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Understanding the Linkages of Household Environmental Deprivation, Asset Index and Child Survival in India

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Often the household environmental factors are combined with the household assets in explaining the economic differentials in population and health parameters of developing countries. Though the utility of wealth index (that combines household environment with assets) in explaining health and health care utilization is established, its utility as a proxy of economic measures is contested. In this paper we attempted to differentiate the role of household environmental factors and the household assets in explaining the infant mortality (IMR) and the under-five mortality (U5MR) in India. We hypothesize that there are no significant differences in IMR and U5MR among those households residing in poor household environmental condition and those who are poor in asset in India. We have used the data from the National Family Health Survey (NFHS-3), 2005-06, India, a population based large scale representative survey. Bi-variate analyses, principal component analysis, life-table technique and hazard model are used in the analyses. Two composite indices namely, an asset index based on consumer durables of the households and household environmental deprivation index based on the household environmental factors are constructed. The indices are categorized as poor and non-poor based on the 50% of the median composite score. Result shows that the correlation coefficient of asset index and household environmental deprivation index is weak. Further, there are no significant differences of IMR and U5MR among households living in poor household environment and those are poor in asset cutting across the states. Results of cox-proportional hazard model indicate that the household environmental factors have significant impact on child survival. It calls for improving the household environmental conditions of the household in promoting child survival in India.

Keywords: Household Environmental Deprivation; Asset Index; Child Survival; IMR; U5MR; Urban India

Introduction

To improve child survival, measurement by reduction of infant and under-five mortality are two monitoring indicators of the Millennium Development Goals (MDGs). Empirical evidences across the globe suggest that the progresses in these indicators are slow and uneven across and within the countries (Lawn et al., 2006). Though the millennium declaration aimed to reduce the infant and under-five mortality by two-thirds by 2015 from the base year (1990), many developing countries including India are lagging behind. According to UNICEF (2009) though the progress in under-five mortality (U5MR) has been made in many countries, the global rate of progress is still insufficient to achieve the MDGs. Africa and Asia combined account for 93 per cent of all under-five deaths that occur each year in the developing world and India accounts about one-fifth of global under-five mortality, which is more than any other country (Black et al., 2010). During 1992-93 and 2005-06, the infant mortality rate (IMR) in India had declined from 79 to 57 per 1000 live births while the under-five mortality rate had declined from 109 to 74 per 1000 live births (IIPS and Macro International, 2007). However, the actual rate of progress in reduction of infant and under-five mortality is lower than the required rate of progress for the country (Ram et al., 2008). The MDG target to reduce the IMR by 27 and U5MR by 41 seems unattainable for the country by 2015 and the global effort in achieving the MDGs is largely contingent on India's success (You et al., 2010).

The child survival, particularly during infancy is broadly affected by a set of endogenous and exogenous factors. Endogenous factors are mainly biological and arise from genetic causes such as congenital disorders, premature births, birth injuries etc. On the other hand, the exogenous factors are mainly environmental or external factors that cause infections and accidents. It is evident that in developing countries most of the deaths among under-five years are associated with the infectious diseases mainly caused by the poor household environmental conditions (Sastry, 1996; Muhuri, 1996; Ayad et al., 1997; Hoque et al., 1999; Folasade, 2000; Anderson et al., 2002; Mutunga, 2007; Kembo & Ginneken, 2009; Fink et al., 2011; Cheng et al., 2012). An estimated 1.87 million children aged below five years in developing countries died in 2004 due to diarrhea (Boschi-Pinto, 2008). Pruss et al. (2002) estimated that 4% of all deaths (including children) and 5.7% of total disability-adjusted life years can be attributed to water, sanitation, and hygiene. Cheng et al.

(2012) found that increase in access to water and sanitation leads to significant decrease in IMR and U5MR. The world health organization (WHO) estimated about 3.5 million deaths and one tenth of global disease burden could be prevented worldwide annually by improving water supply, sanitation, hygiene and management of water resources (Pruss-Ustun et al., 2008). The use of biomass as cooking fuel results in air dense with particulates and gases which affect the lungs and lives. In developing countries, the indoor air pollution leads to a higher chance of respiratory diseases and causes about 2 million deaths annually to children under-five years of age (WHO, 2007). It was estimated that the indoor air pollution caused by traditional cooking fuel is responsible for 3.7% of the loss of disability adjusted life years in developing world (WHO, 2007). However, the deaths due to environmental factors are viewed as relatively preventable and treatable (Pruss-Ustun et al., 2008).

Often the household environmental factors are combined with the household assets in explaining the economic differentials in population and health parameters of developing countries. Though the utility of asset index (that combines household environment with assets) in explaining health and health care utilization is established, its utility as a proxy of economic measures is contested. Theoretically, the households which are economically stronger are likely to have better household environmental condition. But this may not be always true. We believe that the economic proxies (consumer durables) of the household are necessary but not sufficient condition in promoting child survival. Also, little is known on the association of household environmental conditions and economic conditions of the households at disaggregated level. Moreover, the economic conditions measured by economic proxies (also refereed as household asset) are basic necessities of life and often inherited from parents or relatives.

In this paper we attempted to differentiate the role of household environmental factors and the household assets in explaining the infant mortality (IMR) and the under-five mortality (U5MR) in India. We hypothesize that there are no significant differences in child survival among the households residing in poor household environmental condition and they are proof in asset. This is primarily because 1) a sizeable proportion of population residing in poor household environmental condition such as slums have many of the household assets 2) the variables used in the asset index do not adequately measure the household wealth 3) the child health is very sensitive to the environmental condition of the households, such as water contamination, cooking fuel, sanitary facilities etc. The present study aims to understand the role of household environmental deprivations on child survival in India.

The paper has three specific objectives. The first objective is to examine the association of household environmental deprivations and household asset, the second objective is to estimate the infant and under five mortality rate by household environmental conditions and household asset index, and the third objective is to examine the factors associated with child survival (IMR and under five mortality).

Data and Methods

Data

The unit data from National Family Health Survey (NFHS-3), conducted in 2005-06 is used in the analyses. The NFHS-3 is a nationally representative population based survey that successfully interviewed 109,414 households and 124,385 women. Two sets of questionnaires, namely, the household questionnaire and women questionnaire were used in the survey. The household questionnaire collected information of household environmental conditions such as drinking water, dwelling conditions (material used for wall, floor and roof), electrification, cooking fuel, cooking arrangement, window in the house and ownership of consumer durables. This information is used to construct the household environmental deprivation index and an asset index for the household. The women questionnaire collected information on fertility, contraception, nutrition etc from the selected women. From the birth histories of women, kids file and birth history file are prepared. We have used the births of last five years to estimate the IMR and births of last 10 years to estimate the under-five mortality.

Methods

The Principal Component Analysis (PCA) is used to construct the household environmental deprivation index and an asset index of the households, separately for rural and urban areas. This is because the health estimates differ significantly when separate wealth index for rural and urban areas are used against single wealth index (Mohanty, 2009). PCA assigns weight to each of the variables in constructing composite index. A positive weight indicates the better economic status and a negative weight indicates relatively lower economic status. In construction of composite indices, the variables are re-coded in a binary form (0 and 1). In construction of asset index for rural areas, ownership of house is not included and for the urban asset index, the ownership of land is not included. The composite indices are categorized into two, namely, the poor and non-poor. The cut-off point of poor is based on 50% of the median composite score and all other were classified as non-poor.

Bivariate analyses and correlation coefficient are used to understand the association of asset index and the household environmental deprivation index. The alpha test is used to check the reliability of the estimates and Z test is used to test the significance difference in estimates. The life table technique is used to derive the estimates of IMR and U5MR among poor and non-poor, for both household environmental deprivation index and asset index. The cox-proportional hazard model is used to understand the significant predictor of child survival. The combined estimates are derived from rural and urban estimates and the analyses are carried out for India and major states. The infant mortality rate is estimated from the kid's file that depicts the birth history of the women in five years preceding the survey. The under-five mortality rate is estimated from ten years birth history of women preceding the survey from the birth file.

Results

Household Environmental Deprivation Index and Asset Index

Table 1 describes the mean, standard deviation and factor score of household environmental deprivations, separately for rural and urban India. The distribution of variables on household environmental conditions is skewed, both in rural and urban areas. For example, the distribution of households on drinking water showed that 72% of household in urban India used piped water followed by tube well, dug well and other

Table 1.
Mean, standard deviation and factor score of variables used in computation of household environmental deprivation index in urban India, 2005-06.

Household Variables	Urban			Rural		
	Mean	Standard Deviation	Factor Score	Mean	Standard Deviation	Factor Score
Sources of Drinking Water						
Piped water	.719	.449	.145	.281	.450	.196
Tube well	.213	.409	−.133	.532	.499	−.176
Dug well	.048	.213	−.041	.155	.361	.011
Other sources	.020	.140	−.011	.033	.178	−.022
Electricity	.931	.254	.242	.558	.497	.280
Type of Toilet						
Flush toilet	.787	.410	.336	.200	.400	.337
Pit toilet	.040	.196	−.077	.059	.236	.029
No toilet/open field	.172	.378	−.325	.740	.439	−.323
Type of Cooking Fuel						
Electricity/biogas	.601	.490	.340	.088	.283	.316
Biomass	.261	.439	−.328	.891	.311	−.328
Kerosene/charcoal	.138	.345	−.066	.021	.142	.088
Has Window	.847	.360	.269	.586	.493	.279
Material Used in the House						
Finished material used for wall	.889	.314	.268	.534	.499	.268
Finished material used for floor	.807	.395	.275	.305	.460	.323
Finished material used for roof	.924	.265	.231	.714	.452	.216
Persons Per Sleeping Room						
<2 persons	.377	.485	.102	.325	.468	.110
2 - 5 persons	.534	.499	−.038	.543	.498	−.034
>5 persons	.089	.285	−.106	.132	.338	−.102
Cooking Arrangement						
No separate kitchen	.272	.445	−.183	.339	.474	−.183
Separate kitchen	.590	.492	.288	.341	.474	.235
Separate building	.043	.204	−.026	.099	.298	.012
Outdoor	.093	.291	−.188	.220	.414	−.069
ALPHA		**.784**			**.762**	

sources. Similarly, 79% of urban households used flush toilet and 17% didn't had any toilet. About three-fifths of urban households used electricity and biogas as cooking fuel. The standard deviation varies substantially indicating the variability within the urban areas. The factor score of the variables are in expected ways both in rural and urban areas. For example, the factor score of electricity/biogas is .34 and that of biomass is −.33 in urban areas. The alpha value of household environmental deprivation index is .784 in urban and .762 in rural India indicating that the estimates are reliable. **Figures 1** and **2** shows the distributions of household environmental deprivation index for urban and rural India respectively. While the distribution of household environmental deprivation score is less skewed in rural areas, it is more skewed in urban areas.

Table 2 describes the mean, standard deviation and factor score of asset index separately for urban and rural India. It may be mentioned that the variables used in the asset index are economic proxies and not the direct measure of economic status of

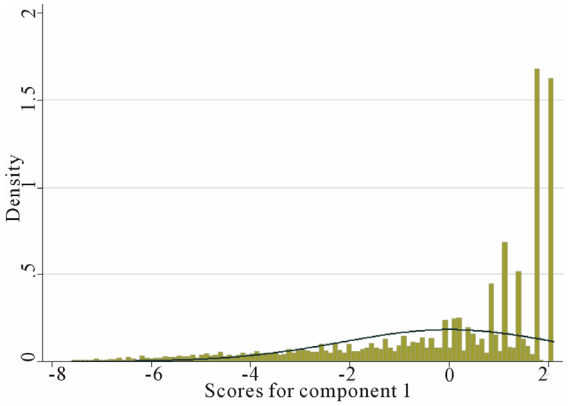

Figure 1.
Distribution of household environmental deprivation index in urban India, 2005-06.

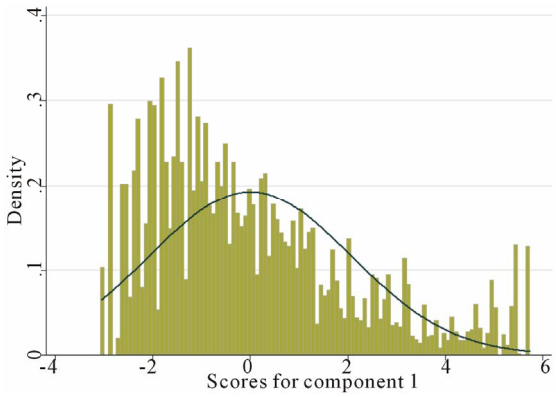

Figure 2.
Distribution of household environmental deprivation index in rural India, 2005-06.

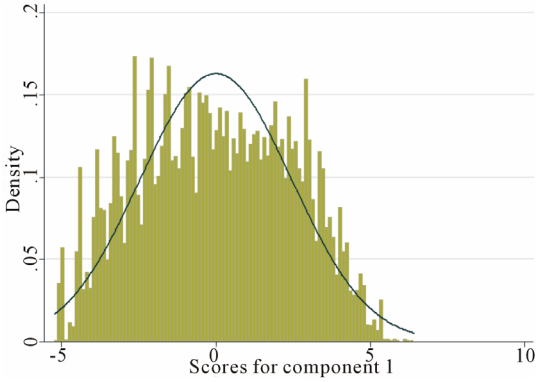

Figure 3.
Distribution of asset index in urban India, 2005-06.

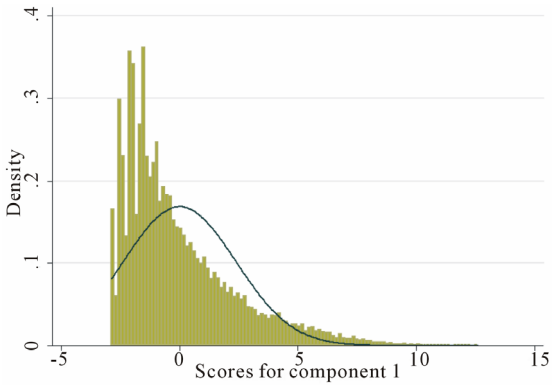

Figure 4.
Distribution of asset index in rural India, 2005-06.

the households. The distribution of households on ownership of consumer durables in urban India showed that it was maximum for watch (91%) followed by cot (86%), fan (85%) and chair (76%) and minimum for agricultural accessories, probably because large proportion of households in urban areas worked in non-agricultural activities. The standard deviation varies from .5 for bicycle and color television to a minimum for thresher (.065) and tractor (.068). Similarly in rural India about 81% of households own a cot followed by own a watch (71%), own a bicycle (51.5%) and own mattress (48.6%). The standard deviation of variables is maximum in mattress and bicycle (.5) followed by marginal land, no land holdings and chair (.49). The factor scores of the variables are positive except no land and marginal land. These groups are poorest as compared to medium and large land holdings. The distribution of asset index for urban and rural India is given in **Figures 3** and **4** respectively. It is negatively skewed in rural areas and normal in urban areas. The alpha value of asset index is .85 in urban and .82 in rural India.

Table 3 provides the cross classification of households in asset index and household environmental deprivation index by place of residence in India. Our interest is to examine the extent of association of household environmental deprivation index and asset index. We have hypothesized that people possessing asset measured by economic proxies not necessarily reside in good household environmental condition. Moreover, studies indicate that the agreement of consumption expenditure and economic proxies in India are not strong in Indian context (Srivastava & Mohanty, 2010). Because many of the variables used in asset index are necessity of life and often inherited. The results indicate that in India about 79.2% households who are asset poor, resides in poor household environmental condition but 27.7% of non-poor also resides in poor household environmental conditions. This is higher in rural areas than urban areas. The correlation coefficient of asset index and household environmental deprivation index is .51; .61 for urban and .48 for rural India indicating weak association of asset index and household environmental deprivation index.

Table 4 provides the correlation coefficient of household deprivation index and asset index by place of residence in the states of India. The correlation coefficient of asset index and household environmental deprivation index varies from .60 in the state of Odisha to .33 in the state of Jammu & Kashmiri. In urban India the correlation coefficient varies from .71 in Chhattisgarh to .34 in Sikkim. Likewise, in rural India the maximum correlation is found in Odisha (.57) and minimum in Delhi (.22). It shows that the association of two indices is generally low and lower in the rural areas than the urban areas, in most of the states.

Estimate of Infant and Under-Five Mortality Rate by Household Environmental Deprivation Index and Asset Index

Table 5 provides the estimates of IMR and U5MR for each

Table 2.
Mean, Standard Deviation (SD) and factor score of variables used in computation of asset index in India, 2005-06.

Wealth Variables	Urban			Rural		
	Mean	Standard Deviation	Factor Score	Mean	Standard Deviation	Factor Score
Own a house	.783	.413	.074	-	-	-
Bank/post office account	.574	.495	.250	.327	.469	.226
Mattress	.753	.432	.248	.486	.500	.207
Pressure cooker	.698	.459	.276	.220	.414	.289
Chair	.760	.427	.255	.438	.496	.269
Cot	.863	.344	.183	.812	.391	.132
Table	.649	.477	.284	.329	.470	.285
Fan	.847	.360	.204	.386	.487	.269
Radio	.389	.488	.156	.269	.444	.171
B & W Television	.256	.436	−.060	.186	.390	.135
Color Television	.514	.500	.294	.125	.331	.258
Sewing	.308	.462	.200	.126	.332	.221
Mobile	.362	.481	.265	.073	.261	.231
Telephone	.266	.442	.270	.080	.271	.246
Computer	.081	.272	.177	.006	.076	.091
Refrigerator	.334	.472	.300	.066	.248	.232
Watch	.910	.286	.160	.713	.453	.200
Bicycle	.501	.500	.084	.515	.500	.112
Scooter	.303	.460	.263	.107	.309	.257
Cart	.010	.099	.014	.074	.262	.086
Car	.061	.239	.169	.010	.099	.124
Pump	.110	.313	.152	.099	.298	.169
Thresher	.004	.065	.029	.022	.147	.099
Tractor	.005	.068	.034	.023	.150	.137
No land	-	-	-	.416	.493	−.091
Marginal land holdings (0 - 2.5 acres)	-	-	-	.392	.488	−.020
Small land holdings (2.5 - 5 acres)	-	-	-	.082	.274	.130
Medium and large land holdings (>5 acres)	-	-		.110	.313	.060
Irrigated land				.380	.485	.115
ALPHA		**.847**			**.820**	

Note: Not used in analysis.

of the variables which are used in construction of household environmental deprivation index and the asset index. The estimates of child survival by source of drinking water showed that the estimated IMR among households access to pipe water is 40 compared to 64 for tube well and 55 for dug well. Similar differences are observed for U5MR and by place of residence. The IMR and U5MR are estimated higher among those households does not have electricity in the household and it is true in rural and urban areas. The mortality rates are much lower among those households access to flush toilet followed by pit toilet households and higher among those households does not have toilet facility or use open field for defecation. In case of cook-

Table 3.
Cross classification of household environmental deprivation index and asset index by type of place of residence in India, 2005-06.

Household environmental deprivation index	Asset Index	
	Poor	Non poor
Urban		
Poor (%)	73.6	13.4
Non-poor (%)	26.4	86.6
N	**25,475**	**23,785**
Rural		
Poor (%)	81.8	34.7
Non-poor (%)	18.2	65.3
N	**30,306**	**27,463**
Combined		
Poor (%)	79.2	27.7
Non-poor (%)	2.8	72.3
N	**55,888**	**51,141**

Table 4.
State level correlation of household environmental deprivation index and asset index by place of residence in India, 2005-06.

States	Correlation Coefficient		
	Urban	Rural	Combined
Andhra Pradesh	.58	.41	.46
Arunachal Pradesh	.60	.52	.54
Assam	.66	.48	.51
Bihar	.63	.48	.50
Chhattisgarh	.71	.40	.49
Delhi	.63	.22	.62
Goa	.58	.48	.55
Gujarat	.54	.45	.47
Haryana	.55	.37	.43
Himachal Pradesh	.46	.35	.36
Jammu & Kashmiri	.48	.26	.33
Jharkhand	.66	.47	.58
Karnataka	.54	.39	.45
Kerala	.48	.38	.47
Madhya Pradesh	.67	.47	.54
Maharashtra	.58	.46	.51
Manipur	.51	.45	.52
Meghalaya	.42	.51	.47
Mizoram	.42	.52	.49
Nagaland	.41	.44	.47
Odisha	.69	.57	.60
Punjab	.65	.38	.52
Rajasthan	.63	.46	.52
Sikkim	.34	.49	.44
Tamil Nadu	.58	.37	.48
Tripura	.62	.53	.58
Uttar Pradesh	.64	.43	.47
Uttaranchal	.65	.45	.49
West Bengal	.66	.51	.56
India	**.61**	**.48**	**.52**

ing fuel, the estimated IMR among households using biomass and kerosene/charcoal is almost double of those households using biogas. This becomes three times higher in rural areas and in urban areas it is little less than two times. Similar differentials are observed for U5MR. In case of cooking arrangement, the estimated IMR among households cooking food within the household is 49 compared to 53 among those households cook food in separate house and 64 among those households cook food outside house. Having window in the households also show significant differential in IMR and U5MR estimates with higher among those households do not have window in house.

After examining the individual component, we attempted to understand the differentials in the estimates of IMR and U5MR rate separately for urban and rural India by household environmental deprivation index and asset index. From the graphs (**Figures 5** and **6**) it is clearly seen that there are no significant differences in the proportion of child surviving under age five for both household environmental deprivation index and asset index. But there are significant differences in child survival between poor and non-poor households either by household environmental poor or asset poor (z test). The proportion of child survival has decreased rapidly from the birth to age five in case of either in poor household environmental condition or asset poor than the non-poor households.

Table 6 describes the differentials in estimated IMR and U5MR among households reside in poor household environmental condition and asset poor by place of residence. For example, the estimated IMR among asset poor and households residing in poor household environmental condition is 62 per 1000 live birth each. Similarly, the U5MR among asset poor is 87 compared to 89 among those residing in poor household environmental condition. The pattern is similar for rural and urban areas. However, the poor and non-poor differentials are large by both household environmental deprivation index and asset index. For example, the estimated IMR among households residing in poor household environmental condition is 62 per 1000 live births compared to 38 among non-poor. The differences are large in rural areas compared to urban areas. This difference indicates that the household environmental condition have significant influence on IMR and U5MR. From the z test it is found that the calculated values of z test are smaller than the tabulated value in 95% confidence interval by place of residence and states in India. We infer that there is not much

Table 5.
Estimated IMR and U5MR of household environmental conditions by place of residence in India, 2005-06.

Household variables	Urban		Rural		Total	
	IMR	U5MR	IMR	U5MR	IMR	U5MR
Sources of drinking water						
Piped water	37	53	46	64	40	57
Tube well	58	69	66	92	64	86
Dug well	43	50	57	83	55	77
Other sources	39	64	49	66	46	66
Electricity						
No	61	82	70	102	69	99
Yes	40	54	49	65	45	59
Type of toilet						
Flush toilet	39	49	35	47	38	49
Pit toilet	53	79	50	72	51	74
No toilet/open field	54	82	66	92	65	91
Type of cooking fuel						
Electricity/biogas	33	40	25	34	32	39
Biomass	55	80	60	86	59	85
Kerosene/charcoal	52	70	72	55	55	68
Window in house						
No	58	77	70	104	67	97
Yes	38	51	49	64	44	58
Material used in wall						
Finished material	39	52	52	71	45	61
Rudimentary	55	75	62	89	61	86
Material used in floor						
Finished material	39	53	43	49	41	52
Rudimentary	51	66	63	92	61	87
Material used in the roof						
Finished material	40	53	53	74	48	64
Rudimentary	59	97	68	97	66	97
Cooking arrangement						
Inside house (no separate kitchen)	53	70	67	90	62	87
Inside house (separate kitchen)	33	42	47	61	40	51
Separate building	42	40	56	75	53	68
Outdoor	65	94	63	89	64	90

difference in proportion dead among households with poor household environmental condition and asset poor households but significant and large differences in child survival among poor and non-poor households.

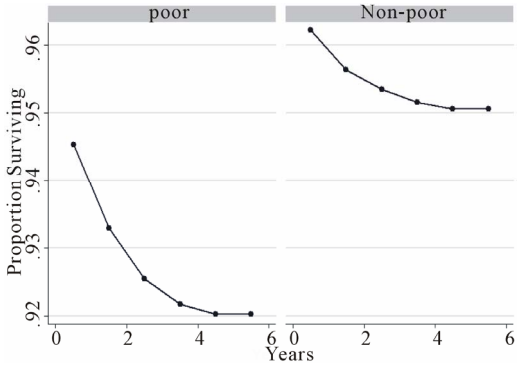

Figure 5.
Child Survival by Asset Index in India, 2005-06.

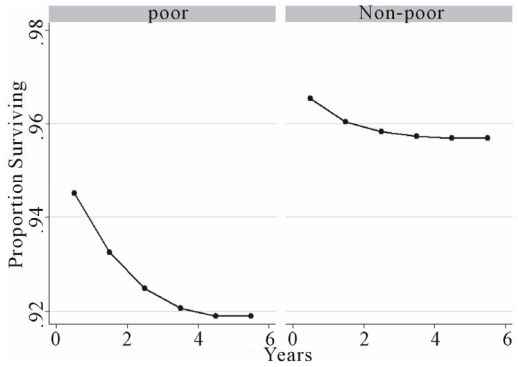

Figure 6.
Child Survival by Household Deprivation Index in Urban India, 2005-06.

Table 6.
Estimated IMR and U5MR by household environmental deprivation index and asset index by place of residence in India, 2005-06.

IMR and U5MR	Household environmental deprivation index		Asset index	
	Poor	Non-poor	Poor	Non-poor
IMR				
Rural	69	42	68	48
Urban	50	33	53	29
India	**62**	**38**	**62**	**42**
U5MR				
Rural	100	53	98	58
Urban	72	40	72	34
India	**89**	**46**	**87**	**50**

Table 7 provides the differential in estimated IMR and U5MR by asset index and household environmental deprivation index for states of India. In most of the states, the general pattern holds true, that is, the estimated IMR and U5MR among the poor are substantially higher than the non-poor, both by household environmental deprivation index and asset index. Among the states, the estimated IMR among those living in poor household environmental condition is maximum in the state of Uttar Pradesh (82) followed by Chhattisgarh, Rajasthan, Madhya Pradesh, Arunachal Pradesh and Jharkhand where IMR is more than 70 per thousand live birth. On the other hand, the IMR among poor household environmental condition households is minimum in the state of Goa (8) followed by Kerala and Tamil Nadu with IMR of 34 each, 37 in Manipur and 38 in Andhra Pradesh. On the other hand, among asset poor households the IMR is higher in the state of Punjab where the IMR is 87 per thousand live birth and minimum in the state of Goa with IMR of 22 per thousand live birth. On comparing the estimated IMR among asset poor and poor household environmental condition we found that the states such as Andhra Pradesh, Haryana, Jammu and Kashmiri, Kerala, Mizoram, Odisha, Rajasthan, Sikkim, Uttar Pradesh and Chhattisgarh have higher IMR among those reside in poor household environmental condition than that of asset poor. Among these states Jammu and Kashmiri has the maximum difference with 21 points difference of IMR between poor household environmental households and asset poor households. Similarly the states like Bihar, Jharkhand and Tamil Nadu have no difference in IMR between asset poor households and poor household environmental condition households. From the table it is also found that most of the states have higher U5MR rates among the households living in poor household environmental condition compared to those are asset poor. There are two states found; Madhya Pradesh and Uttar Pradesh where there is no difference in U5MR between those households living in poor household environmental condition compared to asset poor households.

Factors Affecting Child Survival

Table 8 presents the results of Cox Proportional Hazard model to understand the significant predictor of child survival separately for rural and urban India. Time is the dependent variable and death is the failure variable (0 for surviving and 1 for dead). The independent variables are a set of demographic and social variables, namely, age at birth, education of the mother, preceding birth interval, place of delivery, type of birth (single or multiple), duration of breastfeeding, working status of mother, body mass index of mother, sex of the child, caste of mother and place of residence. Additionally, the household environmental deprivation index and the asset index are included in the hazard model. Results indicate that mother's education, sex of the child, preceding birth interval, place of delivery, type of birth, duration of breastfeeding are significant predictors of child survival in India. Along with these confounders household environmental deprivation is also found a strong predictor of child survival in India and also in both rural and urban India. The relative hazard ratio is .687 [.566 - .835] for the non-poor households compared to those who are poor in household environmental condition. The hazard ratio is higher in rural areas compared to the urban areas. On the other hand, the relative hazard ratio among the asset non-poor is .854 [.717-1.017] compared to those who are asset poor households. The relative hazard ratio is not significant in both rural and urban areas. In the level of education of mothers it is found that the relative hazard ratio is less for the educated mothers than the uneducated mothers. The relative risk is .46 for mothers with secondary and higher education compared to mothers with no education. The hazard ratio is significantly higher for female child compared to male child. The preceding birth interval also has greater influence on child survival. The relative risk of hazard

Table 7.
State level estimated IMR and U5MR by household environmental deprivation index and asset index in India, 2005-06.

STATES	IMR					U5MR				
	Household environmental deprivation index		Asset index			Household environmental deprivation index		Asset index		
	Poor	Non-poor	Poor	Non-poor	D[a]	Poor	Non-poor	Poor	Non-poor	D[b]
Andhra Pradesh	38	44	35	47	03	66	50	52	64	14
Arunachal Pradesh	73	45	84	40	−10	141	78	157	69	−17
Assam	70	61	81	53	−11	90	55	102	47	−13
Bihar	65	47	65	58	00	89	60	93	59	−04
Chhattisgarh	80	40	73	72	07	106	59	102	85	04
Delhi	57	38	60	32	−03	74	33	69	34	05
Goa	8	18	22	13	−14	66	25	86	16	−20
Gujarat	61	42	66	39	−05	84	48	80	52	03
Haryana	67	31	49	41	17	79	42	64	54	15
Himachal Pradesh	42	29	50	29	−08	60	38	54	41	05
Jammu and Kashmir	64	38	43	49	21	77	42	53	55	24
Jharkhand	71	51	71	60	00	101	67	102	72	−01
Karnataka	47	43	54	36	−08	71	54	82	35	−11
Kerala	34	11	33	12	01	14	13	32	8	−18
Madhya Pradesh	73	44	80	40	−07	112	50	112	49	00
Maharashtra	40	36	46	29	−06	61	43	68	33	−06
Manipur	37	26	49	19	−11	61	49	83	37	−21
Meghalaya	42	52	45	49	−03	85	36	71	51	14
Mizoram	42	27	36	32	06	55	31	40	44	15
Nagaland	51	31	54	27	−03	69	50	66	55	03
Odisha	61	65	60	68	01	90	64	96	58	−06
Punjab	59	38	87	31	−28	73	49	77	51	−03
Rajasthan	77	51	76	58	01	104	66	107	66	−03
Sikkim	49	31	39	32	10	57	35	31	44	25
Tamil Nadu	34	30	34	27	00	57	38	59	22	−02
Tripura	53	51	56	47	−02	78	58	91	43	−13
Uttar Pradesh	82	47	81	65	01	120	58	120	86	00
Uttarakhand	58	31	61	36	−02	83	61	109	52	−25
West Bengal	50	45	53	39	−04	60	46	62	39	−01
India	**62**	**38**	**62**	**42**	**00**	**89**	**46**	**87**	**50**	**02**

Note: [a]Differences in IMR of household environmental deprivation index (poor) and asset index (poor); [b]Differences in U5MR of household environmental deprivation index (poor) and asset index (poor).

decreases with increase in the preceding birth interval. The relative risk is significantly higher (3.1 times) for multiple birth compared to the single birth. The duration of breastfeeding is also a significant predictor of child survival. In urban India, mother's education for secondary and higher, preceding birth interval, type of birth, duration of breastfeeding, working status

Table 8.
Hazard ratio and 95% confidence interval of mortality under ages five in India, 2005-06.

Covariates	Hazard ratio			95% Confidence interval		
	Urban	Rural	Total	Urban	Rural	Total
Place of residence						
Urban®						
Rural	-	-	1.145			.963 - 1.361
Household environmental deprivation index						
Poor®						
Non-poor	.687*	.694***	.687***	.464 - 1.018	.554- .870	.566 - .835
Asset index						
Poor®						
Non-poor	.830	.863	.854*	.557 - 1.237	.709 - 1.050	.717 - 1.017
Age at birth						
<19®						
20 - 29	1.316	.796*	.887	.743 - 2.330	.607 - 1.044	.695 - 1.132
30+	1.559	1.052	1.141	.833- 2.916	.777 - 1.425	.870 - 1.497
Education of mother						
No education®	.973	.718**	.797**	.685 - 1.381	.556 - .928	.649 - .978
Primary	.370***	.538***	.466***	.255 - .536	.411 - .703	.375 - .580
Secondary/higher						
Sex of the child						
Male®						
Female	1.198	1.308***	1.270***	.921 - 1.559	1.109 - 1.543	1.104 - 1.460
Preceding birth interval						
<2 years®	.684**	.657***	.654***	.497 - .941	.543 - .795	.555 - .770
2 - 3 years	.505***	.470***	.474***	.360 - .708	.378 - .584	.395 - .569
3+ years						
Place of delivery						
Home®						
Hospital	.733**	.623***	.657***	.541 - .992	.479 - .811	.540 - .800
Caste						
SCs®	1.246	1.011	1.020	.811 - 1.915	.795 - 1.286	.828 - 1.257
STs	.840	.845	.837*	.592 - 1.191	.673 - 1.060	.692 - 1.012
OBC	.704**	1.022	.895	.479 - 1.035	.792 - 1.319	.723 - 1.106
Others						
Type of birth						
Single birth®						
Multiple birth	2.979***	3.065***	3.110***	1.425 - 6.227	2.088 - 4.498	2.222 - 4.377
Working status of mother						

Continued

No®						
Yes	1.428**	1.009	1.085	1.060 - 1.922	.849 - 1.198	.934 - 1.261
BMI of mother						
<18.5®						
≥18.5	1.040	.901	.929	.768 - 1.408	.761 - 1.067	.802 - 1.077
Duration of breastfeeding						
Never breastfeed®						
<11 months	1.271	1.467**	1.383**	.777 - 2.077	1.035 - 2.081	1.041 - 1.838
11 - 23 months	.153***	.214***	.193***	.087 - .270	.147 - .312	.141 - .263
>23 months	.043***	.064***	.055***	.019 - .095	.040 - .101	.039 - .085

Note: ***p < .01, **p < .05, *p < .10, ®Reference category.

of mother and household environmental condition are significant predictors of child survival. In rural India, age at birth, education of mother, sex of child, preceding birth interval, place of delivery, type of birth, duration of breastfeeding and household environmental conditions are the significant predictors of child survival.

Discussion and Conclusion

The study attempts to understand the association of household environmental conditions and asset index. Furthermore, it attempts to understand the state of child survival by household environmental conditions and asset index in India. Result shows that the association of household environmental deprivation index and asset index is weaker and lower in rural areas than in urban areas. The association also varies among the states. In most of the states the association between household environmental deprivation index and asset index is low. Theoretically it is true that the asset households tend to reside in good household environmental condition. However, the association between these two indices in this study does not support the theoretical argument. We further found that there is no significant difference in the risk of infant and child mortality among the asset poor and those poor in household environmental deprivation index. In most of the states, households living in poor household environmental condition experienced higher mortality than the households with poor asset status. The rural areas have relatively higher risk of infant and under-five mortality than the urban areas. By analyzing the chance of child survival by individual variables of household environmental condition, it is found that the risk of infant and under-five mortality is lower among the households having access to improved sources of drinking water, flush toilet, and household using biogases as cooking fuel and electrification. Hence these are found critical determinants of child survival. The multivariate results show that along with the socio-economic and demographic covariates, the household environmental deprivation is found a stronger predictor of child survival. However, interestingly the relative hazard ratio is higher in asset index compared to household environmental deprivation index. It is also found that the hazard ratio is not a significant predictor of child survival in rural and urban India. It calls for improving the household environmental conditions of the households in promoting child survival in India.

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