes in theoretical explanation (Hart, 1998). However, the growth in collection of information related to fetal loss is not yet satisfactory. Much of the lack of information stems from difficulties, inherent in the study of fetal deaths. For a variety of reasons adequate records are difficult to obtain (Freedman, 1996), especially, in developing countries like India. Complete medical histories do not exist for most of the population and the official records available are usually of doubtful accuracy. Reconstructing

pregnancy histories has not proved a satisfactory substitute. Early miscarriages are difficult to identify, and problems of memory and willingness to report fetal deaths are large. More important, among fetal deaths which are reported, induced abortions are difficult to separate from spontaneous abortions (Freedman, 1996).

However, if not since a long period, the information on still births can be availed in India for at least thirty years back from the records of Sample Registration System (SRS), which is a kind of sample survey with dual record system, conducted by the Govt. of India. This is only source of its kind in India, which provides data for various demographic indicators including stillbirth rate for almost all major states in India on annual basis.

The present study has made an approach to review the trends of stillbirths in India with a view to explain the state-wise differentials in stillbirth rate. The researches in the area of infant and child mortality at present, especially in most of the developing countries (like India) are repeatedly concluding the result that the infant and child mortality rates, which were declining significantly with the improvement in maternal and child health care services, now have achieved saturation. Studies show that the health care and other programmatic factors work significantly after a few months of the child's birth. However, to confront the threat to survival of the baby in perinatal period is the most challenging work in this area at present.

Since, stillbirths contribute a significant portion in the component of perinatal mortality, investigating the magnitude of plausible determinants would be desirable from the policy point of view. Stillbirth reflects aspects of reproductive mortality that are not revealed in the more conventional measure of infant mortality. It has biological as well as other socio-economic and psychosocial origin. It was the exposure of these aspects that led Heady and Morris to attempt a separation of the 'social' and 'biological' causes of fetal and infant deaths occurring in Britain in 1949-50. At the time, stillbirths numbered 23 per 1000 total births with infant deaths contributing a further 30 deaths (neonatal 19.5 and post-neonatal 11).

The 'biological' factors in reproductive mortality included maternal characteristics: age, number of previous births, and space between births. The social factors included social class and region. Morris and Heady showed the risk of stillbirth to be highly correlated with low social class, maternal age, and parity. Age of mother is important; very young women and older women have more fetal deaths than others (Differences in fetal mortality by age have been described in Kiser, 1942; United Nations, 1954; Foti, 1962; Shapiro et al, 1962). Gravidity, or the number of pregnancies a woman has had, is also a critical factor (Kiser, 1942; United Nations, 1954; Freedman, 1959; Shapiro, 1962). Parity differences in fetal mortality are substantial.

Moreover, McMillen (1979) concluded in his study, "The data for the sex ratio of fetal deaths indicate a disproportionately high level of male mortality in utero; the pattern of this mortality differential is systematic and tends to be relatively constant over the 38 years of available data".

However, apart from the biological and demographic correlates of stillbirths, the effect of external environment (e.g. physical or social) faced by the prospective mother is also worth significant, because these are preventable. Ahmad et al. (2001) shows that the arsenic water contamination is also a threat to healthy and safe pregnancy outcomes. Malaria infection is considered to be higher among pregnant than non-pregnant women and leads to anaemia, miscarriage, intra-uterine fetal death, premature delivery, low birth weight and maternal death (see Singh, 1999).

A few studies have addressed the effect of maternal employment on the pregnancy outcomes. Savitz et al. (1996) considered jobs held at any time during pregnancy and jobs held during the fifth month of pregnancy, and showed the relative influence of type of jobs during the pregnancy and the pregnancy outcome.

Information on the socio-economic correlates of fetal deaths is scanty. However, a certain amount of information relates such socioeconomic factors as family income and mother's education to fetal death rates in various countries. Where relationships among fetal death rates and various economic variables have been found in the past, the interpretation has usually been that socioeconomic factors may be responsible for certain physical conditions, for differences in the maternal care and hence maternal health, thereby affecting the fetal death rate (Freedman, 1966). Nutritional deficiencies among low income women have been found to contribute to a higher fetal death rate (United Nations, 1954).

Some, but not all, earlier studies in the United States suggest a negative relationship between income and fetal mortality. Woodbury and Rochester, in a series of studies conducted in seven United States cities during 1911-1915, found a negative relationship between stillbirths and family income. Clyde Kiser (1942), however, considering specialized studies done before 1940, concluded that spontaneous abortion and stillbirth rates did not differ greatly among socioeconomic classes for urban, white, married women. His study of married white women based on the National Health Survey (1935-36) showed the highest rate of wastage within each age category in the lowest income class. This group comprised non-relief families whose annual income was less than 1000 dollars and all families partially or wholly on relief. The pattern for incomes above this level, however, was irregular.

Having such background, the present study attempts to utilize the available plausible information on stillbirths and their potential correlates in Indian context, and to frame the trends of their contributions in stirring or sinking stillbirths in Indian perspective comprehensively.

2. Data and Methodology

2.1. Sources and Nature of Data

The analysis in the present paper is based on the data received from the Sample Registration System, using published reports of a series of volumes from 1970 to 2005. With a view to generate reliable and continuous data on various vital event indicators, the Office of the Registrar General, India initiated the scheme of sample registration of births and deaths in India, popularly known as SRS, in 1964-65 on a pilot basis and on a full scale from 1969-70 (following the Registration of Births and Deaths Act, 1969). The SRS since 1970 has been providing the estimates on several fertility and mortality indicators including stillbirth rate.

In addition, the three rounds of National Family and Health Survey (NFHS-I, NFHS-II and NFHS-III) conducted during the last decade and the recent one (IIPS, 1995; IIPS and ORC MACRO, 2000; and IIPS and ORC MACRO, 2007) have been used to explore the state level data on various aspects of socio-economic development, fertility pattern and health programme efforts at three points of time. NFHSs provide sufficient information on the household standard (judged by several asset variables and/or by belongings) as well as some aspects of demographic and health information related to ever-married women of reproductive ages (15-49 years) and their children (born 3-5 years before respective surveys). The present exercise also used the compiled data on the population below poverty line at three points of time from Handbook of Statistics on the Indian Economy, Reserve Bank of India, 2006-07.

2.2. Description of Variables

A detailed description of different variables has been compiled in Table 1. All these variables have been used in analysis under two broad dimensions i.e. socio-economic development indicators and the programme or policy related indicators. The latter also include some of the variables related to risky fertility behaviour, considering this fact that programmes or policies might have impact or control over the risky fertility behaviours as well as the size of family (in terms of children born).

Though, there are numerous aspects, which are related to mother's care during pregnancy, and factors those have adverse impact on the pregnancy outcomes, however, it was not feasible to incorporate all the causative factors, which lead to stillbirths directly or indirectly. The main constraint was put ahead by the lack of information, even though; the present exercise was not going for individual level analysis.

The proportion of female births in last three years before the respective surveys has been included as a socio-economic development indicator. This primarily follows the assumption that, particularly in Indian context, if a woman has one or two female births in advance, there is tendency among Indian mothers to have next birth as male child. Such feelings reflect, in some or other way, the gender bias towards the male child and the mother during their pregnancy takes special care for desirable outcome. Hence, with this assumption in mind, it is expected that this particular variable might have negative relationship with the occurrence of still births.

2.3. Methods of Analysis

The basic intention or the objective behind the present study was to analyze the different causative factors which were responsible for the state level differentials in the stalling of the still birth rate over a long period of time, as well as to appraise the changes among different predictors of stillbirths during the period (1990-2005). SRS provides the stillbirth rate for India and its states, separately for rural and urban areas and that was taken as the dependent or response variable at three points of time, viz. 1991-93, 1997-99 and 2003-05, after computing the moving averages of yearly rates. Turning to the explanatory variables, the analysis has broadly considered two dimensions viz. socio-economic development as well as the programme efforts and its reach.

The state has been considered as the unit of analysis. So, it was not possible to include a very large number of independent variables in the multivariate analysis. Accordingly, the multivariate analysis restricts the number of variables to be included, as the number of observation is small and extremely small numbers of cases per cell are likely to lead to unstable estimates. The rationale behind the present state-level multivariate analysis lies in: a) Firstly, the information or data related to stillbirths in India was not available in the form that could be analyzed on the individual level, and b) The state or district is a useful unit of analysis, bearing in mind the social and programmatic dimension of fertility and mortality changes. Fertility and health care decisions tend to be highly interdependent owing *inter alia* to the influence of social norms, cultural practices and diffusion effects, while on the other hand the effectiveness of the health and family planning programme and its reach to the community depends on the state or district administration.

Considering the variables and panel of data selected for the analysis of stillbirths, the regression equation takes the form;

$$SBR_{st} = \alpha_s + \beta X_{st} + \gamma t + Єst$$

where, SBR_{st} refers to the stillbirth rate in state 's' at time 't', α_s is a state specific effect, β is a vector of coefficients, X_{st} is a vector of explanatory variables, γt is a time dummy, Єst is an error term.

To understand the pathways of direct or indirect influence of various socio-economic and/or programme-policy related variables in explaining the state level differentials in still birth rate, the relevant variables on the basis of their significance; have been selected further, for the path analysis. The structural equation for deriving the path ways can be understood as follows;

$$z = p_{zx}\, x + p_{zy}\, y$$

where, $p_{zx} = b\,(\sigma_x / \sigma_z)$

p_{ij} denotes the path coefficients (i.e. the standardized regression coefficients) which are estimated through standardized regression technique (Rutherford and Choe, 1993). Using the regression results, path coefficients for direct and indirect effects of the variables on stillbirths have been derived.

4. Results and Discussion

4.1. Results from Multivariate Analysis

As can be observed in fig 1.1, there was large differentials in the level of still birth rate (SBR) in the different states of India in 1990-93. The SBR ranges from about 3 per 1000 births in Rajasthan to 23 per 1000 births in Karnataka. One can find the clear distinction among the states, that the SBR was high in the well developed states like Karnataka, Punjab, Andhra Pradesh, West Bengal, Haryana, Maharashtra, Tamil Nadu etc., while all the EAG (Empowered Action Group)[2] states e.g. Bihar, Uttar Pradesh, Rajasthan, Madhya Pradesh, Orissa had recorded very low SBR in comparison to other states. If such distinction could have been explained by the level of development only, it would have been very easy to explain the mechanism. However, the estimated rates (SBR) itself indicate bias in reporting of fetal deaths, which is clear from the results of EAG states that somewhere there might be gaps in the registration processes in well functioning states and on the other side, in states which are supposed to struggle with the poor performances in every dimension. The differentials across states have rather increased in later periods (see fig. 1.2 and fig. 1.3). There appears considerable distinction between rural and urban areas as well. Where in urban areas, during the period 1996-99, there was hardly any considerable difference in the stillbirth rates of Kerala, Madhya Pradesh, Rajasthan, Maharashtra, Orissa and Punjab; SBR in rural areas was ranging from 4 per 1000 births in Bihar and Rajasthan to 17-18 per 1000 births in Punjab, Orissa and Karnataka. Therefore an attempt has been made to explain these state-wise differentials in still birth rate over time since the inception of the last decade to the recent period (2003-05). The changes in the explanatory factors or predictors over the period would certainly reveal the consistency or inconsistency among the variables, which could ultimately help in determining the occurrence of stillbirths.

The multivariate analysis was carried out in three stages. The first stage complied with the fitting of models consisting of socio-economic variables only. The objective was to assess the relative importance of each of the variables in this set and to identify a base model of control variables for the analysis of the programme variables. Similarly, another multivariate model containing the programme and other variables was fitted to assess the relative importance of each of the variables in the set. Finally, these two sets of variables which were found escalating the power of the model significantly related to stillbirths, were regressed together in Model-3 to

assess the net effect of each of the undertaken variables. These three stages of multivariate analysis were done for the period 1991-93, 1997-99, and 2003-05 as well as for the combined data set including the period 1991 to 2005. In addition, this complete exercise was repeated for rural and urban areas separately to capture the differences in mechanism, involved in distinct rural and urban settings. However, the separate results for rural and urban areas have not been comprised in the present paper.

As can be seen in Table 2; the three columns present the results of regression analysis for the three different periods, while the last one deals with the samples pooled for the entire period (1991-2005). Here we can observe that in totality, both the sets of variables explain more or less the same magnitude of variation in stillbirths across the states in India. One can scrutinize very clearly that over the period from 1991-93 to 2003-05 the value of R^2 (which indicates the percent of variation explained by any particular model) has been increased from 0.38 to 0.65. It means that the socio-economic development indicators explain more than 50 percent of variation in stillbirths across the states during the period 2003-05. Moreover, it indicates that the role of socio-economic factors in influencing the occurrence of stillbirths has increased over the years. Among different indicators of socio-economic development, exposure to mass media seems to leave strong impact upon the occurrence of stillbirths, which has been statistically significant over the period. However, the relationship between the mass-media exposure and stillbirths looks negative and of course unpersuasive, which cannot be appreciated by the general research community. On the other hand, when we look at the relationship between women's education and the incidence of stillbirths, we get satisfactory result that with the increase in the level of women's education, stillbirths seem to decrease. Hence, the conclusion we can derive from this result is that if the uneducated women are 'so-called' exposed to mass-media, the impact would not be rather optimistic as far as the occurrence of stillbirths is concerned. Here, one can also argue on the nature of indicator itself, which represents exposure to mass-media. In surveys like NFHS, it is asked from the respondent that in last one week or in last one month, have you once read the newspaper, have you listened radio or have you once visited to theater etc, but up to what extent it would capture the real awareness among the people, it cannot be answered.

The proportion of female births in last three years preceding the respective surveys show significant negative relationship with the incidence of stillbirths. This relationship confirms that there is less chance of occurrence of stillbirths in case the mother had already female births hypothesizing that if a woman would have more number of daughters, she would probably want next child as male, and in doing so she or her family would take more care during her pregnancy and ultimately she would be with less probability to have adverse pregnancy outcome e.g. fetal deaths or stillbirths.

The contribution of programme/policy related variables was observed rather weak in explaining variations in stillbirths across the states. However, the programme/policy related variables like met need for spacing methods, antenatal care, and the higher order births also appeared as influencing factors for the occurrence of stillbirths in one or a few models, though the relationship was not observed consistent over the period.

In contrast, there was observed a number of significant causative factors in urban India (Table not shown), which were responsible for explaining variations in stillbirths across states. Controlling all socio-economic as well as programme-policy related variables, exposure to mass media, met need for spacing methods, antenatal care, higher order births were found some of the important explanatory variables of stillbirths in urban areas of the country, especially in recent period (2003-05). However, the results did not appear consistent over the period.

The basic constraint in rural areas (Table not shown) we found in terms of the lack of significant predictors, which could explain much of the variations in stillbirths across states. Among four independent sets of data, regression result could only explain the greater variation (71%) in the period 1991-93, while the much less percentage of variation in stillbirths, i.e. 27 percent and 48 percent was explained during the period 1997-99 and 2003-05 respectively. It suggests that the model was not fit well with available sets of variables. Though, whatever result we obtained through the present analysis, we observed that the antenatal care and met need for spacing methods were two statistically significant regulating factors of stillbirths during the period 2003-05, particularly in rural India.

4.3. Path Analysis Approach

As we observed in the previous regression analysis that some of the variables were showing sometimes opposite relations with the response variable, as was found in the case of exposure to mass media, and sometimes women's education also seemed to have opposite relationship with stillbirths (in contrast to the hypothesis that with the increase in level of education the incidence of stillbirths would be found rather controlled), though in most cases the results were not found statistically significant. In addition, most of the socio-economic indicators indulge into the mechanism through various indirect ways, which could not be possible to capture simply by regressing one dependent variable with their correlates. While the inter-linkages among several predictors, and the magnitude and direction of impact of one variable upon the other, as well as in doing so, effect of any hidden variable indirectly through other explanatory variables to the ultimate response variable; all these mechanisms must be understood to reach at any conclusion.

After going through the results of regression analysis, we could be able to find out some significant predictors, which, however, were not much consistent over the selected time period (1991-2005). We also found that the exposure to mass media and the female education were important socio-economic development indicator, which had significant impact in explaining the state differentials in the occurrence of stillbirths. We also know that the household or the individual's income should, in some way or the other, influence stillbirths, as the nutrition status of the mother during pregnancy, to a great extent depend on the level of income of the family. Here, in the present analysis, percent of population below poverty line in a state has been taken as a proxy variable for representing the economic status of the people in a state. However, in case of the incidence of stillbirths, none of the set of regression result could able to show the significant and consistent impact of income level on the occurrence of stillbirths. So, all these aspects indicate on things that there is need to see this issue in some different manner or with different pattern of analysis.

Path analysis is only statistical tool through which one can extract out the direct as well as indirect impact of any predictor on the response variable. As we can observe in Table 3, that there are several equations, which have been prepared to reveal out the basic predictors involved behind each of the significant predictors. However, it must be noted here that there has been made an attempt to explore the relationship between the independent predictors of stillbirths and the predictors of the predictors of stillbirths. So, basically, the impact has been tried to assess at two levels with some sort of association if exits between two variables. Here, the presented analysis has no intention in any way to capture all the webs of predictor variables, which ultimately influence stillbirths from any direction.

In all the equations presented in Table 3, we can clearly observe that in case of any response variable, whether it is socio-economic development indicator or any programme or policy related indicator, the set of predictors include mostly the socio-economic development variables. It indicates that the socio-economic development indicators wield their impact more

through indirect sources rather than direct sources, what we were not able to capture through only one set of regression over stillbirths through a limited set of significant predictor variables.

A comprehensive procedure of calculation of path coefficients for different predictors of stillbirths, which is nothing but the standardized regression coefficients, has been shown in Table 4. Hence, on the basis of equations presented in Table 4, the direct and indirect effects of all significant predictors have been calculated, as has been shown in Table 5. The respective tables have also been prepared for the rural and urban India separately, which have not been shown here.

4.4. Direct, Indirect and Total effects of Predictors on Stillbirths

On the basis of procedure applied in Table 4, the final conclusive Table 5 has been prepared to show the direct, indirect and total effects of various predictors, explaining the differentials in stillbirths across states in India. Now, we can observe that the exposure to mass media, which was showing positive relationship with the occurrence of stillbirths, now appears to have negative relationship with the incidence of stillbirths from indirect sources. However, the income indicator (percent BPL) could still not be able to validate our hypothesis and suggest a weak relationship with the occurrence of stillbirths if we examine the pooled data set. Moreover, it must be noted here that when we analyzed the data set separately for rural and urban areas, we observed a positive relationship between poor economic status and the occurrence of stillbirths.

Among the socio-economic development indicators as well as among all other predictors, the total effect of the household environmental standard appears to explain most of the variations across states, the path coefficients of which varies from -0.21 to -0.54 during the three different periods and emerged as an important regulating factor of stillbirths. The maximum (0.519) total effect in the pooled data set has been recorded by the mass media exposure. In rural areas (table not shown), the maximum total effect (0.714) was contributed by the percent BPL, followed by women's mass media exposure and percent female births. In urban areas, the maximum variations in stillbirths across states was explained by the percent higher order births in a state, followed by the women's education and the percent BPL in a state. In rural dataset, there did not appear any consistent direction of predictors towards stillbirths, as has already been discussed that in any of the regression equations, the present set of predictors was hardly able to explain a 50 percent (adjusted) of the variation in stillbirths across states. It indicates the complexity in mechanism involved in the incidence of stillbirths, particularly in rural areas. The other things might be associated with the reliability of the information, on the basis of which we were inferring the results.

5. Concluding Remarks

This paper discusses the analysis of the various determinants or the possible predictors of stillbirths. In addition, the effort has been made to frame the pathways of these predictors, through which these influence the occurrence of stillbirths in India. From the present analysis it reveals that the role of socio-economic factors in influencing the occurrence of stillbirths has been augmented over the period. Among the different indicators of socio-economic development, education of the women (i.e. prospective mothers), the better household environmental standard, and the strong willingness of the mother and the family towards the care during pregnancy emerged as a few of the most regulating factors of the occurrence of stillbirths in India. The latter, as we also discussed in earlier sections, was assessed considering the proportion of female births women already had, and the result showed that this had a direct and strong influence in reducing the occurrence of stillbirths. The acceptance of our hypothesis indicates that the occurrence of

stillbirths also depends upon the intentions of our society towards the outcome of pregnancies. The woman or her family intended to have a male child after already having a few female births tends to have less probability of encountering the incidence of stillbirths. It happens so because of their strong willingness to save the child at any cost and thus they multiply the care they would have done during last pregnancies. Our basic argument here lays in this fact that if we could intend to provide better and safe measures during pregnancies, we could be able to control the unfortunate mishaps in the form of stillbirths which also poorly affects the future reproductive processes of the concerned mother.

The poor economic status of the family was not observed as a strong influencing factor of the occurrence of stillbirths as a whole. However, when we analyzed the data set separately for rural and urban areas, we observed a positive relationship between poor economic status and the occurrence of stillbirths. This suggests that the household economic status has undoubtedly pertinent influence in regulating stillbirths. The exposure to mass media wields positive impact in regulating stillbirths but through indirect sources. Most importantly, the immediate external environment, which was judged by the household environmental standard, seems to lay positive impact in regulating the occurrence of stillbirths in India. Although, some of the programmatic indicators have also been appeared in the analysis as regulating factors for the incidence of stillbirths, however, the phenomenon has not been observed consistent over the period.

Notes

1 This definition of stillbirth is recommended by the World Health Organization.

2 The Empowered Action Group (EAG) was constituted under the chairpersonship of Union Minister for Health & Family Welfare on 20th March, 2001 (announced) as an administrative mechanism to facilitate the preparation of area specific programmes to address the unmet needs, and closely monitor the implementation of the Family Welfare Programme activities in eight poor performing states of India. It includes the states of Bihar, Uttar Pradesh, Madhya Pradesh, Rajasthan, Orissa, Jharkhand, Uttaranchal, and Chhattisgarh. The approval of the Cabinet Committee on Economic Affairs (CCEA) for the EAG was obtained in its meeting dated 21st June 2003.

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Table 1: Variables selected for the analysis of stillbirths in India by taking state as a unit of analysis, 1991-2005

Variables	*Definition*	*Sources of Information*		
		1991-93	1997-99	2003-05
Dependent Variable				
SBR, 1991-93	Still birth rate (per 1000 live+still births) for the period 1991-93 (three years average).	SRS	-	-
SBR, 1997-99	Still birth rate (per 1000 live+still births) for the period 1977-99 (three years average).	-	SRS	-
SBR, 2003-05	Still birth rate (per 1000 live+still births) for the period 2003-05 (three years average).	-	-	SRS
SBR, 1991-05	Still birth rate (per 1000 live+still births) for the period 1991-05 (three years average).	SRS	SRS	SRS
Independent Variables				
(a) *Developmental Efforts:*	Measured through socio-economic development indicators in a state			
Women's education	Percent of ever-married women age 15-49 who are primary school complete and above	NFHS-I (1992-93)	NFHS-II (1998-99)	NFHS-III (2005-06)
Percent BPL (1993,1999 & 2004)	Percentage of population Below Poverty Line in a state	PC,GOI	PC,GOI	PC,GOI
Household Environmental Std.	Mean factor score of the index of household environmental standard, based on the physical standard of living of women in their houses	NFHS-I	NFHS-II	NFHS-III
Exposure to mass media	Mean factor score of the mass-media exposure index, based on the ever-married women age 15-49, who usually read newspaper or magazine, watch television, or listen to the radio at least once a week, or who usually visit a cinema/ theatre at least once in a month	NFHS-I	NFHS-II	NFHS-III
Percent Female Births	Percent of female babies born in last three years before the respective surveys	NFHS-I	NFHS-II	NFHS-III
(b) *Policy or Programme Efforts:*	Measured through various MCH care indicators as well as through effective reach of the programme in general in a state or other policy related variables			
Percent of mothers received more than two doses of TT	Percent of births during the three years preceding the survey for which mother received more than 2 doses of tetanus toxoid injections as a part of different types of antenatal care	NFHS-I	NFHS-II	NFHS-III

Contd...

Variables	*Definition*	*Sources of Information*		
		1991-93	1997-99	2003-05
Met need for spacing methods	Percent of total demand met for spacing methods among currently married women	NFHS-I	NFHS-II	NFHS-III
Percent of young mothers	Percent of ever-married women, whose age is below 18 years and who have given births to babies during the three years preceding the survey	NFHS-I	NFHS-II	NFHS-III
Delivery Complication	Percent of births during the three years preceding the survey, for which mother reported the case of complicated delivery	NFHS-I	NFHS-II	NFHS-III
Advice of care during pregnancy	Percent of women received counseling for care during pregnancy from health workers or health visitors (ANM etc.)	NFHS-I	NFHS-II	NFHS-III
ICDS benefits during pregnancy	Percent of women got any type of benefit during pregnancy from the aanganwadi or the ICDS centre	-	-	NFHS-III
(c) *Fertility Behaviour:*	Measured through higher order births or through composite index of high risk fertility behaviour which has a direct bearing on Still births	NFHS-I	NFHS-II	NFHS-III
Percent of high order births	Percent of births during the three years preceding the survey, whose birth order is four or above	NFHS-I	NFHS-II	NFHS-III
High-risk fertility behaviour	Percent of children born in the last three years at elevated risk of mortality, i.e. those born to mothers less than 18 years of age or older than 34 years, born with a previous birth interval less than 24 months or born with a birth order higher than three	NFHS-I	NFHS-II	NFHS-III

SRS : Sample Registration System, Office of the Registrar General, New Delhi (Respective reports of SRS)
PC,GOI : Planning Commission, Govt. of India, (Source book : Handbook of Statistics on the Indian Economy, Reserve Bank of India, 2006-07)
NFHS-I : National Family Health Survey, 1992-93 ,IIPS, Mumbai
NFHS-II : National Family Health Survey, 1998-99 ,IIPS, Mumbai
NFHS-III : National Family Health Survey, 2005-06 ,IIPS, Mumbai

Table 2: Results of regression analysis depicting the role of explanatory variables in the differentials of still births (late fetal deaths) across states in India, 1991-2005

Models/Variables	*Dependent Variable: Stillbirth Rate during*			
	(1991-93)	(1997-99)	(2003-05)	(1991-2005)
	(I)	(II)	(III)	(IV)
Model I				
Impact of socio-economic development:				
Constant	79.355**	70.425*	86.752**	40.070**
Women's education		-0.188 (-0.68)*	-0.382 (-0.93)*	-0.159 (-0.55)**
Percent BPL		0.081 (0.24)	0.113 (0.22)	0.131 (0.31)*
Household Environmental Standard	-3.228 (-0.22)+		-6.652 (-0.49)	
Exposure to mass media	10.822 (0.74)**	14.196 (1.19)**	34.086 (1.85)**	16.499 (1.03)***
Percent female births	-1.401 (-0.48)*	-1.127 (-0.39)	-1.223 (-0.39)*	-0.769 (-0.26)**
1991-93/1997-99 time dummy©				1.876 (0.17)
1991-93/2003-05 time dummy©				3.752 (0.34)
R^2	0.38 (0.23)++	0.48 (0.29)	0.65 (0.51)	0.44 (0.37)
Sample size	16	16	19	41
Model II				
Impact of Programme/ Policy Intervention:				
Constant	8.665	-6.764	27.039***	16.924***
Met need for spacing methods		-0.732 (-0.39)	-1.002 (-0.34)	-0.257 (-0.11)
Percent of mothers got >2 TT injections	-0.159 (-0.45)	-0.204 (-0.58)*	-0.165 (-0.23)	
Percent young mother (age <18 years)	0.327 (0.26)	0.309 (0.33)		
Percent high order births (4 & more)	0.440 (0.86)	0.258 (0.59)	-0.299 (-0.63)**	
Percent women got advice of care during pregnancy		0.280 (1.39)		
Percent mothers who reported No ANC visit©	-0.422 (-1.63)**			-0.142 (-0.52)***
1991-93/1997-99 time dummy©				-1.628 (-0.14)
1991-93/2003-05 time dummy©				-2.562 (-0.24)
R^2	0.57 (0.42)	0.51 (0.27)	0.41 (0.29)	0.25 (0.19)
Sample size	16	16	19	41

Models/Variables	*Dependent Variable: Stillbirth Rate during* (1991-93) (I)	(1997-99) (II)	(2003-05) (III)	(1991-2005) (IV)
Model III				
Net impact of available determining variables:				
Constant	87.650**	4.918	114.007***	54.448**
Women's education		-0.083 (-0.30)	-0.341 (-0.83)**	-0.168 (-0.57)**
Percent BPL				0.124 (0.29)*
Household Environmental Standard	-2.451 (-0.17)	-5.593 (-0.54)	-7.291 (-0.54)*	
Exposure to mass media	17.545 (1.21)**		26.962 (1.47)**	13.520 (0.84)***
Percent female births	-1.993 (-0.68)**		-1.88 (-0.60)**	-0.828 (-0.28)**
Met need for spacing methods	0.705 (0.37)*	-0.781 (-0.42)		
Percent of mothers got >2 TT injections		-0.33 (-0.94)**		
Percent young mother (age <18 years)		0.204 (0.22)		
Percent high order births (4 & more)	0.593 (1.16)**			
Percent women got advice of care during pregnancy		0.306 (1.52)**		
Percent women got ICDS♣ benefits during pregnancy			0.186 (0.51)**	
Percent mothers who reported No ANC visit©	-0.156 (-0.60)			-0.068 (-0.25)
1991-93/1997-99 time dummy©				1.595 (0.14)
1991-93/2003-05 time dummy©				3.059 (0.28)
R^2	0.80 (0.66)	0.62 (0.37)	0.79 (0.71)	0.46 (0.38)
Sample size	16	16	19	41

+ Figures inside parentheses indicate standardized regression coefficients.

++ Figures inside parentheses indicate adjusted R^2 values.

* Significant at 10% level. ** Significant at 5% level. *** Significant at 1% level.

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© Control Variable.

Table 3: Results of regression analysis with standardized coefficients for the derivation of paths of influencing factors of stillbirths (Late Fetal Deaths) in India, 1991-2005

Equations/Variables	*Standardized Coefficient (β)* (1991-93) (I)	(1997-99) (II)	(2003-05) (III)	(1991-2005) (IV)
Equation 1				
Response variable: SBR (Total)				
Predictor variables:				
Women's education (x_1)	0.375	-0.296	-0.828**	-0.574**
Percent BPL (x_2)	-	-	-	0.294*
Household Environ. Standard (x_3)	-0.206	-0.540	-0.537*	-
Exposure to mass media (x_4)	1.757***	-	1.465**	0.840***
Percent female births (x_5)	-0.838**	-	-0.604**	-0.283**
Met need for spacing methods (x_6)	0.354	-0.416	-	-
Percent of mothers got >2 TT injections (x_7)	-	-0.939**	-	-
Percent young mother (x_8)	-	0.220	-	-
Percent high order births (x_9)	1.332**	-	-	-
Percent women got advice during preg. (x_{10})		1.521**	-	-
Percent women got ICDS♣ benefits during pregnancy (x_{11})	-	-	0.506**	-
No ANC visit (x_{12})©	-	-	-	-0.251
1991-93/1997-99 time dummy (xt_1)©	-	-	-	0.140
1991-93/2003-05 time dummy (xt_2)©	-	-	-	0.280
R^2	0.80 (0.66)	0.62 (0.37)	0.79 (0.71)	0.46 (0.38)
Sample size	16	16	19	41
Equation 2				
Response variable: (x_1)				
Predictor variables:				
Percent BPL (x_2)	-0.109	-0.267	-0.099	-0.097
Exposure to mass media (x_4)	0.525	0.586**	0.875***	0.560***
1991-93/1997-99 time dummy (xt_1)©	-	-	-	0.337***
1991-93/2003-05 time dummy (xt_2)©	-	-	-	0.689***
R^2	0.35 (0.25)	0.61 (0.55)	0.88 (0.87)	0.79 (0.77)
Equation 3				
Response variable: (x_3)				
Predictor variables:				
Percent BPL (x_2)	-0.722***	-0.560**	-0.402**	-
Exposure to mass media (x_4)			0.312	-
Women's education (x_1)	0.329**	0.399**	0.271	-
1991-93/1997-99 time dummy (xt_1) ©	-	-	-	-
1991-93/2003-05 time dummy (xt_2) ©	-	-	-	-
R^2	0.81 (0.79)	0.75 (0.72)	0.78 (0.74)	-
Equation 4				
Response variable: (x_4)				
Predictor variables:				
Percent BPL (x_2)	-0.357	-	-	-0.271**
Women's education (x_1)	0.445*	-	0.935***	0.843***
1991-93/1997-99 time dummy (xt_1)©	-	-	-	-0.414***
1991-93/2003-05 time dummy (xt_2)©	-	-	-	-0.676***
R^2	0.45 (0.36)	-	0.87 (0.87)	0.68 (0.65)

Contd…

Equations/Variables	(I)	(II)	(III)	(IV)
Equation 5				
Response variable: (x_6)				
Predictor variables:				
Percent BPL (x_2)	-0.081	-	-	-
Women's education (x_1)	0.650**	0.707*	-	-
Exposure to mass media (x_4)	-0.392	-0.522	-	-
1991-93/1997-99 time dummy (xt_1)©	-	-	-	-
1991-93/2003-05 time dummy (xt_2)©	-	-	-	-
R^2	0.29 (0.12)	0.22 (0.10)	-	-
Equation 6				
Response variable: (x_7)				
Predictor variables:				
Percent BPL (x_2)	-	0.591*	-	-
Women's education (x_1)	-	-	-	-
Exposure to mass media (x_4)	-	0.657**	-	-
Percent high order births (x_8)	-	-	-	-
Percent young mother (x_9)	-	-	-	-
High risk fertility behaviour	-	-	-	-
1991-93/1997-99 time dummy (xt_1) ©	-	-	-	-
1991-93/2003-05 time dummy (xt_2) ©	-	-	-	-
R^2	-	0.30 (0.19)	-	-
Equation 7				
Response variable: (x_8)				
Predictor variables:				
Percent BPL (x_2)	-	0.348*	-	-
Women's education (x_1)	-	-1.113***	-	-
Exposure to mass media (x_4)	-	0.923***	-	-
1991-93/1997-99 time dummy (xt_1) ©	-	-	-	-
1991-93/2003-05 time dummy (xt_2) ©	-	-	-	-
R^2	-	0.76 (0.70)	-	-
Equation 8				
Response variable: (x_9)				
Predictor variables:				
Percent BPL (x_2)	0.105	-	-	-
Women's education (x_1)	-0.539**	-	-	-
Exposure to mass media (x_4)	-0.493**	-	-	-
Met need for spacing methods (x_6)	0.232*	-	-	-
1991-93/1997-99 time dummy (xt_1) ©	-	-	-	-
1991-93/2003-05 time dummy (xt_2) ©	-	-	-	-
R^2	0.88 (0.84)	-	-	-

+ Figures inside parentheses indicate adjusted R^2 values. © Control variable.
* Significant at 10% level. ** Significant at 5% level. *** Significant at 1% level.
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Table 4: Direct and indirect effects of the developmental and programmatic factors on stillbirths (Late Fetal Deaths), (x_0), India, 1991-2005.

Equations	*Path Coefficient*	*Values* (1991-93) (I)	(1997-99) (II)	(2003-05) (III)	(1991-2005) (IV)
	Direct Effect				
Women's education (x_1) $\rightarrow (x_0)$	$p_{0,1}$	0.375	-0.296	-0.828	-0.574
Percent BPL (x_2) $\uparrow$	$p_{0,2}$	-	-	-	0.294
Household Environ. Standard (x_3)	$p_{0,3}$	-0.206	-0.54	-0.537	-
Exposure to mass media (x_4)	$p_{0,4}$	1.757	-	1.465	0.84
Percent female births (x_5)	$p_{0,5}$	-0.838	-	-0.604	-0.283
Met need for spacing methods (x_6)	$p_{0,6}$	0.354	-0.416	-	-
Percent of mothers got >2 TT injections (x_7)	$p_{0,7}$	$p_{0,7}$	-0.939	-	-
Percent young mother (x_8)	$p_{0,8}$	-	0.22	-	-
Percent high order births (x_9)	$p_{0,9}$	1.332	-	-	-
Percent women got advice during preg. (x_{10})	$p_{0,10}$		1.521	-	-
Percent women got ICDS♣ benefits during pregnancy (x_{11})	$p_{0,11}$	-	-	0.506	-
	Indirect Effect				
$x_1\ x_3\ x_0$	$p_{3,1}\ x\ p_{0,3}$	-0.068	-0.215	-0.146	-
$x_1\ x_4\ x_0$	$p_{4,1}\ x\ p_{0,4}$	0.782	-	1.370	0.708
$x_1\ x_6\ x_0$	$p_{6,1}\ x\ p_{0,6}$	0.230	-0.294	-	-
$x_1\ x_8\ x_0$	$p_{8,1}\ x\ p_{0,8}$	-	-0.245	-	-
$x_1\ x_9\ x_0$	$p_{9,1}\ x\ p_{0,9}$	-0.718	-	-	-
$x_1\ x_4\ x_3\ x_0$	$p_{4,1}\ x\ p_{3,4}\ x\ p_{0,3}$	-	-	-0.157	-
$x_1\ x_4\ x_6\ x_0$	$p_{4,1}\ x\ p_{6,4}\ x\ p_{0,6}$	-0.062	-	-	-
$x_1\ x_4\ x_9\ x_0$	$p_{4,1}\ x\ p_{9,4}\ x\ p_{0,9}$	-0.292	-	-	-
$x_1\ x_6\ x_9\ x_0$	$p_{6,1}\ x\ p_{9,6}\ x\ p_{0,9}$	0.201	-	-	-
$x_2\ x_1\ x_0$	$p_{1,2}\ x\ p_{0,1}$	-0.041	-	0.082	0.056
$x_2\ x_4\ x_0$	$p_{4,2}\ x\ p_{0,4}$	-0.627	-	-0.589	-0.228
$x_2\ x_6\ x_0$	$p_{6,2}\ x\ p_{0,6}$	-0.029	-	-	-
$x_2\ x_7\ x_0$	$p_{7,2}\ x\ p_{0,7}$	-	-0.555	-	-
$x_2\ x_8\ x_0$	$p_{8,2}\ x\ p_{0,8}$	-	0.077	-	-
$x_2\ x_9\ x_0$	$p_{9,2}\ x\ p_{0,9}$	0.140	-	-	-
$x_4\ x_1\ x_0$	$p_{1,4}\ x\ p_{0,4}$	0.197	-0.173	-0.725	-0.321
$x_4\ x_3\ x_0$	$p_{3,4}\ x\ p_{0,3}$	-	-	-0.168	-
$x_4\ x_6\ x_0$	$p_{6,4}\ x\ p_{0,6}$	-0.139	0.217	-	-
$x_4\ x_7\ x_0$	$p_{7,4}\ x\ p_{0,7}$	-	-0.617	-	-
$x_4\ x_8\ x_0$	$p_{8,4}\ x\ p_{0,8}$	-	0.203	-	-
$x_4\ x_9\ x_0$	$p_{9,4}\ x\ p_{0,9}$	-0.657	-	-	-
$x_4\ x_6\ x_9\ x_0$	$p_{6,4}\ x\ p_{9,6}\ x\ p_{0,9}$	-0.121	-	-	-
$x_6\ x_9\ x_0$	$p_{9,6}\ x\ p_{0,9}$	0.309	-	-	-

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Table 5: Direct, Indirect and Total effects of the selected determining variables on stillbirths (Late Fetal Deaths) in India, 1991-2005.

Dimension/ Variables	*Effects on occurrence of stillbirths, India**											
	Direct Effect				*Indirect Effect*				*Total Effect*			
	(I)	(II)	(III)	(IV)	(I)	(II)	(III)	(IV)	(I)	(II)	(III)	(IV)
Socio-economic development:												
Women's education (x_1)	0.375	-0.296	-0.828	-0.574	0.073	-0.754	1.068	0.708	0.448	-1.050	0.240	0.134
Percent BPL (x_2)	-	-	-	0.294	-0.557	-0.478	-0.507	-0.172	-0.557	-0.478	-0.507	0.122
Household Environ. Standard (x_3)	-0.206	-0.54	-0.537	-	-	-	-	-	-0.206	-0.54	-0.537	-
Exposure to mass media (x_4)	1.757	-	1.465	0.84	-0.720	-0.370	-0.892	-0.321	1.037	-0.370	0.573	0.519
Percent female births (x_5)	-0.838	-	-0.604	-0.283	-	-	-	-	-0.838	-	-0.604	-0.283
Impact of Programme/ Policies:												
Met need for spacing methods (x_6)	0.354	-0.416	-	-	-	-	-	-	0.354	-0.416	-	-
Percent of mothers got >2 TT injections (x_7)	-	-0.939	-	-	-	-	-	-	-	-0.939	-	-
Percent young mother (x_8)	-	0.22	-	-	-	-	-	-	-	0.22	-	-
Percent high order births (x_9)	1.332	-	-	-	-	-	-	-	1.332	-	-	-
Percent women got advice during preg. (x_{10})		1.521	-	-	0.309	-	-	-		1.521	-	-
Percent women got ICDS♣ benefits during pregnancy (x_{11})	-	-	0.506	-	-	-	-	-	-	-	0.506	-

* Figures inside the parentheses I, II, III and IV represent the time period 1991-93, 1997-99, 2003-05 and 1991-2005 respectively.

♣ Integrated Child Development Scheme.

Fig. 1.1: India: State level differentials in Stillbirth Rate, 1990-93 (SRS)

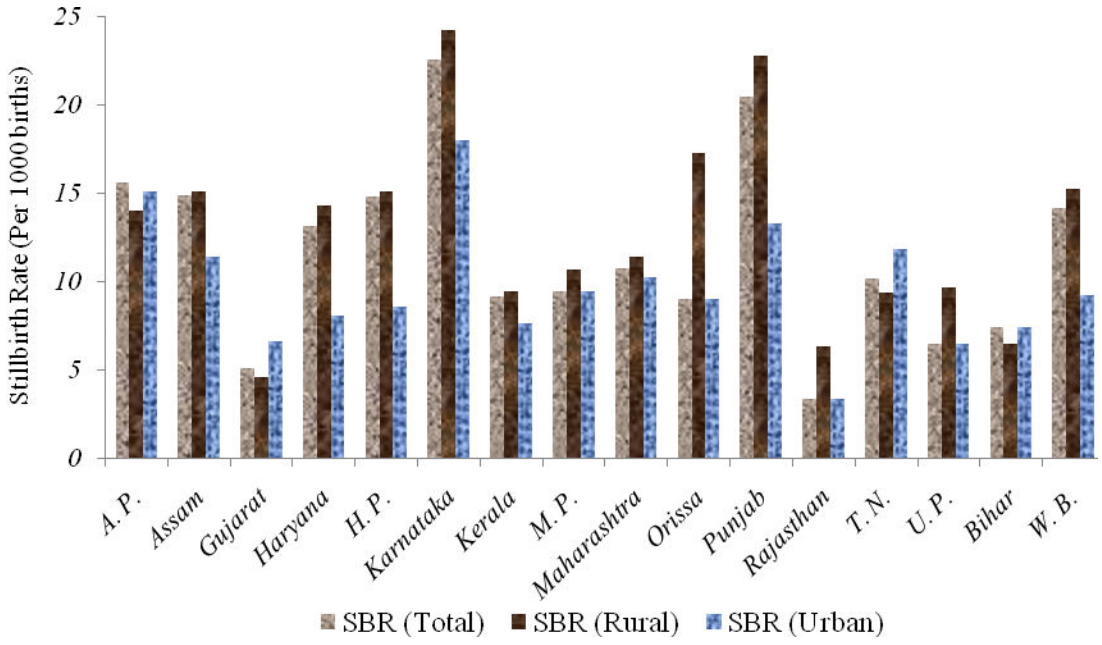

Fig. 1.2: India: State level differentials in Stillbirth Rate, 1996-99 (SRS)

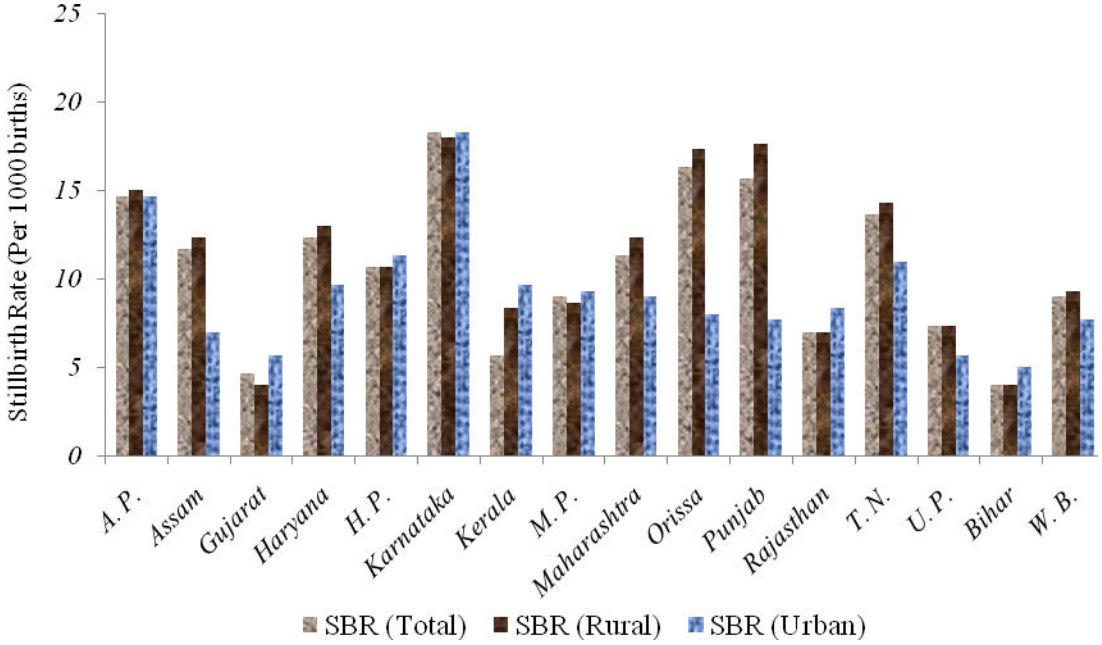

Fig. 1.3: India: State level differentials in Stillbirth Rate, 2003-05 (SRS)