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# A Preliminary Analysis of the Relationship Between Generalised Deprivation and Infant Mortality in Rural India

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***Abstract*:** In this paper an attempt has been made to examine the relationship between poverty and infant mortality in rural India. In the process, a case has been advanced in favour of measuring deprivation in non-income dimensions, particularly in the sphere of access to infrasructural facilities. To this end, an index of 'generalised deprivation' of access to infrastructural facilities has been constructed. This index has been employed to explore the relationship between deprivation and infant mortality. The results show that the incidence of generalised deprivation has positive impact on infant mortality, which suggests that there is a case for improving access to basic infrastructural facilities such as drinking water provided by a tap, public transport, healthcare facilities, clean fuel, electricity for lighting, and 'pucca' road. Also, in this paper, an account of the magnitude and spatial variability in the incidence of generalised deprivation suffered by the rural population in India is provided, which is expected to be of considerable use to planners and policy makers.

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## I. Introduction

Maternal well-being is an important determinant of infant mortality. Studies indicate that factors such as birth injuries, sepsis, low birth weight, placenta previa, birth asphyxia, intrauterine hypoxia, and premature birth are important causes of infant mortality and stillbirth (see, for example, United Nations (1954), Waldron (1998a, 1998b), James, Aitken, and Subramanian (2000), and Special Report: Reducing Perinatal and Neonatal Mortality (henceforth, Special Report) (2004)). Infant deaths due to birth injuries, placenta previa, intrauterine hypoxia, and birth asphyxia could be controlled, to a large extent, by hospitalisation at birth and effective obstetrical care (United Nations (1954). But the leading causes of infant mortality such as preterm birth and low birth weight are associated with health/nutritional status of the mother (Jejeebhoy and Rao (1995), and Special Report (2004)). This implies that infant and late foetal deaths could be reduced, to a large extent, by improving the nutritional status of the mother, particularly during pregnancy. For this reason, there is a case for considering hunger/poverty to mean not being in good health/nutritional status. In this connection, the observation by Sen (1987, p17) acquires a great deal of relevance. He points out that "In the case of nutritional achievements it depends on such factors as (1) metabolic rates, (2) body size, (3) age, (4) sex (and, if a woman, whether pregnant or lactating), (5) activity levels, (6) medical conditions (including the presence or absence of parasites), (7) access to medical services and the ability to use them, (8) nutritional knowledge and education, and (9) climatic conditions". The list, apart from being comprehensive, points to the importance of reckoning deprivation in non-income dimensions to achieved functionings, particularly to be in good nutritional status. Given the list, I shall concentrate only on explaining how access to infrastructural facilities impinge on the nutritional status of women during pregnancy which, if not the sole factor, is an extremely important determinant of late foetal and infant mortality.

The list by Sen (1987), provided above, suggests that the nutritional status of the mother, apart from being a function of quantum of food consumed, is a function of nutritional intake/absorptive capacity of the body. Nutritional intake capacity depends on the health status of the mother. Health status of the mother in turn depends on a number of environmental factors such as the availability of clean drinking water; the control of conditions like amoebiasis, hookworm infestation, chronic diarrhoea, and malaria; and the availability of clean fuel for energy requirements (Jayaraj and Subramanian (2004)). By ensuring that the households have access to the basic amenities of life, particularly safe and protected drinking water, a large number of these conditions, which affect the nutritional intake capacity of mothers, could be prevented.

Provision of safe and adequate drinking water also helps to conserve the energy of the mother, which improves her nutritional status and that of the foetus and the nursling (Burger and Esrey, (1995). Availability of safe drinking water is also likely to reduce the incidence of late foetal and infant mortality due to diarrhoea and other intestinal infestations. Hygiene and use of healthcare facilities, apart from being influenced by access to basic amenities, also depend on education/literacy status of the mother. Thus female literacy acquires relevance in the context of reducing infant mortality.

Apart from access to basic amenities and literacy status, work of women is cited to be an important determinant of the incidence of infant deaths. Work, particularly domestic drudgery (Patrizia and Francoise (1987)) and in agriculture (Swaminathan (1997)), is suggested to influence the health status of the mother and the survival of infants. Domestic drudgery, particularly cooking, has adverse health effects. Biomass smoke level and poor ventilation lead to respiratory infections in young children, adverse pregnancy outcomes for women exposed during pregnancy, chronic lung disease and associated heart disease in adults, and cancer (Tata Energy Research Institute, (1994)). Banerjee (1996) also points out that polluted air indoors, apart from causing adverse pregnancy outcomes, causes high infant mortality. High infant mortality in turn is an important cause of high reproductive burden, which is an important determinant of nutritional status of women. Thus access to clean fuel acquires a great deal of relevance in this context.

Work in agriculture, particularly the tasks of transplanting saplings in rice cultivation and weeding often performed by women, has adverse implications for pregnancy outcomes. Batliwala (1998: p34), observes, "This [performing the task of transplanting] means that every woman — heavily pregnant or otherwise — is squatting on her haunches for hours together. Obstetricians confirm that such physical strain and pressure on the uterus could well trigger off premature labour in the last trimester of pregnancy, and not to mention increasing chances of still birth". This observation makes it clear that work in agriculture is an important factor which triggers premature birth, and as noted earlier, is an important cause of infant mortality.

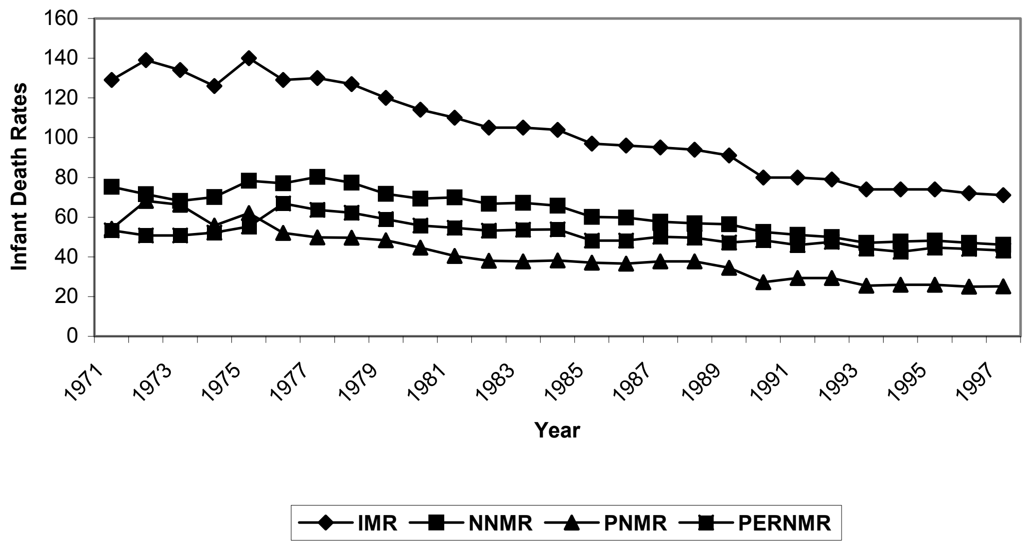
Utilisation of healthcare facilities should help to reduce late foetal and infant deaths. Use of healthcare facilities, apart from being influenced by knowledge/education of women, to a large extent, is determined by easy access to such facilities. Easy access to such facilities for the rural population, in turn, depends on the availability of transport facilities, in particular the public transport, and the type of road (metalled/'pucca' or 'kaccha' road) connectivity that a village has with the urban centres, where the healthcare facilities are often located. For these reasons, it is clear that the health of the population, in general, and that of women during pregnancy in particular, depends on access to basic infrastructural facilities.

For this reason, there is a case for analysing the relationship between deprivation in the space of access to infrastructural facilities and the incidence of infant mortality which, to a large extent, is determined by health/nutritional status of women. Such an attempt envisages the construction of an index of 'generalised deprivation' of access to infrastructural facilities (henceforth index generalised deprivation). Also, for reasons stated earlier, an attempt will be made to study the impact of female literacy and work participation of women in agriculture on infant mortality. To this end, the paper is divided into 4 sections (excluding the introduction). Section 2 provides an account of the trends in infant mortality rate and its components (neonatal, and postnatal mortality rates). Trend in peri-natal mortality rate, which includes stillbirth and infant deaths in the first week (within 7 days of birth) also is analysed. Section 3 details the construction of the index of 'generalised deprivation', and also provides an account of the magnitude and spatial disparity in the extent of 'generalised deprivation' suffered by the rural population in India. The impact of 'generalised deprivation', female literacy, and the incidence of work, particularly wage work, by females in agriculture on infant mortality is analysed in Section 4. Concluding observations are made in the last section, Section 5.

## II. Trends in Indicators of Infant Death Rates

Trend in infant mortality rate in India is analysed employing the data provided by the Sample Registration System for a period of 27 years between 1971 and 1997. A visual account of the trends in, apart from infant mortality rate, neonatal, postnatal, and perinatal mortality rates are provided in Figure 1. The curve that lies at the top of Figure 1 pertains to the infant mortality rate. This curve indicates that since the beginning of the 1970s there has been a steady decline in the infant mortality rate in India. However, the slope of the curve becomes less steep since the beginning of the 1990s, and indeed shows that the infant mortality rate has stagnated between 1993 and 1997. The second curve from the top is that of the neonatal mortality rate. It is observed that while neonatal mortality rate too has declined in India, the gap between the infant mortality rate curve and the neonatal mortality rate cure has narrowed. This suggests that deaths of infants in the first 28 days are assuming relatively greater significance in determining the level of infant mortality rate in India. Further, the curve that lies in the third position, which is that of perinatal mortality rate, for most part of the period between 1971-1997, almost coincides with the neonatal mortality rate curve towards the end of this period. The observed behaviour of

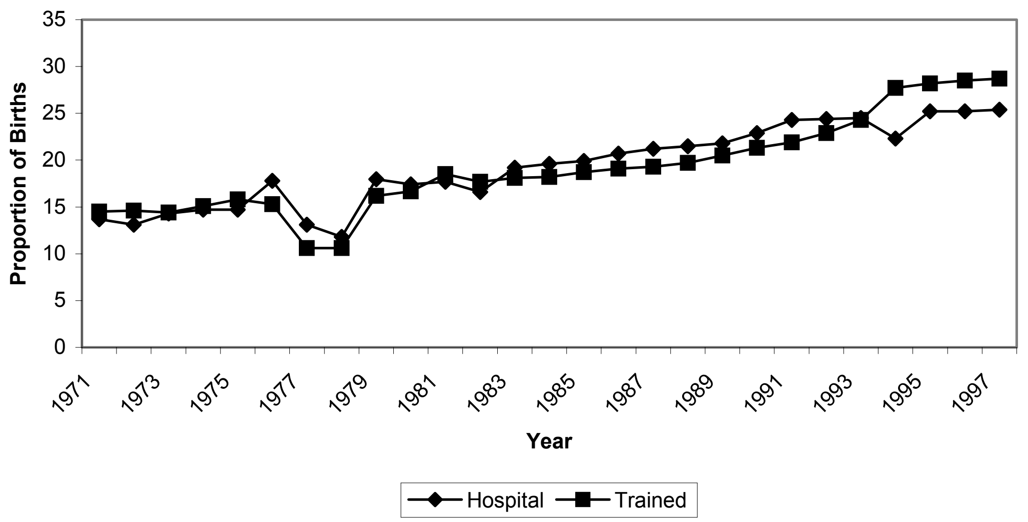
**Figure 1: Behaviour of Infant Death Rates in India: 1971-1997**



these curves suggests that further reductions in infant mortality rates, to a large extent, depend on reducing the perinatal (mortality within the first week of birth) mortality in India. Causes for neonatal/perinatal mortality include birth defects, premature birth, injuries at birth, and low birth weight. Births attended by trained professionals and in hospitals are expected to lead to reductions in infant deaths due to some of these causes. For this reason the trend in type of medical attention utilised at birth and the relationships between medical attention at birth and, the rates of: (1) infant mortality, (2) neonatal mortality, (3) postnatal/post-neonatal mortality, (4) perinatal mortality, and (5) stillbirth are examined.

As a first step, a brief account of the trends in the distribution of births by the type of medical attention received at birth is provided. For this purpose data furnished by the Sample Registration System for all India, combined for rural and urban areas, are employed. Figure 2, provides the graph of the per cent distributions of the total births that received medical attention in institutions, and by trained professionals (qualified to attend birth) — the two categories that represent access to healthcare by professionals qualified to assist at birth — for the period 1971-1997. The curves in figure 2 show that: (1) there has been steady improvements in healthcare provided at birth in this period: both curves are increasing; (2) in the first five years, between 1971 and 1976, birth attendance by

**Figure 2: Trends in the Distribution of Births by Type of Medical Attention at Birth in India: 1971-1997**



trained professionals was higher than births in hospitals, but since then births in hospitals had increased faster, and indeed, the curve for hospital births lies above that of births attended by trained professionals for most part in this period; (3) in the last four years once again the proportion of births attended by trained professionals is observed to be higher than births in hospitals; and (4) it appears that by 1993 the improvements in medical attention at birth in India have halted. It may be noted here that the decline in infant mortality rate in India in the last five years since 1993 has been very slow. While it is true that the percentage of total births attended by trained professionals (births in institutions and attended by trained professionals) has gone up considerably from 28.2 per cent in 1971 to 55.1 per cent in 1997, it is distressing to note that, even as late as in 1997, 43.9 per cent of the births in India were not attended by professionals qualified to assist at birth. Having looked at the trends, the relationship between infant death rates and the type medical attention received at birth is explored.

**Table 1: Estimated Correlation Co-efficients Between Types of Medical Attention Received and Indicators of Infant Death Rates: India 1971-1997**

| Infant Death Rates | Institutions | Trained Professionals | Both Institutions and Trained Professionals |
|---|---|---|---|
| IMR | -0.952 | -0.910 | -0.949 |
| NMR | -0.934 | -0.928 | -0.951 |
| PNMR | -0.900 | -0.830 | -0.881 |
| Peri-NMR | -0.736 | -0.828 | -0.803 |
| StillBR | -0.737 | -0.728 | -0.747 |

*Note*: 1) The abbreviations IMR, NMR, PNMR, and Peri-NMR, respectively denote, infant, neonatal, postnatal, and perinatal mortality rates; and StillBR the stillbirth rate.
(2) IMR, NMR, and PNMR are defined, respectively, as the number infant deaths per one thousand live births in year, respectively, less than a year old, less than 28 days old, and more than 28 days but less than a year old.
(3) Perinatal mortality is the sum of the numbers of deaths of infants of less than 7 days old and the stillbirths in a year. StillBR and Peri-NMR are defined per thousand live and stillbirths per annum.

*Source:* (1) Data on IMR are taken from Registrar General of India (1999): *Compendium of India's Fertility and Mortality Indicators 1971*
(2) Data on type of medical attention at birth have been obtained, respectively for the periods 1971 to 1980, and 1981 to 1997, from: (i) *Sample Registration System,* for the years since 1971 to1980; and (ii) Selected Socio Economic Statistics, India

Simple correlation co-efficients have been estimated between each indicator of infant death/mortality rates and proportion of births (i) in institutions, (ii) attend by trained professionals, and (iii) in institutions and attended by trained professionals. The estimated correlation co-efficients are provided in Table 1. All the correlation co-efficients are negative, and their absolute values exceed 0.7. They are also found to be statistically significant at 1 per cent level. These results indicate the importance of attention at birth by trained professionals to reduce IMR.

## III. Generalised Deprivation: Magnitude and Spatial Disparity

### *III.1 Measurement*

The importance of access to infrastructural facilities for health and nutritional status of women during pregnancy has already been pointed out, and the relationship between 'generalised deprivation' and IMR has been rationalised. An empirical examination of the relationship between infant mortality and the incidence of failure to have access to infrastructural facilities calls for constructing an index of 'generalised deprivation' of access to infrastructural facilities. To construct such an index, six basic facilities: (1) public transport (availability of a bus stop or a railway station), (2) drinking water provided by a tap, (3) health/medical care, (4) 'pucca' or metalled road, (5) electricity for lighting, and (6) clean fuel for cooking have been selected. Having indicated the selection of the facilities, in what follows, the construction of the index is detailed.

In each case, the instance of failure to have access to a particular infrastructure is quantified by the number of persons living in villages/households that do not have access to the facility. To be more precise, for the rural areas of *each* district the following quantities are defined.

$P_j$ is the total population of the district.

$P^1_j$ is the population living in villages (a village is the smallest unit of revenue administration in India) that do not have either a bus stop or a railway station. It may be stated here that the availability of public transport helps easy access to healthcare facilities located outside the village. [Notice that the Population Census provides, for each village in a district, data on the availability of a bus stop, a taxi stand, and a railway station. Making use of the data, the villages that are not served by either a bus stop or a railway station have been identified. The population of these villages in a district, then, have been aggregated to obtain the total population in the district not served at least by one of these two facilities as: $P^1_j = \sum_{l=1,L} n_l$, where $n_l$ is the population of $l^{th}$ village which does not have either a bus stop or a railway station, and L represents the total number of the villages in a district which do not have either a bus stop or a railway station.]

$P^2_j$ is the population living in villages that do not have access to tap water for drinking. Drinking water provided by a tap is considered to be safe, and also does not require physical energy to lift it. [The Population Census furnishes data on the availability of taps that provide drinking water for each village. Employing this data, the villages which do not have a tap have been identified, and $P^2_j$ is estimated as: $P^2_j = \sum_{t=1,T} n_t$, where $n_t$, is the total population of the $t^{th}$ village which does not have a tap that provides drinking water, and T represents the total number of such villages.]

$P^3_j$ is the population living in villages that do not have any kind of medical facility (including that of the services of a community health worker). Availability of medical facility within a village makes access to it easy. However, it is to be noted that the quality of medical services provided at the local level may not be of adequate standard. This is noted here, but no attempt is made to correct for the quality of healthcare facility available within a village, as data required for such adjustment are hard to obtain. [The Population Census provides for each village data on the availability of all types of medical or health services including that of a community health worker. These data have been utilised to identify the villages which do not have access to any healthcare facilities, and by aggregating the population of all such villages $P^3_j$ has been obtained as: $P^3_j = \sum_{h=1,H} n_h$, where $n_h$ is the total population of the $h^{th}$ village that does not have any kind of medical facility, and the total number of such villages is represented by H.]

$P^4_j$ is the population living in villages that are not connected to the world outside with a ‘pucca’ (or metalled) road. This facility is included in the expectation that availability of ‘pucca’ road helps mobility and aids easy access to healthcare facilities located outside a village. [The Population Census contains data on the type of connectivity (such as a ‘pucca’ or metalled road, a ‘kacha’ road, a navigable waterway, and a footpath) that a village has with the world outside. This source of information helps to identify villages that are not connected by a 'pucca' road. The population of the villages have been aggregated to obtain $P^4_j$ as: $P^4_j = \sum_{r=1,R} n_r$, where $n_r$ is the population of the $r^{th}$ village that is not connected by a 'pucca' road, and R denotes the total number of such villages in the district.]

$P^5_j$ is the population living in households that do not have access to electricity. Access to electricity for lighting is expected to reduce the extent of carbon monoxide indoors, and also is expected to help detect the sufferings of infants better during night. [The Population Census provides for each district data on the proportion of households not having access to electricity, the total population, and total number of households. Employing these data, the population living in households that do not have access to electricity has been estimated as: $P^5_j = \pi_j P_j$, where $\pi_j$ is the proportion of the households in district j which do not have access to electricity, and $P_j$ is the total population of the district. It is important to note here that we have assumed that the average family size does not vary between households which have and which do not have access to electricity. This assumption has been made out of necessity arising from non-availability of data on the average family size for the two categories of households.]

$P^6_j$ is proportion of the population which belongs to households that depend on cow dung cake, firewood, coal/lignite, and other sources of fuel as principal sources of energy for cooking. Burning these sources of fuel for cooking is expected to increase the level of carbon monoxide indoors. [The Population Census provides for each district data on the: (i) proportions of households which depend on cow dung cake, firewood, coal/lignite, and other sources (consisting of largely the crop residue) as medium of energy for cooking; (ii) total population; and (iii) total number of households. Making use of the data on the variables mentioned above, the proportion of the total rural households which depend on labour intensive sources of fuel, which emit heat and carbon monoxide in large quantities, has been obtained as $\gamma_j = \alpha_j+\beta_j+\rho_j+\xi_j$, where $\alpha_j$, $\beta_j$, $\rho_j$, and $\xi_j$ respectively are the proportions of the households in district j using cow dung cake, firewood, coal/lignite, and other sources as fuel for cooking. $P^6_j$ has been estimated as: $\gamma_j P_j$. Notice that $P_j$ is the total rural population of district j. It may be noted here that in estimating $P^6_j$ we have assumed that the average household size does not vary between households that use the above-mentioned sources of fuel and relatively clean sources like LPG and kerosene for cooking.]

A composite indicator of deprivation for the rural areas of each district obtained by aggregating the population deprived of the facilities is given by:

(1) $D_j = \Sigma_{i=1,6} P^i_j$,

where $P^i_j$ is the population of jth district deprived of access to facility i, and $D_j$ is the aggregate population of district j deprived of at least one of the 6 selected infrastructural facilities. It is clear that $D_j$ is not normalized for population size. A procedure that will yield a normalized composite index of deprivation that is in the nature of the 'headcount ratio' (a widely employed rudimentary index of poverty) is obtained by:

(2) $D^*_j = \Sigma_{i=1,6} P^i_j / 6P_j$ .

Employing information on $D^*_j$, an overall index of deprivation $D^*$ for the total rural population in the 15 major states (the states, and the total number of districts in the 15 states will be provided later) has been estimated as:

(3) $D^* = \Sigma_{j=1,J}\, \varphi_j\, D^*_j$,

where $D^*_j$ is the value of the composite index of deprivation for district j, $\varphi_j$ is the share of rural population accounted for by district j in the total rural population in the 15 major states, J represents the total number of districts in the 15 states, and $D^*$ is the weighted average (the weight being the share of rural population accounted for by a district of the total rural population in the 15 major states) of the extent of deprivation suffered by the rural population in the 15 major states.

Notice that $D^*_j$ s and $D^*$ are contained in the interval [0,1]. While the lower bound signifies access to all six facilities, the upper bound corresponds to a situation where there is no access to any of the six facilities.

*III.2 Sources of Data*

Data for constructing the index of 'generalised deprivation' of access to infrastructural facilities have been obtained from the Population Census of India 1991. To elaborate on, for the rural areas of each district data on total population, total number of households, proportion of the households that (a) do not have access to electricity; and (b) use cow dung cake, firewood, coal/lignite and other sources which largely consist of the crop residue, for cooking have been obtained from the publication titled *Census of India 1991: Housing and Amenities*. Data on the availability of infrastructural facilities for each village are provided in the *Village Directory, Census of India 1991* – in the directory designated as VILL-DIR available on floppy diskette. For seven states the village directory also contains data on total population of each village. But for eight states, the data on total population of villages had to be abstracted from *Village Primary Census Abstract, Census of India 1991* (in the directory designated as PCA, available on floppy diskette) and matched with information on infrastructural facilities available in the village directory for each village. While matching the data considerable problems have been encountered, the details of which are provided in an Appendix on village level data along with the list of states where such problems arose.

Employing the sources of data, mentioned above, for each district in the 15 major states, the total number of villages and the total population living in villages that do not have access to each one of the infrastructural facilities has been obtained to construct $D^*_j$. It may mentioned here that the number of villages over which such aggregation has been performed is 547795, distributed across 381 (Four districts: The Greater Bombay, Madras, and Calcutta, respectively known as Mumbai, Chennai, and Kolkotta now, and Hyderabad which are 100 per cent urban have been left out of the analysis) that constitute the 15 major states (the list of selected states could be obtained from Table 3). The rural population of the selected states together account for 97.63 per cent of the total rural population of India (excluding the population of Jammu and Kashmir, where the 1991 Population Census could not be conducted owing to disturbed conditions).

As noted earlier, in this paper, an attempt is also made to explore the relationships between (1) female literacy and IMR, and (2) wage work participation of females in agriculture and IMR. To this end, data on female literacy, defined as the proportion of literate females to total females aged 7 and above, for each district are taken from Census of India, 1991, (Series – 1, India), *Final Population Totals: Brief Analysis of Primary Census Abstract,* Paper-2 of 1992. WPAG, defined as the percentage of females employed in agriculture to total females in a district, has been constructed employing data from: Census of India, 1991, *Provisional*

*Population Totals: Workers and Their Distribution*, Paper- 3 of 1991, Registrar General & Census Commissioner, New Delhi, India.

*III.3 Generalized Deprivation: Magnitude and Spatial Variability*

The main objective for constructing the index $D^*_j$ is to explore the relationship between the IMR in the rural areas and the extent of generalised deprivation. However, the knowledge on the extent and spatial distribution of the burden of deprivation suffered by the rural population in India has both intrinsic and practical utility for planners, policy makers, and academics. This knowledge also helps us to evaluate the status of the living condition of the rural population in India after a little more than 4 decades of independence. The estimated $D^*$ at 0.62224, which lies on the higher side of the scale going from 0 to 1, suggests that extent of generalised deprivation suffered by the rural population in India is extremely high. The values of $D^*_j$ vary between a low of 0.2075 in Gandhinagar district in Gujarat to a high of 0.8977 in Deoghar in Bihar, and the estimated co-efficient of variation for $D^*_j$, expressed in per cent terms, at 27.98 reveals that there exists considerable spatial variability in the extent of deprivation experienced by the rural population in India.

To get an idea on the distribution of the population by the level of deprivation suffered, the districts have been grouped into five categories as districts where the level of deprivation is: (i) very low, (ii) low, (iii) medium, (iv) high, and (v) very high. These five groups consist, respectively of districts with $D^*_j$ values (i) ≤ 0.3455, (ii) > 0.3455 but ≤ 0.4836, (iii) > 0.4836 but ≤ 0.6216, (iv) > 0.6216 but ≤ 0.7596, and (v) > 0.7596. The size-class intervals for the five groups have been arrived at by an equal distribution of the difference between the lowest and the highest values of $D^*_j$ between these groups. In Table 2, the distribution of the districts (number and the proportion, expressed in per cent terms, of the total districts in each deprivation group), and the per cent of the total rural population accounted for by districts in each category in total rural population of India are provided.

The numbers in Table 2 are largely self-explanatory. They clearly bring out the extent of deprivation suffered by the rural population. While *only* 22.83 per cent of the rural population were living in districts where the level of deprivation was either very low or low (judged to be very low or low based on the average level of deprivation experienced by the rural population in India, which as noted earlier was very high), a little less than 55 *per cent* were living in districts that constitute the deprivation groups high and very high. Indeed, the fact that more than *one-fourth* of India's rural population were experiencing levels of deprivation in access to basic amenities in excess of 0.75, as captured by the index $D^{*}_{j,}$ speaks very poorly for the achievements made in the 44 years since independence and the beginning of the 1990s in India.

**Table 2: Number and Proportion of Total Districts, and the Share of Total Rural Population in Each Deprivation Group in India[1]: 1991**

| Level of Deprivation | No. of Districts | Proportion (in Per cent) of Districts in Each Deprivation Group to Total Districts in India | Per cent Share of Rural Population in Each Deprivation Group in Total Rural Population in India |
|---|---|---|---|
| Very Low | 35 | 9.19 | 7.20 |
| Low | 60 | 15.75 | 15.63 |
| Medium | 81 | 21.26 | 22.51 |
| High | 106 | 27.82 | 28.53 |
| Very High | 99 | 25.98 | 26.13 |
| **Total** | **381** | **100** | **100** |

Note: [1] India as constituted by the 15 Major States.

*Source*: Estimated Employing data from (a): *Census of India 1991: Occasional Paper No.5 of 1994, Housing and Amenities: A Data Base on Housing and Amenities for Districts, Cities and Towns,* Demography, Training and Data Dissemination Division, Office of the Registrar General & Census Commissioner, India; (b) Census of India 1991: *Village Directory,* – available on floppy diskette

In order to get a better picture of the extent of spatial disparity that obtains in the distribution of the burden of deprivation, the distribution of number of districts in each state classified by the level of deprivation suffered by the rural population is provided in Table 3. Further, it may be noted that the states are grouped into two categories as those located to the South and to the North of Vindhyas — the mountain range that runs across the middle of the Indian sub-continent. The numbers are largely self-explanatory, and hence only the broad picture that emerges is outlined here. It is clear from the numbers presented in Table 3 that, in general, the population living in districts to the south of Vindhyas are relatively better served with basic amenities than their counter parts living to the north of the mountain range. A comparison of the percentage of districts that falls in the last two categories: 'high' and 'very high' for states to the south and north of Vindhyas brings out the sharp north-south divide in achievements made in the sphere of access to basic amenities: while only 5.71 per cent of the districts in the south are in the last two deprivation categories, the proportion of the districts in the north that fall in these categories is shockingly high at 72.10 per cent. In general, the results strongly confirm the notion that the South Indian states are better developed than their counter parts in North India.

While it is true that in general the rural population living to the north of Vindhyas is worse-off than those living to the south, in some of the northern states they do enjoy better access to the basic amenities. For example, the rural areas in states such as Haryana, Punjab, and Gujarat are better served with the basic amenities. Indeed, Haryana with 68.75 per cent of its districts being concentrated in the 'very low' deprivation category, is only behind Kerala — the best performing state in the Indian union. It is also to be noted that rural population in Gujarat and Punjab have had better access to basic amenities compared to the population in Tamilnadu: the second best in the group of states to the south of Vindhyas.

**Table 3: Distribution of Districts in Each State According to Levels of Deprivation: 1991**

| States | Levels of Deprivation | | | | | Total |
|---|---|---|---|---|---|---|
| | Very Low | Low | Medium | High | Very High | |
| **States Located to the South of Vindhyas** | | | | | | |
| Andhra Pradesh | 0 (0.00) | 4 (18.18) | 14 (63.64) | 4 (18.18) | 0 (0.00) | 22 (100.00) |
| Karnataka | 0 (0.00) | 4 (20.00) | 15 (75.00) | 1 (5.00) | 0 (0.00) | 20 (100.00) |
| Kerala | 10 (71.43) | 4 (28.57) | 0 (0.00) | 0 (0.00) | 0 (0.00) | 14 (100.00) |
| Maharastra | 0 (0.0) | 13 (44.83) | 15 (51.72) | 1 (3.45) | 0 (0.00) | 29 (100.00) |
| Tamilnadu | 1 (5.00) | 13 (65.00) | 6 (30.00) | 0 (0.00) | 0 (0.00) | 20 (100.00) |
| **Sub-total** | **11 (10.48)** | **38 (36.19)** | **50 (47.62)** | **6 (5.71)** | **0 (0.00)** | **105 (100.00)** |
| **States Located to the North of Vindhyas** | | | | | | |
| Assam | 0 (0.00) | 0 (0.00) | 0 (0.00) | 8 (34.78) | 15 (65.22) | 23 (100.00) |
| Bihar | 0 (0.00) | 0 (0.00) | 0 (0.00) | 11 (26.19) | 31 (73.81) | 42 (100.00) |
| Gujarat | 9 (47.37) | 8 (42.10) | 2 (10.53) | 0 (0.00) | 0 (0.00) | 19 (100.00) |
| Haryana | 11 (68.75) | 5 (31.25) | 0 (0.00) | 0 (0.00) | 0 (0.00) | 16 (100.00) |
| Madhya Pradesh | 0 (0.00) | 0 (0.00) | 0 (0.00) | 16 (35.56) | 29 (64.44) | 45 (100.00) |
| Orissa | 0 (0.00) | 0 (0.00) | 0 (0.00) | 1 (7.69) | 12 (92.31) | 13 (100.00) |
| Punjab | 3 (25.00) | 8 (66.37) | 1 (8.33) | 0 (0.00) | 0 (0.00) | 12 (100.00) |
| Rajasthan | 0 (0.00) | 0 (0.00) | 10 (37.04) | 15 (55.55) | 2 (7.41) | 27 (100.00) |
| Uttar Pradesh | 1 (1.59) | 1 (1.59) | 17 (26.98) | 40 (63.49) | 4 (6.35) | 63 (100.00) |
| West Bengal | 0 (0.00) | 0 (0.00) | 1 (6.25) | 9 (56.25) | 6 (37.50) | 16 (100.00) |
| **Sub-total** | **24 (8.70)** | **22 (7.97)** | **31 (11.23)** | **100 (36.23)** | **99 (35.87)** | **276 (100.00)** |
| **Total** | **35 (9.19)** | **60 (15.75)** | **81 (21.26)** | **106 (27.82)** | **99 (25.98)** | **381 (100.00)** |

*Source*: Same as in Table 1.

The list of extremely poor performing states is constituted by Assam, Bihar, Madhya Pradesh, Orissa, and West Bengal where the most deprived categories: 'high' and 'very high' account for more than 90 per cent of the districts in each one of these states. This completes the discussion on the extent and spatial variability in the distribution of 'generalised deprivation' experienced by the rural population in India. Next, an attempt is made to assess the relationship between infant mortality and 'generalised deprivation'.

## IV Generalised Deprivation and Infant Mortality

### *IV.1 Magnitude and Spatial variability in Infant Mortality Rate*

As a prelude to the analysis of the relationship between infant mortality (IMR) and generalised deprivation, the magnitude and spatial variability in IMR is discussed here. For this purpose the estimates provided by Rajan and Mohanachandran (1998) at the district level are employed. To the best of my knowledge, this is the only source, which furnishes information on IMR for the rural, urban and total areas of each district in India. From their table, Table: Infant and Child Mortality Estimates for Districts of India as per 1991 Census, published in the *Economic and Political Weekly*, May 9, 1998, pp1120-1140, the data on IMR for the rural areas of the 381 districts in the 15 major states selected for the analysis have been obtained. The data show that the probability of a live-born dying before the first birthday in rural India varied between a low figure of *2.6 per cent* in Thiruvananthapuram in Kerala and a very high one at *15.5 per cent* in Baleshwar in Orissa in 1991. The estimated co-efficient of variation in IMR, expressed in per cent terms, is high at 32.92.

In order to obtain a better picture of the distribution of the incidence of infant mortality across space, districts have been classified into five categories, as: (i) Very Low, (ii) Low, (iii) Medium, (iv) High, and (v) Very High, based on IMR. These groups, respectively, include districts for which the IMR is (i) ≤ 51.8, (ii) > 51.8 but ≤ 77.6, (iii) > 77.6 but ≤ 103.4, (iv) > 103.4 but ≤ 129.2, and (v) >129.2. The above size-class intervals have been arrived at by equally distributing the difference between the lowest and highest values of IMR. It is important to note here that the classificatory scheme adopted is not based on any 'normative' consideration, but is based on the lowest and highest levels of IMR estimated to have obtained for rural areas across districts in India.

For each selected state, classified as those located to the south and north of Vindhyas, data on the number of districts, and the proportion of districts in total districts in India, in each IMR group is provided in Table 4. The numbers in table 4 are largely self-explanatory, and hence only the salient features of the numbers are highlighted here. Figures in parentheses in the last two columns of the last row of this table show that, as late as in 1991, there were 76 (nearly 20 per cent of all districts) districts in India, where the IMR was found to be in excess of 103, which figure is more than *9-times* as high as the figure (reported in the *Health Statistics Quarterly, 19,* available on the Internet) for England and Wales at 11.1 in 1991; and almost 300 per cent as high as that of Kerala at 37.

A comparison of the numbers provided in the last row (titled as sub-total) of the upper panel with that in the second row from the bottom of the table clearly shows that the performance of the states to the north of Vindhyas, assessed in the sphere of survival of infants, was poor (as in the case of access to infrastructural facilities) compared to their counter parts to the south of the mountain range. While *only 5.07 per cent* of the districts to the north of the mountain range fall in the very low IMR category, more than *one-third* of the districts located to the south are found to be members of this group. More over, all the 15 districts where the level of IMR was very high belong to states in the north. In this connection, it may be noted that all districts where the generalised deprivation was observed to be very high too belong to states to the north. These results show that to a large extent the spatial pattern observed in the case of generalised deprivation holds true for IMR.

However, the numbers do suggest that, as observed in the case of ‘generalised deprivation’, there are exceptions to the general spatial pattern observed. The exceptions are Punjab and Haryana. In these two states, all districts, except one in Haryana which falls in the very low category, are concentrated in the low category. On the other hand three of the five states in the south have at least one district in the medium IMR category. Surprisingly, the performance of Bihar appears to be as good as that of Maharastra and Gujarat, where access to infrastructural facilities was far better than in the former. Thus, the case of Bihar appears to somewhat negate the ‘a priori’ expectation on the relationship

**Table 4: Distribution of Districts in Each State According to Levels of IMR: 1991**

| States | Levels of IMR | Total |
|---|---|---|

| | **Very Low** | **Low** | **Medium** | **High** | **Very High** | |
|---|---|---|---|---|---|---|
| **States Located to the South of Vindhyas** | | | | | | |
| Andhra Pradesh | 10 (45.45) | 11 (50.00) | 1 (4.55) | 0 (0.00) | 0 (0.00) | 22 (100.00) |
| Karnataka | 2 (10.00) | 15 (75.00) | 3 (15.00) | 0 (0.00) | 0 (0.00) | 20 (100.00) |
| Kerala | 13 (92.86) | 1 (7.14) | 0 (0.00) | 0 (0.00) | 0 (0.00) | 14 (100.00) |
| Maharastra | 8 (27.59) | 13 (44.83) | 6 (20.69) | 2 (6.89) | 0 (0.00) | 29 (100.00) |
| Tamilnadu | 7 (35.00) | 13 (65.00) | 0 (0.00) | 0 (0.00) | 0 (0.00) | 20 (100.00) |
| **Sub-total** | **40 (38.10)** | **53 (50.48)** | **10 (9.52)** | **2 (1.90)** | **0 (0.00)** | **105 (100.00)** |
| **States Located to the North of Vindhyas** | | | | | | |
| Assam | 1 (4.35) | 7 (30.43) | 13 (56.52) | 2 (8.70) | 0 (0.00) | 23 (100.00) |
| Bihar | 4 (9.52) | 26 (61.91) | 12 (28.59) | 0 (0.00) | 0 (0.00) | 42 (100.00) |
| Gujarat | 5 (26.32) | 6 (31.58) | 8 (42.10) | 0 (0.00) | 0 (0.00) | 19 (100.00) |
| Haryana | 1 (6.25) | 15 (93.75) | 0 (0.00) | 0 (0.00) | 0 (0.00) | 16 (100.00) |
| Madhya Pradesh | 0 (0.00) | 0 (0.00) | 10 (22.22) | 23 (51.11) | 12 (26.67) | 45 (100.00) |
| Orissa | 0 (0.00) | 0 (0.00) | 2 (15.38) | 9 (69.23) | 2 (15.38) | 13 (100.00) |
| Punjab | 0 (0.00) | 12 (100.00) | 0 (0.00) | 0 (0.00) | 0 (0.00) | 12 (100.00) |
| Rajasthan | 0 (0.00) | 5 (18.52) | 14 (51.85) | 8 (29.63) | 0 (0.00) | 27 (100.00) |
| Uttar Pradesh | 2 (3.17) | 13 (20.64) | 30 (47.62) | 17 (26.98) | 1 (1.59) | 63 (100.00) |
| West Bengal | 1 (6.25) | 10 (62.50) | 5 (31.25) | 0 (0.00) | 0 (0.00) | 16 (100.00) |
| **Sub-total** | **14 (5.07)** | **94 (34.06)** | **94 (34.06)** | **59 (21.38)** | **15 (5.43)** | **276 (100.00)** |
| **Total** | **54 (14.17)** | **147 (38.58)** | **81 (27.30)** | **61 (16.01)** | **15 (3.94)** | **381 (100.00)** |

*Source*: Same as in Table 1.

between generalised deprivation and infant mortality. This calls for identifying state/local specific factors that may influence the IMR, but such an attempt is beyond the scope of this paper.

*IV.2 The Relationship between IMR and Generalised Deprivation*

At the outset, it is to be noted that while the objective is to explore the relationship between IMR and generalised deprivation, as stated earlier in Section I, the impact of literacy and the incidence of female work participation in agriculture is also explored. To begin with the correlation co-efficient between IMR and generalised deprivation index is estimated. The estimated correlation co-efficient at 0.575, given the number of observations to be 381, is fairly high and significant at 1 per cent level. The squared value of the correlation co-efficient ($r^2$) at 0.330 indicates that 33 per cent of the total variation in the rural IMR across districts in 1991 is explained by the variation in the incidence of generalised deprivation experienced by the rural population. This suggests that IMR in the rural areas could be reduced significantly by attending to removal of deprivation in access to the basic amenities such as tap water, clean fuel, electricity for lighting, 'pucca' road, public transport, and healthcare.

To analyse the impact of female literacy, and the incidence of wage work of females in agriculture, along with that of generalised deprivation, the following linear multiple regression equation[1] has been estimated.

(5) $IMRj = a_0 + b_1 D^*_j + b_2 FLIT_j + b_3\ WPAG_j + b_4 DUMM_j + u_j$,

where $D^*$ is the deprivation index; FLIT is the female literacy rate; WPAG is the rate of work participation of females in agriculture; DUMM is the regional dummy variable that takes value 1, if district j belongs to states located to the south of Vindhyas else 0; u is unobserved the random error term; j represents the district; $a_0$ is the intercept, $b_1$ to $b_3$ are slope co-efficients, and $b_4$ is the co-efficient of intercept dummy. It may be observed here that only the incidence of wage work in agriculture on infant mortality is analysed, as females who work as wage labourers, rather than cultivators, are likely to be more often engaged in transplanting and weeding, which are cited (see, in this connection, Batliwala (1998)) to be important activities that may trigger off premature labour. For reasons, stated earlier in the introduction, it is expected that while the co-efficients of FLIT and DUMM will bear negative sign, that of $D^*$ and WPAG will be positive. Given the 'a priori' expectation on the sign of the co-

[1] In this paper, the regression technique is employed as an exploratory tool, and the concern is to identify the direction and the statistical significance of the relationships between the dependent variable and the independent variables. Since the objective is not to get precise estimates of the co-efficients of the variables, neither alternative forms are tried, nor tests for multicollinearity conducted.

efficients, the sources of data employed are indicated. The source of data employed for the construction of the variable D* has already been stated.

The estimated equation is as follows:

$$(5')\ IMRj = 60.805 + \underset{(6.276)}{46.784D^{*}_{j}} \ \underset{(-3.759)}{-0.296FLIT_{j}} + \underset{(2.484)}{49.081\ WPAG_{j}} - \underset{(-5.468)}{21.360DUMM_{j}} + e_{j};$$

$$R^2 = 0.447 \qquad F=75.912 \qquad N=381$$

where $e_j$ is the estimated random error term, and other variables are as defined earlier. The results show that all the co-efficients have expected sign, and are significant at 1 per cent level. The value of $R^2$ suggests that the included variables together explain 40 per cent of the total variability in the estimated IMR across districts. These results confirm that it is possible to reduce IMR by (i) increasing the literacy status of women, and (ii) lowering the incidence of generalised deprivation. The results also show that work in agriculture has positive impact on IMR. It is important to note here that while work participation of women is likely to improve their autonomy, work in agriculture has deleterious impact on their physical well-being status. There is a case for providing maternity benefit in the form of an allowance for those who work in agriculture so that they may withdraw from tedious labour during pregnancy. Such allowance may be restricted to a maximum of two births/pregnancies.

The co-efficient of $D^{*}_{j}$ suggest that generalised deprivation has positive influence on IMR. Available evidence, which is somewhat more direct, also indicates the importance of access to basic amenities, antenatal care, and nutritional status of the mothers. Such evidence is available in *India: National Family Health Survey (NFHS-2), 1998-99*. First the data on indicators of infant deaths classified by (1) birth interval, and (2) birth size of infants, are provided in Table 6.

The numbers in table 6 are self-explanatory. They clearly show that as the time gap between successive births are lower the infant, neonatal, and postnatal mortality rates increase. Birth interval is expected to be inversely related to the nutritional status of women, for short birth interval between successive births leaves little scope for women to regain their lost nutrients and fats (see, in this connection, Girma and Genebo (2002)). For this reason, the observed inverse relation, in general, between indicators of infant death rates and birth interval shows that as nutritional status of women deteriorates survival chances of infants decline. It is also important to note that birth size of babies (an indicator of general nutritional status of mothers) is, in general, inversely related to the rates of infant deaths: neonatal, postnatal, and infant mortality rates increase as we move away from very small to large birth size. These results confirm that deterioration in the nutritional status of women has negative impact on the survival chances of infants.

**Table 6: Data on Infant Death Rates and Indicators of Nutritional Status of the Mothers**

| **Indicators of Nutritional Status** | **Rural** | | | **Urban** | | |
|---|---|---|---|---|---|---|
| **Birth Interval** | **NMR** | **PNMR** | **IMR** | **NMR** | **PNMR** | **IMR** |
| < 24 Months | 77.4 | 41.6 | 119.0 | 49.4 | 23.1 | 72.6 |
| 24-47 Months | 37.5 | 24.3 | 61.9 | 26.9 | 15.4 | 42.2 |
| 47 + Months | 26.0 | 16.5 | 42.5 | 17.9 | 7.9 | 25.9 |
| **Birth Size** | | | | | | |
| Very Small | 111.2 | 42.6 | 153.8 | (106.5) | (17.5) | 40.3 |
| Small | 48.5 | 29.7 | 78.2 | 43.5 | 23.1 | 35.4 |
| Average | 32.4 | 21.6 | 54.0 | 21.5 | 13.9 | 66.6 |
| Large | 33.4 | 21.1 | 54.6 | 31.0 | 9.3 | (124.0) |
| **Total** | 51.7 | 28.0 | 79.7 | 33.5 | 15.8 | 49.2 |

*Note*: (1) Figures in parentheses indicate that the rate is based on relatively small number of births
(2) Abbreviations employed in this table are as noted in Table 2.
(3) The rates are for the three-year period preceding the survey in 1998-99.

*Source*: *India: National Family Health Survey (NFHS-2), 1998-199*, International Institute of Population Sciences, Mumbai, India, and ORC Macro, Calverton, Maryland, USA.

Having looked at the impact of nutritional status on survival chances of infants, the impact of access to health and delivery care is analysed in what follows. Data on the rates of neonatal, postnatal, and infant mortality rates classified by (1) literacy/educational status of mothers, (2) level/types of medical care, and (3) level of standard of living are provided in Table 7. As a prelude to the discussion on the results presented in Table 8, the measurement, as employed by NFHS-2, of the variables medical care, and standard of living (as the measurement of literacy/educational status is straight forward to understand) is indicated. Medical care includes (1) antenatal care received from a health worker, (2) delivery assistance provided by a doctor, nurse, trained midwife, or other health professional, and (3) postnatal care received in a health facility or at home within two months of delivery. While no care indicates the worst situation, all three types of care received represent the best-case scenario. Standard of living index has been constructed taking into account the type of house; type of toilet facility; source of lighting; main fuel for cooking; source of drinking water; separate room for cooking; ownership status of house, agricultural land, land irrigated, livestock, and durable goods. In every case the access has been ranked from best to worst, and weights have been assigned in that order. The aggregate index of living standard obtained for each household has been employed for classification of households as Low, Medium and High. This index essentially captures access to basic amenities and source of livelihood, namely land. Given the categories of types of medical facilities utilised, and the spheres included for assessing the standard of living, the salient features of the numbers provided in Table 7 are discussed.

**Table 7: Data on Indicators of Infant Death Rates and Indicators of Access to Healthcare and Amenities.**

| **Indicators of Access to Amenities** | **Rural** | | | **Urban** | | |
|---|---|---|---|---|---|---|
| **Literacy/Educational Status of Women** | **NMR** | **PNMR** | **IMR** | **NMR** | **PNMR** | **IMR** |
| Illiterate | 57.0 | 32.4 | 89.4 | 44.1 | 23.8 | 67.8 |
| Literate and less than Middle School | 44.0 | 20.3 | 64.3 | 30.8 | 11.8 | 42.6 |
| Middle School | 36.1 | 15.0 | 51.1 | 29.5 | 13.3 | 42.8 |
| High School and Above | 26.9 | 8.8 | 35.7 | 22.2 | 8.2 | 30.4 |
| **Medical Care** | | | | | | |
| No Care | 54.2 | 36.8 | 90.9 | 46.2 | 20.0 | 66.2 |
| One or Two Types | 35.8 | 19.0 | 54.7 | 35.8 | 19.3 | 55.1 |
| All Three Types | 22.4 | 14.5 | 36.9 | 21.8 | 8.2 | 30.1 |
| **Standard of Living** | | | | | | |
| Low | 56.5 | 33.7 | 90.2 | 48.8 | 27.3 | 76.1 |
| Medium | 50.7 | 25.3 | 76.0 | 34.6 | 16.9 | 51.5 |
| High | 37.4 | 14.7 | 52.1 | 24.1 | 8.9 | 33.0 |

*Note:* As in Table 7.
*Source*: Refer Table 7.

In every case, as expected, the mortality rates of infants decline as we move from worst to best-case scenario. For example, the neonatal mortality rate declines from 56.5 to 37.4 as we move from low to high standard of living. Similarly, 57 to 26.9 as we move from births to illiterate women to those who have completed at least high school education. These results, which strengthen the results obtained at the district level for the rural areas of India, clearly suggest that access to basic amenities, education, and medical care helps to improve the survival chances of infants. In this connection, deprivation in a large number of fronts such as, child labour[2]/school-less-ness, fertility, mortality, literacy, and expectation of life at birth thrive in an environment of generalised deprivation of access to infrastructural facilities. In the cause of mitigating deprivation in all these fronts, it is important to provide for creating basic infrastructures at any cost.

## V Concluding Observations

In this paper an attempt has been made to analyse the impact of generalised deprivation on infant mortality. In the process the trends in perinatal, neonatal, postnatal and infant mortality rates in India have been explored (Section II). This exercise revealed that the contribution of neonatal mortality to infant mortality rate has been increasing over time, which suggests that the later, to a large extent, could be reduced by bringing down the former. However, Visaria (2004) is of the opinion that neonatal mortality is "inherently more difficult to reduce". While it may true that neonatal mortality may be relatively more difficult to reduce compared to postnatal mortality, the experience of developed countries, and the data for India do show that neonatal mortality could be reduced to a considerable extent. The data show that, by 2002, in England and Wales the neonatal mortality has been reduced to 3.6 per thousand live births. But this rate in India was shockingly high at 51.7 in 1998-99. The figure for England and Wales compared to that for India indicates the possible extent to which the early infant deaths in India could be reduced. The analysis of the data on infant mortality by types of access to healthcare points to the importance of having access to all three types of care: antenatal acre, delivery assistance by trained professionals, and postnatal care. It is important to note that the neonatal mortality rate for births that did not receive healthcare of any type at 54.2 is more than two hundred per cent as high as that for births that received all three types of care at 22.4.

In this context, it is also important to know the causes for neonatal mortality. The data provided in Arokiasamy and Pradhan (2005) show that in 1995 premature births accounted for 53.5 per cent of all infant deaths in India. It appears that the immediate causes that trigger off premature labour are not well known. However, the causes of death of premature babies appear to be known. In premature infants (1) the fat fold is not fully developed, and (2) the lungs are not matured. So these infants tend loose body heat and develop breathlessness. Deaths due to these causes could be avoided by providing proper neonatal care. This points to

[2] See, in this connection, Jayaraj and Subramanian (2002).

the importance of access to, not just healthcare by trained professionals at birth, but quality healthcare. Thus there is need for improving the neonatal care facilities available in India.

Apart from healthcare, educational achievement of women plays an important role in reducing the extent of infant mortality and neonatal mortality. Both infant and neonatal mortality rates, for women who have at least completed high school, respectively at 35.7 and 26.9, are fairly close to that for women who have received all three types of healthcare facilities, respectively at 36.9 and 22.4. These results show that it is important to improve the educational status of women.

Birth weight also influences the survival chances of infants. The evidence suggest that birth weight is a function of the nutritional status of women, and nutritional status depends on, apart from quantity and quality food consumed, access to basic amenities that help to improve the nutrient absorptive capacity of the body. To this end, providing access to infrastructural facilities, particularly to those that reduce the domestic drudgery, should be given top priority. Access to basic amenities might also relieve women and girl children from the drudgery of domestic work, and help the later to attend school. Schooling, it has already been noted, has positive impact on survival of infants.

The estimated linear regression on infant mortality clearly shows that infant mortality in India could be reduced by reducing the incidence of failure to have access to infrastructural facilities. The results also show that female literacy aids reduction in IMR. The spatial patterns that obtain in the cases of both infant mortality and generalised deprivation show that rural population in north India suffer more in both spheres of deprivation. It is also important to note that the incidences of illiteracy, child labour/school-less-ness, poor nutritional status, and low expectation of life at birth, appear to be, in general, high in states to the north compared to that for states to the south of Vindhyas, which suggests that deprivation in different spheres thrive together. To break the nexus between deprivations in different spheres it is important to invest on infrastructural facilities. Hence there is a case for maintaining the pressure on the state to create and maintain basic infrastructures.

# APPENDIX

## On Village Level Data Sources

It has been noted elsewhere that to construct the index of generalised deprivation of access to infrastructural facilities, the computerised village level data provided by the Population Census 1991, in the two directories named as Village Directory and Primary Census Abstract, have been employed. In this appendix, the use and the problems faced in employing the data from these sources are highlighted. A file in the village directory contains information on the availability of various infrastructural facilities for each one of the villages in a district. For seven states: Bihar, Haryana, Kerala, Maharastra, Orissa, Punjab and Uttar Pradesh, the files in the village directory provide, apart from the data on infrastructural facilities available, the data on total population of each village in a district. This made the task of identifying the villages and the population of each one of the villages deprived of access to a particular infrastructural facility in a district, in these 7 states, relatively easy. In the case of the other eight states: Andhra Pradesh, Assam, Gujarat, Karnataka, Madhya Pradesh, Rajasthan, Tamilnadu, and West Bengal, the files in the village directory contain data on only the availability of various amenities in each one the villages in a district. Hence, data on total population of each village had to be abstracted from the *Village Primary Census Abstract, Census of India 1991* (in the directory designated as PCA, available on floppy diskette), and matched with the other relevant data on availability of infrastructural facilities. This made our task very difficult. The task of combining and matching information from two different files for each village for every district in these 8 states posed considerable problems as the order in which the villages have been arranged differed between the files in the village directory and the files in the village primary census abstract. Moreover, the format used by the census to enter the location code, which is unique to each village that helps to identify a village, in files in the two directories was different. The software employed to enter data in different states was also not the same. For some states, dbase had been used for data entry and for some lotus had been employed. To match the information on availability of various amenities and total population of each village, we had to utilise all our expertise on the various computer soft-wares such as lotus, excel, dbase and SPSS.

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