INTER-DISTRICT DIFFERENTIALS AND INEQUALITY IN INFANT MORTALITY IN INDIA

Malay Das

Assistant Professor, Department of Economics,
Naba Barrackpur Prafulla Chandra Mahavidyalaya

Abstract: *This paper examined the inter-district differentials and inequality in infant mortality rate (IMR) in India. For this purpose, the paper used the data from second and third rounds of District Level Household Survey (DLHS) and 61st round of National Sample Survey (NSS) The IMR for each district of India has been estimated by pooling birth history data from DLHS-2 and DLHS-3. The economic differentials and inequality in IMR has been assessed with respect to monthly per capita consumption expenditure (MPCE) class. The MPCE for each district has been estimated using household consumption expenditure data from 61st round of NSS. The Lorenz curve was used to examine the extent of inequality in IMR. Major findings indicate that out of 587 districts, 24.9% districts had IMR of above 60, 53.5% districts had IMR in the range of 30-60 and 21.6 percent districts had IMR of below 30. In the low MPCE class, about half of the districts (49%) had IMR of above 60 and only 5% districts had IMR of below 30 whereas in the high MPCE class, 16% districts had IMR of above 60 and 48% districts had IMR of below 30. The degree of inequality in infant mortality was higher among economically backward districts compared to that among economically well-off districts in India.*

Key words: *Infant Mortality Rate, Differentials, Inequality, Lorenz Curve, Districts, India.*

Introduction

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 (Das, 2013; 2017). The health related millennium development goal also called for improving child survival across the countries (UN, 2000). During the decades of 1990-2010, India had 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 one thousand live births) in 2010 (Registrar General of India, 2009a; 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 one thousand live births) and lowest in the states of Goa and Manipur (10 per one thousand 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 one thousand live births) the IMR of richest wealth quintile (29 per one thousand 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, 2009b; 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.

Though, in the past, many studies have been carried out to provide the district level estimates of infant mortality in India (Registrar General of India, 1988; 1997; 2009; 2011; Irudaya Rajan and Mohanachandran, 1998; Ram *et al*., 2013), very little attempt has been made to understand the district level inequality in infant mortality in India. It may be mentioned that the progress in socio-economic development and health aspects of a state or nation largely depends on that of its sub-regions. Therefore, disparities in socio-economic development and health progress across the districts may be an obstacle to the development of the country as a whole (Das, 2013). The reduction in infant mortality in India is largely depends upon that in the districts. Without faster reduction in infant mortality in India, the millennium development goal of improving child survival cannot be achieved. However, most existing studies on the analysis of infant and child mortality in India are pertained to the national and

state level. In order to implement programmes for improving child health situation and thereby improving quality of people in the country, the estimates of infant mortality at the lower administrative areas like districts are needed. However, there were no much studies on infant or child mortality analysis pertaining to the district level. Even no study examined the district-level variation and inequality in infant mortality with respect to household income or consumption expenditure status. The household consumption expenditure status, on the other hand, may reveal the actual economic status of the households. In a country like India, the income data is not readily available and the consumption expenditure data is considered to be more reliable than income data. Therefore, examining district-level variation and inequality in infant mortality with respect to household consumption expenditure status is quite imperative. Specifically, this paper assessed the inter-district differentials and economic inequality in infant mortality with respect to monthly per capita consumption expenditure (MPCE) in India, considering the districts as the units of analysis.

Data and methods

The paper used 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) to estimate the IMR (per one thousand live births) at the district level in India (Das, 2013; 2017). The IMR was estimated for 587 districts of the 33 states of India (except for the districts of Jammu and Kashmir, and Nagaland); by pooling birth history data from DLHS-2 and DLHS-3. 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 were combined to ensure sufficient sample size and robust estimates of IMR for districts of India. The estimates of IMR were confined to infant deaths among all live births taking place in three years preceding the date of survey (O'Donnell *et al*., 2008).

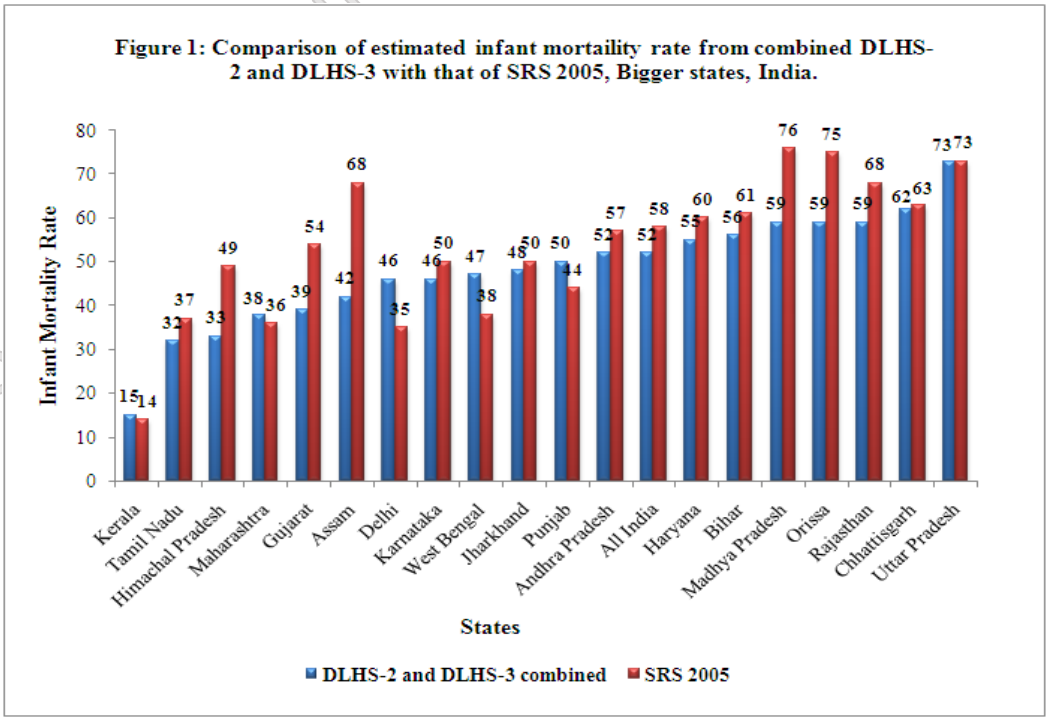
In Demographic and Health Surveys, the direct method such as life table (LT) method is preferred to estimate infant and child mortality based on birth history data as it permits the estimates of standard errors for corresponding mortality estimates. Under this method, the survival probability of children 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). In this paper, the IMR at the district level in India is estimated by pooling birth history data from DLHS-2 and DLHS-3 and applying the LT method. 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). Inequality in infant mortality at the district level has been examined with respect to MPCE. The higher the level of MPCE, the higher will be the economic status of the districts. The MPCE at the district level in India has been estimated using household consumption expenditure data from the 61st round of National Sample Survey (NSS) collected during 2004-05. In many population research and demographic surveys, the consumption data is considered to be more reliable than income data. The National Sample Survey (NSS) collects data on important socio-economic aspects on a comprehensive basis for the whole country by using scientific sampling techniques. The first round of NSS was conducted in 1950, and since then, the information on various subjects has been collected through various rounds of NSS. Prior to 61st round, the NSS was designed to provide the reliable estimates at state level. For the first time, the data of NSS 61st round (2004-05) was designed to provide the estimates at the district level. In earlier rounds of NSS, the data were collected through two-stage stratified sampling scheme whereas in 61st round of NSS, the data were collected through multi-stage stratified sampling procedure. In the 61st round of NSS, the districts were taken as strata for selection of first stage units (FSU). Both rural and urban parts of the districts were taken as sub-strata for selection of sample villages and urban blocks respectively (Das, 2013). The economic differentials and equality in IMR have been examined with respect to the distribution of districts by MPCE class categories and level categories of IMR. For this purpose, both levels of MPCE and levels of IMR have been categorized into four categories and three categories, respectively. With respect to MPCE, The districts were classified into four categories using the minimum cut-off point below the mean value and maximum cut-off point above the mean value in the district level MPCE, as of 2004-05. The standard deviation (SD) in district level MPCE is considered as an interval below and above the mean value to determine the minimum and maximum cut-off points. The MPCE, as of 2004-05, in all the districts are distributed with mean of Rs.691 and SD of Rs.254. The minimum and maximum cut-off points were estimated to be Rs.437 and Rs. 945, respectively. Thus, the districts with MPCE of less than or equal to Rs. 437 were classified as the low category, with MPCE between Rs. 438-690 as the lower middle category, with MPCE between Rs. 691-944 as the higher middle category, and with MPCE of more than or equal to Rs. 945 as the high category of MPCE class. With respect to the levels of IMR, the districts were classified into three categories; districts with IMR of below 30, with IMR of 30-60 and with of IMR of above 60 (Das, 2013).

Results

Reliability of the district level estimates of IMR in India

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 were referred to that of 2005 as the estimates are derived by pooling data from DLHS-2 and DLHS-3 (Das, 2013). Figure 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 was 52 per one thousand live births; close to that from SRS 2005 (58 per one thousand 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 was 56 per one thousand live births compared to 61 per one thousand live births from SRS 2005. Similarly, the estimated IMR for Chhattisgarh was 62 per 1000 live births compared to 63 per one thousand 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 from 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 were fairly reliable and acceptable (Das, 2013).



Distribution of districts by levels of IMR and states in India

In order to see the distribution of districts by levels of IMR, the districts were classified into three categories; districts with IMR of below 30, with IMR of 30-60 and with of IMR of above 60. Table 1 presents the distribution of districts by levels of IMR and states in India. It is observed that out of 587 districts, 53.5 percent (314 districts) had IMR in the range of 30-60 and 24.9 percent (146 districts) had IMR of above 60 while only 21.6 percent (127 districts) had IMR of below 30.

Table 1: Distribution of districts by levels of IMR in India and States.

States/All India	Infant Mortality Rate			Total Number of districts
	Below 30	30-60	Above 60	
Andaman & Nicobar Islands	2			2
Andhra Pradesh	2	15	6	23
Arunachal Pradesh	11	5		16
Assam	9	15	3	27
Bihar		24	13	37
Chandigarh		1		1
Chhattisgarh		9	7	16
Dadra & Nagar Haveli	1			1
Daman & Diu	2			2
Delhi	1	7	1	9
Goa	2			2
Gujarat	8	15	2	25
Haryana		16	4	20
Himachal Pradesh	7	4	1	12
Jharkhand	1	18	3	22
Karnataka	7	15	5	27
Kerala	13	1		14
Lakshadweep	1			1
Madhya Pradesh	1	27	17	45
Maharashtra	10	24	1	35
Manipur	8	1		9
Meghalaya	1	6		7
Mizoram	8			8
Orissa	1	20	9	30
Pondicherry	4			4
Punjab		17	3	20
Rajasthan		19	13	32
Sikkim	2	2		4
Tamil Nadu	12	17	1	30
Tripura		4		4
Uttar Pradesh		16	54	70
Uttarakhand	7	6		13
West Bengal	6	10	3	19
All India*	**127**	**314**	**146**	**587**

*Excluding Jammu and Kashmir, and Nagaland.

The pattern of distribution of districts by levels of IMR is not similar across the states. For example, in Arunachal Pradesh, 11 out of 16 districts had IMR below 30 and the remaining 5 districts had IMR in the range of 30-60. Similarly, in Kerala, 13 out of 14 districts had IMR below 30 and the remaining one district had IMR in the range of 30-60. In case of Maharashtra, out of 35 districts 10 districts had IMR below 30, 24 districts had IMR in the range of 30-60 and one district had IMR above 60. On the contrary, none of the districts in Uttar Pradesh and Bihar had IMR below 30. However, majority of the districts in Uttar Pradesh (54 out of 70) had IMR above 60 while majority of the districts in Bihar (24 out of 37) had IMR in the range of 30-60. This analysis also shows that majority of the districts (113 out of 146) having IMR of above 60 are mainly from six of the eight EAG states of India (Bihar, Chhattisgarh, Madhya Pradesh, Orissa, Rajasthan and Uttar Pradesh).

Inter-district differentials in IMR in India

The district level estimates of IMR shows that there has been a wide variation in the levels of IMR among districts of India. According to the estimates of IMR, the level of IMR ranges from a highest of 107 in the district of Balangir of Orissa, followed by Faizabad and Kheri of Uttar Pradesh (105 and 102, respectively), and Budaun of Uttar Pradesh and Srikakulam of Andhra Pradesh (100 in each). The district-level variation in the levels of IMR also evident from the mapping of districts developed based on district-level estimates of IMR (Figure 2).

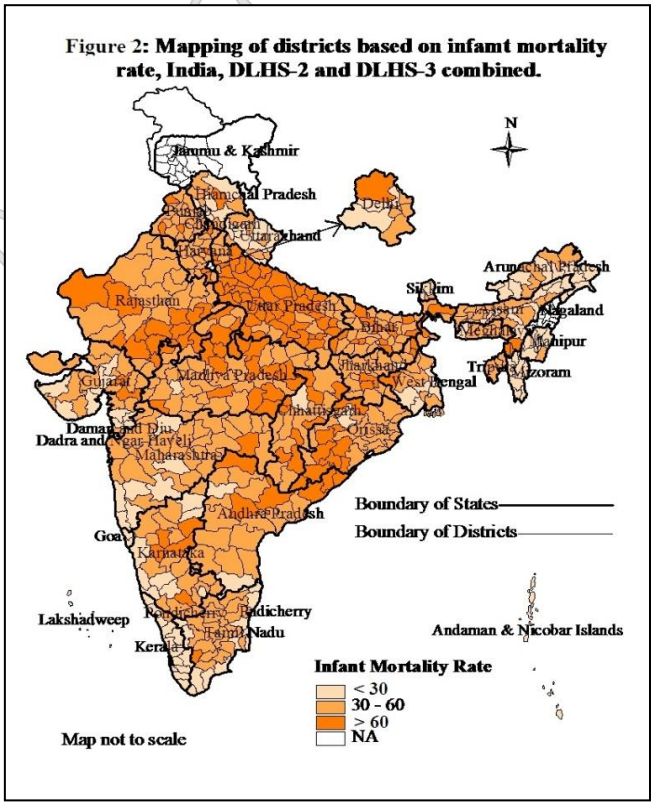


Figure 2: **Mapping of districts based on infamt mortality rate, India, DLHS-2 and DLHS-3 combined.**

Figure 2 clearly depicts that the majority of the districts having IMR of more than 60 are mainly from the states Bihar, Chhattisgarh, Madhya Pradesh, Orissa, Rajasthan and Uttar Pradesh. On the contrary, the majority of the districts having IMR of below 30 are mainly from the states of Karnataka, Kerala, Tamil Nadu, Gujarat, Maharashtra, Uttarakhand, West Bengal, Arunachal Pradesh, Assam, Manipur and Mizoram. A large variation in IMR even exists among the districts within different states of India. For example, in case of Bihar, the IMR ranges from a highest of 77 in the district of Kaimur Bhabua, followed by Khagaria (75), Saharsa and Jehanabad (74 in each), and Muzaffarpur and Jamui (70 in each) to a lowest of 35 in the district of Saran, preceded by Munger and Siwan (37 in each) and Gaya (39). Similarly, in Rajasthan, it ranges from a highest of 82 in the district of Tonk followed by Baran (76), Bundi and Udaipur (74 in each) and Jodhpur (72) to a lowest of 35 in the district of Jhunjunun, preceded by Dungarpur (38), Ganganagar (40) and Alwar (42).

Economic differentials in IMR among districts of India

Table 2 presents the percent distribution of districts by MPCE class and levels IMR in India. It is observed that, among the districts in low MPCE class, about half of the districts (49%) had IMR of above 60 and only 5% districts had IMR of below 30. On the contrary, in high MPCE class category, 16% districts had IMR of above 60 and about half of the districts (48%) had IMR of below 30. In general, it is observed that a major proportion of districts in low and lower middle MPCE class categories had IMR of 30-60 or above 60 compared to a small proportion of districts in high and higher middle MPCE class categories. Thus, this analysis indicates that the economically backward districts had higher levels of IMR compared to economically better-off districts in India.

Table 2: Percent distribution of districts by MPCE class and levels of infant mortality rate (IMR), India.

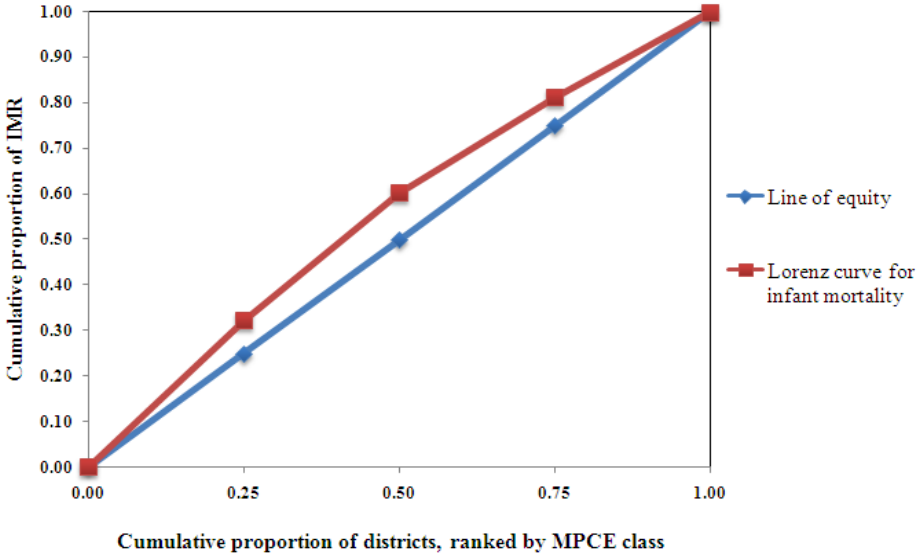
MPCE Class (in Rs.)	Levels of IMR			Total
	<30	30-60	> 60	
Low (<= 433)	4.5 (3)	46.3 (31)	49.3 (33)	100.0 (67)
Lower middle (434-681)	11.0 (30)	58.1 (158)	30.9 (84)	100.0 (272)
Higher middle (682-930)	33.3 (55)	56.4 (93)	10.3 (17)	100.0 (165)
High (>= 931)	48.1 (37)	36.4 (28)	15.6 (12)	100.0 (77)
All India*	**21.5 (125)**	**53.4 (310)**	**25.1 (146)**	**100.0 (581)**

*Excluding the districts of Jammu and Kashmir, and Nagaland, and four districts of Delhi (North, East, New Delhi and Central), one district of Maharashtra (Mumbai) and one district of Andaman and Nicobar Islands (Nicobar). Note: Figures in the parentheses represent the number of districts.

Economic inequality in IMR: Exploration by Lorenz curve

In the previous section the economic differentials in IMR at the district level has been examined by the distribution of districts with reference to MPCE class categories. In this section, an attempt has been made to understand the economic inequality in IMR among districts of India 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 MPCE class (on X axis) (Das, 2013; 2017) (Figure 3).

Figure 3: Lorenz curve representing economic inequality in infant mortality among districts of India.



It is observed that there is a 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. It is further observed that 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 (Das, 2013).

Summary and Conclusion

In the decades of 1990-2010, 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 (Das, 2013). 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 (Das, 2013). Using data from population based surveys, this paper examines the extent of district-level differentials and inequality in infant mortality in India, considering the districts as the units of analysis.

This paper assessed the inter-district differentials and inequality in infant mortality in India with respect to the vital indicator of infant mortality i.e. IMR. The IMR has been estimated for 587 districts of the 33 states (except Jammu and Kashmir, and Nagaland) of India using birth history data pooling from DLHS-2 and DLHS-3. An attempt was made to assess the economic differentials in IMR across the districts of India. For this purpose, the districts were classified by levels of IMR, with reference to MPCE class defined based on district level MPCE for 2004-05. Additionally, the Lorenz curve for IMR has been drawn based on MPCE class to assess the district-level inequality in infant mortality. Analysis showed 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 one thousand live births), followed by Faizabad and Kheri of Uttar Pradesh (105 and 102 per one thousand live births, respectively). About one-fourth of the districts (146 out of 587) had IMR of above 60 of which 73% districts (106 out of 146) are economically backward and belonging to the states of Bihar, Madhya Pradesh, Odisha, Rajasthan and Uttar Pradesh. District-level 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. These results are also similar to that of Das (2017; 2023). The analyses of Das (2017; 2023) showed that along with socio-economic factors, availability of basic sanitation has strong bearing on infant mortality; would help in reducing infant mortality at the district level in India. It was also evident that the economically backward districts in India were likely to have lower health care services and higher infant mortality (Das, 2015; 2017). 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.

References

Das, M. (2013). "Economic Disparity and Demographic Differentials in Districts of India, Thesis of Doctor of Philisophy, International Institute for Population Sciences, Deonar, Mumbai

Das, M. (2017). "Inter-district wealth-based differentials and inequality in infant mortality in India", *IAHRW International Journal of Social Sciences Review*, 5(3): 442-449.

Das, M. (2015). "Investigating inter-district disparity in RCH care utilization status in India, 2002-2007", *International Journal of Development Research*, 5(8): 5359-5365.

Das, M. (2023). "Household Environment Status and Infant Mortality", *International Journal for Multidisciplinary Research*, 5(2): 1-10.

International Institute for Population Sciences (IIPS) and Macro International. (2007). National Family Health Survey (NFHS-3), 2005-2006: India, Vol. 1. IIPS, Mumbai.

Irudaya Rajan, S and P. Mohanachandran. (1998). Infant and Child Mortality Estimates-Part I. *Economic and Political Weekly* 33(19): 1120-1140.

O'Donnell, O., E. van Doorslaer, A. Wagstaff and M. Lindelow. (2008). Analyzing Health Equity Using Household Survey Data: A Guide to Techniques and Their Implementation. The World Bank, Washington, DC 20433.

Planning Commission. (2009). Report of the Expert Group to Review the Methodology for Estimation of Poverty. Government of India, Planning Commission, available at: http://planningcommission.nic.in/reports/genrep/rep_pov.pdf

Planning Commission. (2011). India Human Development Report (2011): *Towards Social Inclusion*, Institute of Applied Manpower Research, Government of India, Oxford, Oxford University Press.

Planning Commission. (2012). Press Notes on Poverty Estimates, 2009-10. Government of India, Planning Commission, available at: http://planningcommission.nic.in/news/press pov1903.pdf.

Ram, U., P. Jha, F. Ram, K. Kumar, S. Awasthi, A. Shet, J. Pader, S. Nansukusa, and R. Kumar. (2013). Neonatal, 1-59 months, and under-5 mortality in 597 Indian districts, 2001 to 2012: estimates from national demographic and mortality surveys. *Centre for Global Health Research*, published online: http://www.cghr.org/index.php/2013/09/child-mortality-in-indian-districts/

Registrar General of India. (2009a). Compendium of India's Fertility and Mortality Indicators 1971-2007 based on the Sample Registration System. Ministry of Home Affairs, Government of India, New Delhi.

Registrar General of India. (2009b). District Level Estimates of Child Mortality in India Based on the 2001 Census Data. Ministry of Home Affairs, Govt. of India, New Delhi.

Registrar General of India. (2011). *Annual Health Survey Bulletins 2010-11*, Office of the Registrar General and Census Commissioner, Govt. of India, available at: http://www.censusindia.gov.in.

Registrar General of India. (2012). SRS Based Abridged Life Tables 2003-07 to 2006-10, SRS Analytical Studies, Report No.1 of 2012, New Delhi.

Registrar General of India. (2013). *SRS Bulletin*, Sample Registration System, Vol.48, No.2, September 2013.

Registrar General of India. (2006). Sample Registration System Statistical Report 2005. Report No.2 of 202006. Ministry of Home Affairs, Government of India, New Delhi.

Registrar General of India. (1988). Child Mortality Estimates of India. Occasional Paper No.5 of 1988. Registrar General, India, New Delhi.

Registrar General of India. (1997). District Level Estimates of Fertility and Child Mortality for 1991 and their Interrelations with Other Variables. Occasional Paper No.1 of 1997. Registrar General, India, New Delhi.

Registrar General of India. (2011). *Annual Health Survey Bulletins 2010-11*, Office of the Registrar General and Census Commissioner, Govt. of India, available at: http://www.censusindia.gov.in.