International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Household Environment Status and Infant Mortality: A Study of West Bengal

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Abstract

The factors influencing infant mortality have been documented in a number studies. A number of individual, biological and household environmental factors were found to be the significant predictor of infant mortality in any human setting. Most existing studies on early childhood mortality in India were based on census data. Using the data from second and third rounds of District Level Household and Facility Survey of India this paper assessed the pattern and degree of association of infant mortality with household environment status at the district level in West Bengal. The estimates of infant mortality rate for districts of West Bengal were derived based on birth history data. The household environment status for each district was determined based on three selected household environment factors, namely, availability of toilet facility, availability of safe drinking water and existence of pucca house. Key findings showed that the northern and western districts of this state were backward in terms of household environment status and mostly the districts of those regions had higher levels of infant mortality. The association of availability of toilet facility with infant mortality was found to be significant and stronger, compared to that of other two household factors.

Keywords: Infant Mortality Rate, Household Environment Status, Districts, West Bengal

Introduction

The infant mortality is an important indicator of child survival and health. It is also regarded as one of the important indicators reflecting quality of life in a community and socio-economic development in a country. A number of studies have been carried out in India to provide the district level estimates of infant and child mortality using indirect methods (Registrar General of India, 1988; 1989; 1997; 2009; Prakasam *et al*., 2000; Irudaya Rajan and Mohanachandran, 1998). All these studies provided the district level estimates of vital rates in India using the data from decadal censuses of India. The Registrar General of India, using indirect estimation technique, provided comparable estimates of infant and child mortality at the district level based on CEB and CS data from 1981, 1991 and 2001 censuses (Registrar General of India, 1997; 2009). All these studies provided the evidence of large inter-district variation in infant and child mortality in India and within different states. Irudaya Rajan and Mahachandran (1998) using data from 1991 census of India estimated infant and child mortality for districts of India. They also showed that the districts of southern states had lower infant and child mortality than districts of northern states of India.

The factors determining the levels of infant and child mortality have been extensively addressed in demographic literature. Available evidences from India and other countries indicate that the level of infant mortality is influenced by number of individual, biological, health care and health facility, environmental and socio-economic factors (Caldwell, 1986; Jain and Visaria, 1988; Jain, 1988; Das Gupta, 1990; Hobcraft *et al*., 1984; 1985; Mosley and Chen, 1984; Rutstein, 2000; Suwal, 2001). However, past evidences from India indicate that along with socio-economic, individual and biological factors, household and social environmental factors also play significant role influencing child survival in the first year of life (Jain and Visaria, 1988; Jain, 1988; Visaria, 1988). The relationship of most of these factors with infant mortality is found to be similar in some other studies also (Das Gupta, 1990; Pradhan and Arokiasamy, 2006). Some other district-level studies based on various census data had also demonstrated that along with socio-economic and physical infrastructural factors, safe drinking water has significant effect on early childhood mortality (Bhattacharya, 1999; Bhattacharya and Chikwama, 2012).

The purpose of this paper was to assess the infant mortality differentials and understand the association of infant mortality with household environmental factors at the district level in West Bengal. The state of West Bengal is one of the large states of India, which has experienced substantial improvement in socio-economic indicators (such as increase in literacy, reduction in poverty and improvement in overall state of human development) over the decades (Planning Commission, 2011; Navaneetham and Dharmalingam, 2011; Registrar General of India, 2011). The demographic situation has also improved in this state. The decadal growth rate of population in West Bengal declined from 17.8 percent during 1991-2001 to 13.9 percent during 2001-2011 and remains below the national average (17.6 percent) (Registrar General of India, 2011). In terms of child mortality, the state has been performing better than national average. The infant mortality rate (IMR) of West Bengal had declined from 71 in 1991 to 51 in 2001 and 33 in 2009 while that of India had declined from 80 in 1991 to 66 in 2001 and 50 in 2009 (Registrar General of India, 2009a; 2011b). Though this state has experienced substantial improvement in socio-economic and demographic indicators, its average performance in overall state of human development remains below the national average and the performance of many poorer states of India (Planning Commission, 2011). Not only that, there were large socio-economic disparities among the districts in this state and, particularly, the northern and a few western districts of this state were economically underdeveloped (Planning Commission, 2011). Moreover, there were large variation in early childhood mortality among the districts in this state. The poorer districts were found to have higher infant and child mortality compared to the richer districts (Prakasam *et al*., 2000; Irudaya Rajan and Mohanachandran, 1998, Registrar General of India, 2009). Most existing studies on district level estimates of infant and child mortality in India were based on census data. Though, there is also scope for estimating child mortality indicators for districts of India from population based surveys, not much attempt has been made so far in this respect. This present paper aimed at estimating infant mortality and understanding the association of infant mortality with household environment factors at the district level in West Bengal.

Data and Methods

The data from second and third rounds of District Level Household and Facility Survey (DLHS) i.e. DLHS-2 (2002-04) and DLHS-3 (2007-07) were used to estimate the IMR at the district level in West

Bengal. The IMR was estimated for 19 districts of the state. The IMR for each district was estimated by pooling birth history data from DLHS-2 and DLHS-3. The DLHS, under the Reproductive and Child Health project aimed to provide data on key RCH indicators at the district level. Beside the information on key RCH indicators, the information on birth history was also available from both the surveys. The DLHS-3 collected the detailed information on live births (birth order, date of birth, surviving status and age at death of live born children etc.) for all pregnancies to all ever married women aged 15-49 years (excluding women whose gauna was not performed) since January 1, 2004 while DLHS-2 collected the same information on live births taking place during the lifetime of all currently married women aged 15-44 years. It may be mentioned that it was not possible to derive the reliable estimates of IMR at the district level based on birth history data from DLHS-3 due to insufficient sample of child deaths in many districts. Hence, 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 West Bengal. The estimates of IMR were confined to infant deaths among all live births taking place in three years preceding the date of survey. The DLHS-3 also provides data on household amenities such as availability of safe drinking water and toilet facility, and type of house etc.

In Demographic and Health Surveys, the direct method such as life table (LT) method is preferred to estimate infant and child mortality based on birth history data as it permits the estimates of standard errors for corresponding mortality estimates. Under this method, the survival probability of children in a specific age is calculated, which requires data on date of interview, and date of birth, survival status and age at death of children born in a specific reference period preceding the date of survey (O'Donnell et al., 2008). The IMR for all districts of West Bengal was estimated by pooling birth history data from DLHS-2 and DLHS-3 and applying the LT method. In order to understand the association of infant mortality with household environment factors at the district level, three households environment factors, namely, households having toilet facility, households having safe drinking and households having pucca house were chosen. In each of these factors, the percentage of households had been derived from DLHS-3 data. Moreover, a household environment index (HEI) was calculated for each district to understand the district-level variation in household environment status. The HEI was derived using the following formula

$$NV_i = \frac{x_i - x_{min}}{x_{max} - x_{min}}$$

where, NV_i is the normalized value, x_i is the observed value, x_{min} is the minimum value and x_{max} is the maximum value of *i-th* indicator. Here, the maximum and minimum values of each indicator were chosen from the ranking of 19 districts in each indicator.

Results

District-level variation in household environment status

The household environment status of each district was examined with respect to availability of toilet facility, access to safe drinking water and existence of pucca house. For each of these household environmental factors, the proportion of household was derived. The estimates showed that there was considerable variation in the proportion of households having toilet facility among the districts of West Bengal. The proportion of households having toilet facility was highest in the district of Kolkata (99.8%), preceded by North 24 Parganas (95.4%), East Medinipur (94.2%) and Nadia (82.9%) and

lowest in the district of Purulia (10%), followed by Bankura (16.4%), Birbhum (25.2%) and Uttar Dinajpur (30.9%). The proportion of households with safe drinking water was highest in the district of Kolkata (89.7%), preceded by Darjeeling (59.6%), North 24 Parganas (44.5%) and Jalpaiguri (41.8%) and lowest in the district of Uttar Dinajpur (4%), followed by Murshidabad (9.9%), East Medinipur (12.5%) and Nadia (13.2%). The proportion of household with pucca house was highest in the district of Kolkata (67.8%), preceded by Darjeeling (52%), Howrah (51.7%) and North 24 Parganas (42%) and lowest in the district of Koch Bihar (9%), followed by West Medinipur (10.3%), Dakshin Dinajpur (11.8%) and Uttar Dinajpur (14.6).

This analysis, thus, showed that there was remarkable disparity in the availability of toilet facility, access to safe drinking water and existence of pucca among the districts of West Bengal. Moreover, the estimates of coefficient of variation in these dimension clearly showed that the degree of disparity in these dimensions was not similar across the districts. The degree of disparity was found to be higher in case of households having safe drinking water (0.778) and households having pucca house (0.593), compared to households having toilet facility (0.479) (Table 1).

Table 1: Descriptive analysis of the selected household environmental indicators, Districts, West Bengal

Household environmental indicators	Mean	Standard Deviation	Coefficient of variation
Proportion of households having toilet facility	58.9	28.2	0.479
Proportion of households having access to safe drinking water	26.7	20.8	0.778
Proportion of households having pucca house	27.7	16.4	0.593

For further investigation into the district-level variation in household environment status, the ranking analysis of the districts had been carried out based on the HEI. This analysis also highlighted the existence of remarkable disparity in household environment status among the districts of West Bengal. The value of HEI was highest in the district of Kolkata (1.000), preceded by Darjeeling (0.719), North 24 Parganas (0.662) and Haora (0.635) and lowest in the district of Puruliya (0.087), followed by Uttar Dinajpur (0.109), Bankura (0.125) and Birbhum (0.143).

Essentially, the district of Kolkata placed the first rank in household environment status while the districts of Darjeeling and North 24 Parganas placed the second and third position household environment status. On the contrary, the district of Puruliya placed the lowest rank in household environment status while the districts of Uttar Dinajpur and bankura placed the second last and third last positions in household environment status, respectively. In overall, it was observed that, northern and western districts of West Bengal were backward in terms of household environmental condition compared to southern districts, with some exceptions (Table 2).

Table 2: Ranking of Districts based on household environment index, West Bengal

Districts	Normalized Values			Household environment index	Rank
	Proportion of households having toilet facility	Proportion of households having access to safe drinking water	Proportion of households having pucca house		
Kolkata	1.000	1.000	1.000	1.000	1
Darjeeling	0.781	0.648	0.729	0.719	2
North 24 Parganas	0.951	0.472	0.562	0.662	3
Haora	0.811	0.367	0.726	0.635	4
Hugli	0.782	0.329	0.513	0.541	5
Jalpaiguri	0.546	0.442	0.368	0.452	6
Barddhaman	0.564	0.311	0.451	0.442	7
Nadia	0.812	0.108	0.271	0.397	8
South 24 Parganas	0.679	0.176	0.291	0.382	9
East Medinipur	0.938	0.099	0.094	0.377	10
Koch Bihar	0.676	0.120	0.000	0.265	11
Murshidabad	0.426	0.068	0.245	0.247	12
Maldah	0.237	0.172	0.165	0.191	13
West Medinipur	0.392	0.131	0.020	0.181	14
Dakshin Dinajpur	0.279	0.194	0.046	0.173	15
Birbhum	0.170	0.118	0.141	0.143	16
Bankura	0.071	0.149	0.155	0.125	17
Uttar Dinajpur	0.233	0.000	0.094	0.109	18
Puruliya	0.000	0.122	0.138	0.087	19

Inter-district differentials in IMR in West Bengal

Table 3 presents the estimated IMR and corresponding standard errors for districts of West Bengal. The estimates of IMR showed that there was a wide variation in the levels of IMR among the districts of West Bengal. The level of IMR (per 1000 live births) was lowest in the district of Kolkata (12), preceded by East Medinipur (16), North 24 Parganas (23) and Nadia (26) and highest in the district of Uttar Dinajpur (76), followed by Jalpaiguri (69), Puruliya (68) and Murshidabad (60). Thirteen of the nineteen districts of this state had IMR of more than 30.

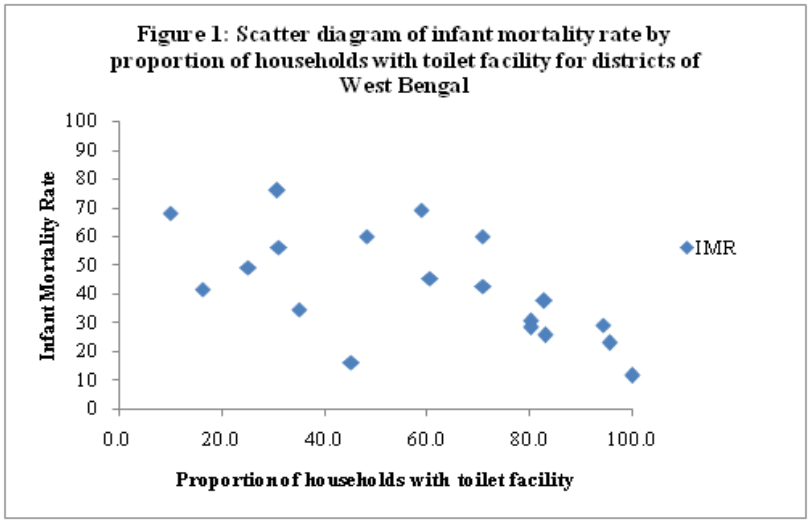
And, particularly, seven districts (Birbhum, Maldah, Koch Bihar, Murshidabad, puruliya, Jalpaiguri and Uttar Dinajpur) had IMR above the state average of 47. These estimates clearly showed that, mostly the northern and western districts of West Bengal had higher infant mortality compared to the districts of other parts of the state.

Table 3: Estimated Infant Mortality Rate and Corresponding Standard Errors in districts of West Bengal

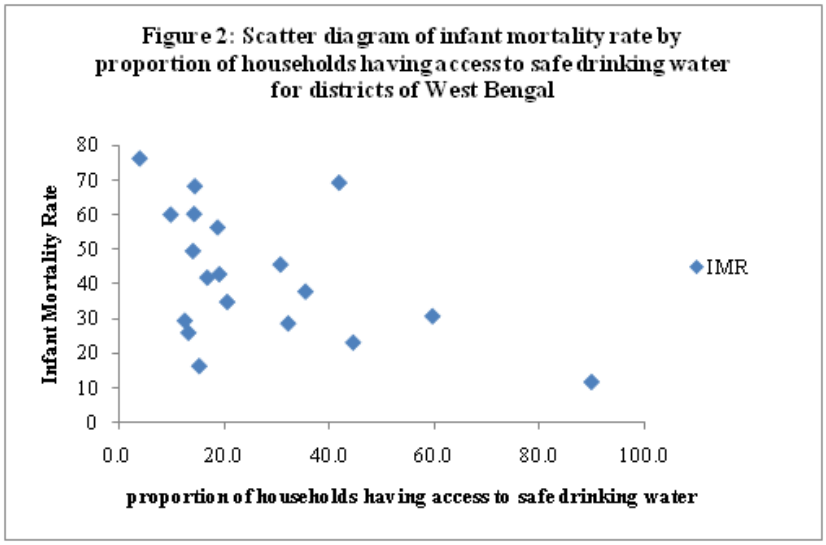
Districts	Infant mortality rate (Per 1000 live births)	Standard Error
Darjiling	31	0.0084
Jalpaiguri	69	0.0108
Koch Bihar	60	0.0092
Uttar Dinajpur	76	0.0084
Dakshin Dinajpur	35	0.0085
Maldah	56	0.0087
Murshidabad	60	0.0087
Birbhum	49	0.0085
Barddhaman	46	0.0097
Nadia	26	0.0081
North 24-Parganas	23	0.0072
Hugli	29	0.0089
Bankura	42	0.0087
Puruliya	68	0.0102
West Medinipur	16	0.0054
Howrah	38	0.0093
Kolkata	12	0.0066
South 24-Parganas	43	0.0079
East Medinipur	29	0.0102
West Bengal	**47**	**0.0021**

Association of infant mortality with household environment

An attempt was made to understand the association of infant mortality with three household environment indicators, namely, availability of toilet facility, availability of safe drinking water and existence of pucca house. Since all these three indicators are positive in nature, it was expected that the district with higher proportion of households with toilet facility might have lower infant mortality rate and vice-versa. Interestingly, the same had reflected from the analysis. The association of infant mortality with availability of toilet facility was in expected direction and found to be regular, with few exceptions. For example, the districts of Kolkata, North 24-Parganas, East Medinipur, Nadia, Howrah, and Hugli were better off in terms of toilet facility compared to the districts of Puruliya, Bankura, Birbhum, Uttar Dinajpur and Maldah. The districts in the former had lower levels of infant mortality compared to the districts in the later. This result is also evident from the scatter diagram of district-level infant mortality plotted against the district-level proportion of households with toilet facility (Figure 1). The scatter diagram clearly shows that infant mortality decreases with increase in households with toilet facility. This further indicates that the association of infant mortality with toilet facility was strong.



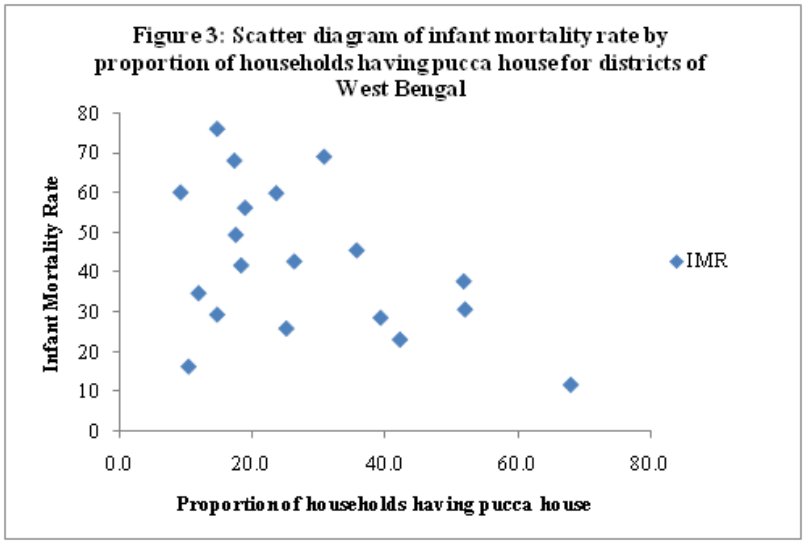
It was also expected that the district with higher proportion of households having safe drinking water might have lower levels of infant mortality. However, this was not for all districts. The analysis showed that the district with lower proportion of households having safe drinking water even had lower levels of infant mortality. For example, the districts of East Medinipur, Nadia and West Medinipur with lower proportion of households having safe drinking water had lower levels of infant mortality compared to other districts. This is also evident that the districts with relatively better-off condition in terms of safe drinking water had higher infant mortality. For example, the districts of Jalpaiguri, howrah and Barddhaman with relatively higher proportion of households having safe drinking water had higher infant mortality.



This indicates that the district-level infant mortality was independent of safe drinking water and the association between these two variables was weak. The scatter diagram of district-level infant mortality plotted against the district-level proportion of households with safe drinking water also clearly showed that the association of infant mortality and safe drinking water was was not uniform and was irregular across the districts (Figure 2).

Furthermore, it was expected that the districts with higher proportion of households having pucca house might have lower levels of infant mortality. however, this was not evident from the analysis. The

association of infant mortality with existence of pucca house was also found to be weak and irregular across the districts. This is also evident from the scatter diagram of infant mortality plotted against the district-level proportion of households having pucca house (Figure 3).



In order to understand the degree of association of infant mortality with the three household variables, the correlation analysis was carried out. The correlation coefficient of district-level IMR and availability of toilet facility was found to be -0.6 (significant at 1% level) while that of IMR and safe drinking water was -0.485 (significant at 5% level), indicating the fact that the level of infant mortality is negatively associated with toilet facility and safe drinking water. Again, correlation coefficient of IMR and existence of pucca house was, though not significant, found to be -0.443, indicating that the IMR is negatively correlated with existence of pucca house. In overall, it was observed that the association of toilet facility with infant mortality was relatively stronger, compared to that of other two household environment variables.

Summary and Conclusion

The purpose of this chapter was to estimate the infant mortality rate (IMR) and understand the association of IMR with three household environment variables, namely, availability of toilet facility, access to safe drinking water and existence of pucca house the district level in the state of West Bengal. The analysis of the household environment indicators showed that there was large disparity in all three household environment indicators among the districts of this state. Some northern districts such as the districts of Jalpaiguri, Koch Bihar and Uttar Dinajpur and some western districts such as the districts of Puruliya, Birbhum and Bankura were relatively more backward in terms of household environment condition. on the contrary, the districts of Kolkata, North 24-Pargans, Howrah and Hugli, belonging to the southern part of the state, were found to be better-off in terms of household environment status. The district of Kolkata placed the top position and the district of Puruliya placed last position in terms of household environment condition. One of the major reasons for the district of Kolkata to occupy the first rank in household environment status is that this district continued to be fully urbanised and advanced in socio-economic and infrastructure development. It is evident that the northern and western districts of this state were backward in terms of per capita income and physical infrastructure development

(Raychaudhury and Haldar, 2009). Moreover, the level of industrialization in northern and western districts was low (Planning Commission, 2002; Government of West Bengal, 2012).

A large variation in infant mortality was also found to exist among the districts of West Bengal. Though, many past studies had shown that the level of infant mortality declined in most districts of all states of India including West Bengal (Registrar General of India, 1988; 1989; 1997; 2009; Prakasam *et al*., 2000; Irudaya Rajan and Mohanachandran, 1998), many districts of this state continued to have higher infant mortality. The northern districts (such as Jalpaiguri, Koch Bihar and Uttar Dinajpur) and the western districts (such as Birbhum, Puruliya and Murshidabad) had IMR of above 40. These districts were also backward in terms of household environment status. This indicates the fact that the districts with low household environment status were likely to have higher infant mortality. It was expected that the districts with better household environment status might have lower infant mortality. However, it was found that the association of availability of toilet facility with infant mortality was significant and relatively stronger, compared to that of other two household environment variables. The association of other two household environment variables with infant mortality was weak or irregular, with some exceptions, across the districts. The correlation coefficient of availability of toilet facility and infant mortality was found to be negative (-0.60) at 1% level of significance, indicating the fact that the districts with more households having toilet facility would have lower infant mortality. This, further, indicates the fact that the availability of toilet facility is an important predictor of district-level differentials in infant mortality in the state West Bengal. The targeted intervention in the districts with worse household environment status may be helpful to promote health care utilization and thereby reducing infant mortality in those districts.

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