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District-Level Wealth-Inequality in Infant Mortality in India

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ABSTRACT

Using data from population based surveys; it has been tried to examine the extent of district-level wealth inequality in infant mortality in India, considering the districts as the units of analysis. Analysis shows that there was significant variation in infant mortality among districts of India. About one-fifth of the districts had IMR of above 65 of which more than 65% districts are economically backward. The degree of wealth inequality in infant mortality was higher among economically backward districts than that of economically well-off districts. Results from regression analysis suggest that the factors such as female literacy, proportion of households having toilet facility and female workforce participation rate are the most significant predictors of district level variation in infant mortality. The proportion of households having toilet facility has strong bearing on infant mortality, indicating that availability of basic sanitation would help in reducing infant mortality. The female literacy and female workforce participation rate have strong and negative effects on infant mortality. The magnitude of the coefficients for female literacy, proportion of households having toilet facility and female workforce participation indicates that the level of IMR would decline by 7%, 5% and 4% for every 10% increase in female literacy rate, proportion of households having toilet facility and female workforce participation rate, respectively. It has been found that the level of IMR is likely to be higher in northern region and Uttar Pradesh and lower in southern region of India.

Keywords: Infant mortality rate, inequality, female literacy, female workforce, India

Infant mortality is an important determinant of child survival and child health. It is also regarded as one of the vital demographic indicators reflecting the quality of life in a community and the state of social and human development of any setting worldwide. Therefore, the reduction in infant mortality is probably the major priority issue in health related programmes of most developing countries. The health related millennium development goal also called for improving child survival across the countries (UN, 2000). In last two decades (1990-2010), India has shown significant progress in socio-economic dimensions (such as sustained economic growth, reduction in poverty, increase in literacy and longevity, and reduction of infant mortality) (Planning Commission, 2009; 2011; 2012; Registrar General of India, 2012). With faster socio-economic development, the level of infant mortality rate (IMR) has sharply declined in India during 1990-10); by more than 30 points from 80 in 1990 to 47 (per 1000 live births) in 2010 (Registrar General of India, 2009; 2012). However, the pace of reduction in infant mortality varies considerably across the states and among socio-economic groups in India (IIPS and Macro International, 2007). Moreover, the variation in IMR, particularly, at the sub-national level in India remains to be high (Registrar General of India, 2011). The states' pattern suggests that in 2012, the infant mortality rate (IMR) was highest in the state of Madhya Pradesh (56 per 1000 live births)

and lowest in the states of Goa and Manipur (10 per 1000 live births). Out of 35 state of India, eight states have the IMR above the national IMR of 42 (Registrar General of India, 2013). Besides state level variation in IMR, economic differentials in IMR are large across states and among socio-economic groups. The IMR in poorest wealth quintile was more than two times (70 per 1000 live births) the IMR of richest wealth quintile (29 per 1000 live births). Recent studies indicate that there are even large inter-district variations in infant and child mortality in India. The levels of infant and child mortality in districts of northern states remain high (Registrar General of India, 2009; 2011; Ram *et al*., 2013). Meanwhile, the under-five mortality, which largely varies with infant mortality rate (IMR), varies largely across and within the states. India alone accounts for one-fifth of under-five mortality worldwide. Hence, the global health related millennium development goal in reducing infant child mortality is largely contingent on India's progress in reduction of infant and child mortality.

Most existing studies on the analysis of infant and child mortality in India are pertained to the national and state level. However, there are no much studies on infant or child mortality analysis pertaining to the district level. Even there is no study that examined the district-level variation in infant mortality with respect to district-level household wealth status. It may be mentioned that the progress in child health of a nation is largely depends on that of its sub-regions. In India, the districts are the lower administrative regions next to the state level. In the wake of decentralized planning in India, the districts are the central focus of effective planning and program implementation. The household wealth status, on the other hand, may reveal the actual economic well-being of the households. Therefore, examining district-level variation in infant mortality with respect to household wealth status is quite imperative. Specifically, this paper examines the district-level variation as well as wealth inequality in infant mortality in India, considering the districts as the units of analysis.

Database and Methodology

The analysis of the paper is mainly based on the data from District Level Household and Facility Survey-2 (DLHS-2), 2002-04 and District Level Household and Facility Survey-3 (DLHS-3), 2007-08. The IMR for each district is estimated by pooling birth history data from DLHS-2 and DLHS-3. Due to insufficient sample of infant deaths for many districts in DLHS-3, the information on birth history from DLHS-2 and DLSH-3 are combined to ensure sufficient sample size and robust estimates of IMR for districts of India. The life table method (O'Donnell *et al*., 2008) is applied to estimate the IMR at the district level. The IMR is estimated for 587 districts of the 33 states (except Jammu and Kashmir, and Nagaland) of India. The estimates of IMR are confined to the infant deaths among all live births taking place in three years preceding the date of survey. To examine the reliability of the district level estimates of IMR, the national and state level estimates of IMR are compared with that from Sample Registration System (SRS) Statistical report 2005 (Registrar General of India, 2006).

The wealth status of each district is determined by the value of wealth index (WI), defined based on a set of 19 selected household indicators available from DLHS-3. These indicators are selected based on two criterions- the indicators with coefficient of variation of 40% or more and common existence in both rural and urban areas. The WI for each district of India is computed by applying principal component analysis (PCA) and aggregation method (Raychaudhuri and Haldar, 2009). The PCA is applied to compute the factor loadings and weights of the selected indicators. The method applied to compute the CWI is:

$$I = \sum_{i=1} NV_i \left(\sum_{j=1} | L_{ij} | .E_j \right) / \sum_{i} \left(\sum_{j=1} | L_{ij} | .E_j \right)$$

Where, I is the index, is the normalized value of *i-th* indicator, L_{ij} is the factor loading of *i-th* indicator on *j-th* factor, E_j is the Eigen value of the *j-th* factor.

To check the reliability of the estimated WI, The district-level estimates of WI is compared with district-level estimates of monthly per capita consumption expenditure (WI) derived from the 61st round of National Sample Survey (NSS), 2004-05.

In order to see the district-level variation in IMR in terms of wealth status, the districts are cross-classified by categories of WI score and levels of IMR. The Lorenz curve is used to examine the extent of wealth inequality in IMR among the selected districts.

To understand the factors determining district level differentials in infant mortality in India, the ordinary least square (OLS) regression analysis is carried out, where the district level IMR is the dependent variable. A set of eight independent variables, namely, female literacy rate, proportion of urban population (i.e. level of urbanization), proportion of Muslim population, proportion of combined scheduled caste and scheduled tribe (SC/ST) population, proportion of households with access to safe drinking water, proportion of households having toilet facility, female workforce participation rate and wealth index (WI) is included in the analysis. Additionally, four regional dummy variables, namely, North dummy (1 for the districts of Chhattisgarh, Madhya Pradesh and Rajasthan), South dummy (1 for the districts of Andhra Pradesh, Karnataka, Kerala and Tamil Nadu), Uttar Pradesh dummy (1 for the districts of Uttar Pradesh) and Bihar dummy (1 for the districts of Bihar) are used to understand the role of regions in explaining the regional pattern in infant mortality. The estimates on the selected independent variables are derived from DLHS-3 and 61st round of NSS.

Results and Discussion

In order to examine the reliability of the district level estimates of IMR, the national and state level estimates of IMR are compared with that from SRS for the year 2005 (Registrar General of India, 2006). The estimates of IMR are referred to that of 2005 as the estimates are derived by pooling data from DLHS-2 and DLHS-3. Fig. 1 presents the comparison of estimated IMR with that from SRS 2005 for India and bigger states (states with population of more than or equal to 10 million) of India. The IMR for India estimated from pooled DLHS-2 and DLHS-3 data is 52 per 1000 live births; close to that from SRS 2005 (58 per 1000 live births). The state level estimates of IMR derived using pooled data from DLHS-2 and DLHS-3 are also closer to that from SRS 2005. For example, the estimated IMR for Bihar is 56 per 1000 live births compared to 61 per 1000 live births from SRS 2005.

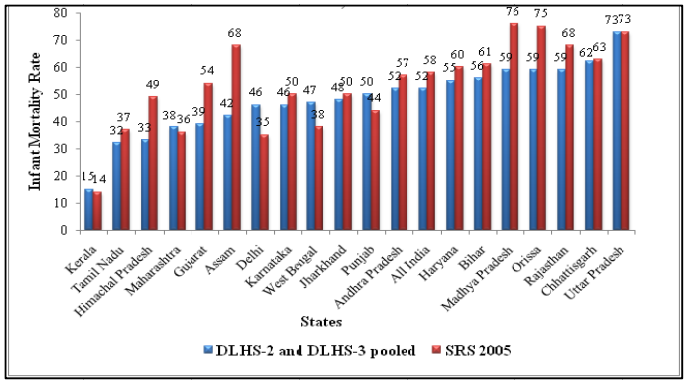

Fig. 1: Comparison of estimated infant mortality rate from pooled DLHS-2 and DLHS with that of SRS 2005, Bigger states, India

Similarly, the estimated IMR for Chhattisgarh is 62 per 1000 live births compared to 63 per 1000 live births from SRS 2005. The IMR for Uttar Pradesh estimated from pooled DLHS-2 and DLHS-3 data is same as to that from SRS 2005. The correlation coefficient of the state level estimates of IMR derived using pooled data and that of SRS 2005 is found to be very strong (0.81). This suggests that the estimates of IMR derived using pooled data from DLHS-2 and DLHS-3 are fairly reliable and acceptable.

In order to understand the district-level differentials in IMR, the districts are classified into four categories; districts with IMR of below 30, with IMR of 30-44, with IMR of 45-65 and with IMR of above 65. The distribution of districts by levels of IMR shows that about one-fifth of the districts (119 out of 587) had IMR of above 65. More than one-third of the districts (207 districts) had IMR in the range of 45-65 while only a little over one-fifth of the districts (125 districts) had IMR below 30. A major proportion of districts (58%) had IMR in the range of 30-65. The level of IMR was highest of 107 per 1000 live births in the district of Balangir of Odisha, followed by Faizabad and Kheri of Uttar Pradesh (105 and 102 per 1000 live births, respectively). It is further noticed that, more than 70% of the districts (87 out of 119) having IMR of above 65 are mainly from five of the eight Empowered Action Group states (Bihar, Chhattisgarh, Madhya Pradesh, Odisha, Rajasthan and Uttar Pradesh)

of India. The district-level variation in IMR can also be noticed from Fig. 2.

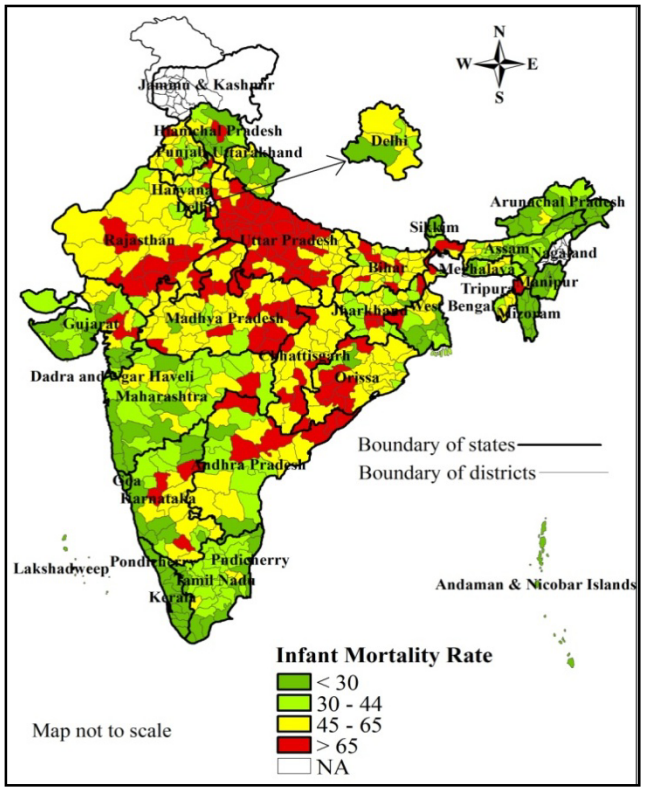

Fig. 2: Mapping of districts based on infant mortality rate, India, DLHS-2 and DLHS-3 combined

Table 1: Percent distribution of districts by categories of WI score and levels of IMR, India

Categories of CWI	Levels of IMR				Total
	<30	30-44	45-65	>65	
Low (≤ 0.117)	8.3 (6)	18.1 (13)	40.3 (29)	33.3 (24)	100 (72)
Lower middle (0.118-0.279)	12.1 (34)	18.5 (52)	42 (118)	27.4 (77)	100 (281)
Higher meddle (0.280-0.442)	34.3 (47)	31.4 (43)	26.3 (36)	8 (11)	100 (137)
High (≥ 0.443)	41.2 (40)	24.7 (24)	26.8 (26)	7.2 (7)	100 (97)
All India*	21.6 (127)	22.5 (132)	35.6 (209)	20.3 (119)	100 (587)

*Excluding the districts of Jammu and Kashmir, and Nagaland.

Note: Figures in the parentheses represent the number of districts

Table 1 presents the percent distribution of districts by categories of WI and levels of IMR in India. The average IMR in low WI category was 56 compared to 37 in high WI category. More than 30% districts in low WI category had IMR of above 65 compared to only 7% districts in high WI category. On the other hand, only 8% districts in low WI category had IMR of below 30 compared to 41% districts in high WI category. A major proportion of districts in low and lower middle WI categories had IMR of more than 44 compared to a small proportion of districts in high and higher middle WI categories. This analysis, thus, indicates that the economically backward districts had higher levels of IMR compared to economically better-off districts in India.

Wealth inequality in IMR among districts of India is examined with the help of Lorenz curve. The Lorenz curve for IMR is drawn by plotting the cumulative proportion of IMR (on Y axis) against the cumulative proportion of districts ranked by WI score categories (on X axis) (Fig. 3). It is observed that there is significant gap between the line of equity and the Lorenz curve for IMR, indicating that there was a sharp inequality in infant mortality among districts of India Moreover, the Lorenz curve for IMR lies above the line of equity, indicating that the degree of inequality in infant mortality was higher among economically backward districts compared to that among economically well-off districts in India.

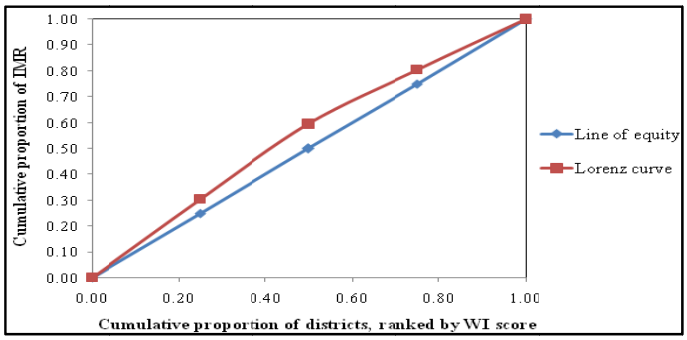

Fig. 3: Lorenz curve representing district-level wealth inequality in infant mortality in India

An OLS regression analysis is carried out to understand the factors determining district level variation in infant mortality in India. The data relating to 581 districts of India are included in this analysis, where the IMR

estimated from combined birth history data from DLHS-2 and DLHS-3 is the dependent variable.

Table 2: Results of linear regression analysis for IMR as a dependent variable based on the data of 581 districts of India

Independent variables	Mode l1	Mode l2	Mode l3	Mode l4
Wealth index	-0.586*** (10.43)	-0.511*** (6.44)	-0.016 (0.18)	0.020 (0.24)
Proportion of urban population	—	0.041 (0.70)	0.017 (0.31)	0.049 (0.93)
Female workforce participation rate	—	-0.154** (2.18)	-0.273*** (4.12)	-0.274*** (4.31)
Proportion of Muslim population	—	-0.150** (2.14)	0.064 (0.94)	0.000 (0.01)
Proportion of SC/ST population	—	-0.103** (2.28)	0.091** (2.01)	0.074* (1.69)
Proportion households with access to safe drinking water	—	—	0.088** (2.55)	0.082** (2.46)
Proportion households having toilet facility	—	—	-0.434*** (10.61)	-0.251*** (5.31)
Female literacy rate	—	—	—	-0.619*** (6.98)
North dummy	—	0.158*** (6.56)	0.103*** (4.14)	0.057** (2.30)
South dummy	—	-0.049* (1.86)	-0.057** (2.37)	-0.047** (2.02)
UP dummy	—	0.212*** (7.12)	0.201*** (6.43)	0.168*** (5.52)
Bihar dummy	—	0.043 (1.09)	0.041 (1.04)	-0.012 (0.31)
Constant	-1.185	-1.171	-1.209	-0.899
R^2	0.16	0.35	0.46	0.50
Number of districts	581	581	581	581

@Used in logarithmic form. ***Significant at 1% level (p<0.01). **Significant at 5% level (p<0.05). *Significant at 10% level (p<0.10).

Note: The dependent variable is infant mortality rate, which is in logit form. Figures in the parentheses are the absolute t-ratios.

A set of eight independent variables, namely, female literacy rate, proportion of urban population (i.e. level of urbanization), proportion of Muslim population, proportion of combined SC/ST population, proportion of households with access to safe drinking water, proportion of households having toilet facility, female workforce participation rate and wealth index (WI) is included in the analysis. Additionally, four regional dummy variables (north, south, and Uttar Pradesh and Bihar dummies) are included to understand the role of regions in explaining the regional pattern in infant mortality. The results of regression analysis for IMR are presented in Table 2.

In regression analysis four alternative regression models are developed. In Model1, only WI is included. It is found that WI has significant and negative association with IMR and it alone accounts for 16% of the explained variation (R^2=0.16) in infant mortality. The association of WI with IMR also remains significant and in the same direction in Model 2. However, this variable remains insignificant in the subsequent models thereafter, controlling for other variables, particularly, availability of safe drinking water and toilet facility. The significant negative association of the WI variable with IMR indicates that the districts with higher economic well-being are likely to experience lower infant mortality.

Based on all four regression models, it is seen that the factors such as female literacy, proportion of households having toilet facility and female workforce participation rate have a strong and negative effects on IMR. The magnitude of the coefficients for these three variables implies that the level of IMR would decline by 7%, 5% and 4% for every 10% increase in the female literacy rate, proportion of households having toilet facility and female workforce participation rate, respectively. The proportion SC/ST population has significant and positive effects on IMR while the level of urbanization and size Muslim population has no significant effect on IMR, controlling for all variables. All dummy variables except the Bihar dummy are found to have significant association with infant mortality. The coefficients for north and Uttar Pradesh dummies are positive while the coefficient for south dummy is negative, indicating that the level of infant mortality is likely to be higher in northern region and Uttar Pradesh and lower in southern region of India.

Conclusion

In last two decade, India has made significant progress in economic growth, reduction in poverty, and improvement in female literacy and health and health care utilization. However, large disparities in socio-economic dimensions and child health exist among and within the states of India. It may be mentioned that widening regional inequalities in child health aspects within a state or nation may cause adverse child health consequences, which may, in turn, be an obstacle to the social as well as human development of the state or nation as a whole. Existing studies on child health inequality in India have been limited to national and state level. One of the major reasons for limited number of studies on district level analysis in India was possibly due to non availability of data at the district level. However, the population based surveys have bridged this gap and made the scope for researchers to generate indicators in districts of India. Using data from population based surveys, this paper examines the extent of district-level wealth inequality in infant mortality in India, considering the districts as the units of analysis.

Analysis shows that there was significant variation in infant mortality among districts of India. The level of IMR was highest in the district of Balangir of Odisha (107 per 1000 live births), followed by Faizabad and Kheri of Uttar Pradesh (105 and 102 per 1000 live births, respectively). About one-fifth of the districts (119 out of 587) had IMR of above 65 of which more than 65% districts (78 out of 119) are economically backward and belonging to the states of Bihar, Madhya Pradesh, Odisha, Rajasthan and Uttar Pradesh. District-level wealth inequality in infant mortality was sharp and significant in India. The degree of wealth inequality in infant mortality was higher among economically backward districts compared to that among economically well-off districts in India. Results from regression analysis suggest that the factors such as female literacy, proportion of households having toilet facility and female workforce participation rate are the most significant predictors of district level variation in infant mortality. The proportion of households having toilet facility has strong bearing on infant mortality, indicating that availability of basic sanitation would help in reducing infant mortality. The female literacy and female workforce participation rate have strong and negative effects on infant mortality, indicating that the districts with higher female literacy and female work participation are likely to experience lower infant mortality. The magnitude of the coefficients for female literacy, proportion of households having toilet facility and female workforce participation indicates that the level of IMR would decline by 7%, 5% and 4% for every 10% increase in female literacy rate, proportion of households having toilet facility and female workforce participation rate, respectively. Regional location has a strong influence on IMR. The level of IMR is likely to be higher in northern region and Uttar Pradesh and lower in southern region of India. The district-level wealth index (i.e. district-level wealth status) has no significant relationship with IMR, controlling for all variables. This is most likely due to its strong correlation with other variables such as availability of safe drinking water and toilet facility.

Based on the analysis, it may be recommended that the targeted intervention in the economically backward districts with high infant mortality would be helpful to reduce the IMR in India. The availability of basic sanitation should be emphasized in health related programs to improve child health situation and thereby reducing infant mortality in the backward districts of India.

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