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Does Lack of Healthy Housing Affect the Prevalence of Infectious Diseases? Linkages between Household Environment and Urban Health in India

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Abstract

This study analyses the temporal variations in the prevalence of infectious diseases and their relationship with changing household environments in urban India using data from last three rounds of National Sample Survey on Morbidity and Health Care. The major infectious diseases are clubbed into three categories - water borne diseases (WBD), air borne diseases (ABD) and vector borne diseases (VBD). The prevalence of ABD is sharply rising followed by VBD in urban India during the last two decades. There are wide inter-state variations in household amenities like modern cooking fuels, access to safe water, availability of flush toilet facility, underground drainage, etc., which have direct linkages with infectious diseases. Urban areas have growing trend of infectious diseases due to increasing pressure on available basic infrastructure. They need better living condition, improvement of domestic hygiene, cleaner environment and sanitation, and targeted public health interventions.

Key words: Healthy housing; urban health; household environment; infectious diseases; India.

I. Introduction

The world experienced dramatic population growth during the last five decades (1961-2011) with the increased number of inhabitants from 3 to 7 billion. During the same period, India's population has also grown rapidly from 382 million to 1.24 billion (United Nations, 2015). This enormous growth of population has brought drastic changes in population dynamics which are closely linked to rural and urban developmental issues and their solutions. Therefore, it becomes necessary to consider population dynamics to avoid the burden of exacerbating poverty, basic health and environmental risks (United Nations, 2012).

At present compounded effect of population dynamics has increased the urban population growth which leads to housing problem. Consequently, most of the urban dwellers have been forced to live in sub-standard housing areas and are prone to the greater risk of infectious diseases. Moreover, due to the haphazard and unplanned urban structure of many cities, civic bodies are unable to provide them proper infrastructure, and this deprivation creates a significant public health issue. It came into the limelight after a meeting of 40 experts from 18 countries conducted by WHO at Geneva in 2010. In this meeting, the term *'Healthy Housing'* was first coined and it was anticipated that this initiative will help effectively to prevent the wider range of infectious diseases and unintentional injuries which occur in a house (WHO, 2010).

An infectious disease is considered a second global risk followed by water crises based on its mass impact (WEF, 2015). It is mainly classified based on infecting agents such as vector borne diseases (VBDs), water borne diseases (WBDs) and air borne diseases (ABDs) (Alirol, Getaz, Stoll, Chappuis, & Loutan, 2011). The VBDs is a group of six major infectious diseases, namely, Malaria, Dengue, Chikungunya, Lymphatic filariasis, Japanese Encephalitis and Kala-

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azar, which are mainly transmitted by mosquitoes and other vectors. The epidemiology of VBDs is considerably influenced by various factors such as vector bionomics, climate, density, socio-economic and behavioural factors. Among all VBDs, malaria is reported as a major disease and in 2014 hundred million malaria cases were recorded. However, reporting of malaria cases declined during the period 2000-2014 (WHO, 2015). Followed by it, Filariasis has been an important public health problem in India. It has been estimated that VBD has borne the burden of 1.6 per cent of the disease (Peters, Yazbeck, Sharma, Ramana & Pritchett, 2002).

The rapid and unplanned population growth in urban India increases the load on infrastructure. Consequently, in the absence of adequate safe water, people are force to use unsafe water for their daily use. Moreover, inadequate sanitation facilities and substandard housing condition increase the risk of water borne diseases (Saker, Lee, Cannito, Gilmore, & Campbell-Lendrum, 2004). Empirical evidence proves that un-purified water use is the cause of diseases like diarrhoea, cholera, trachoma, hepatitis, etc. Hepatitis, among all diarrhoeal diseases is considered as the fourth deadliest disease in the world (WHO, 2012). In India, every year around 4 to 5 lakh children die before the age of five years due to diarrhoeal effect. Moreover, the diarrhoeal disease accounts 8.2 per cent of the total disease burden on India (Peters, Yazbeck, Sharma, Ramana & Pritchett, 2002; GOI, 2002)

Pathogenic microbes infection causes ABDs. Several household factors such as quality of building materials, cooking fuel, crowding and insufficient ventilation play a catalyst role in creating a favourable environment for microbes. Inhalation in contaminated environment infects the sanitized person and further speared it to others via coughing, sneezing, laughing and close personal contact with an infected person. Among all ABDs, acute respiratory infection (ARI), and Tuberculosis (TB) are more prevalent diseases. According to the World Health Organization (WHO), TB is considered as the seventh deadliest disease which accounts for three per cent of total deaths (WHO, 2012). India bears more than three per cent of total disease burden due to Tuberculosis (Peters, Yazbeck, Sharma, Ramana & Pritchett, 2002) and consequently has the highest ranking in terms of TB patients (Donnelly, 2009).

The high-risk areas for all these types of infectious diseases are rural area and urban slums which lack adequate basic infrastructure like water, sanitation, clean fuel, etc. In India, there is a clear gap of basic infrastructure and health services between slum and non-slum areas. A minimum standard of housing is essential for healthy and civilised existence. There is also an increasing recognition universally about the close relation between housing, health and wellbeing of the people. On the other hand, miserable housing conditions of slums in cities have always been major concerns from planning and policy point of view. As per the Twelth Five Year Plan, the flagship programme of National Health Mission (NHM) expanded its coverage and included urban parts of the country and initiated National Urban Health Mission (NUHM) in May 2013. This programme primarily focuses on slums and other urban poor to meet the diverse health requirements. It is also trying to prepare institutional mechanism and management systems to meet the health-related challenges of a rapidly growing urban population (NHM, 2013).

Most of the benefits of the urban health programmes are underutilized in India and hence there still exists an acute problem of infectious diseases in urban slums. In context to this, it is important to understand the current scenario of infectious diseases to upgrade the vision of public health sectors. The present study analyses trends in the prevalence of major infectious diseases along with the changes in household environmental factors in the last two decades. It also assesses the effects of household environmental factors on various infectious diseases in urban setting.

II. Data and methods

The present study utilized data from the last three rounds of NSS (52^{nd}, 60^{th}, and 71^{st} round) on ‘Morbidity and Health Care’ in India. The fifty-second round of data was collected from July 1995 to June 1996 (NSS, 1998), 60th round of data from January 2004 to June 2004 (NSS,

2006) and the 71st round from January 2014 to June 2014 (NSS, 2014). These surveys were conducted by the Ministry of Statistics and Programme Implementations, Government of India. These NSS rounds are a multi-stage cluster sample survey covering all states and union territories. The surveys have covered all ailments both acute and chronic. They collected the data on curative aspect of the general health care system. Along with utilization of health care services provided by the public and private health sectors were collected from the nationally representative households in the three rounds, covering 120942, 73868 and 65932 sample households in 52nd, 60th and 71st rounds respectively. All those respondents were considered as patients who continued to suffer in the last 15 days and 365 days of reference period preceding the date of survey. A person suffering from one ailment in a different episode in the reference period has been considered as a different case for the study.

Methodology

In this study several indicators have been computed for examining issues regarding infectious disease which are as follows:

Vectorborne disease (VBD): it comprises all types of short duration fevers and information was asked for the reference period of last 15 days preceding the date of survey.
Waterborne disease (WBD): it refers to the information related to water borne disease, i.e., diarrhoeal diseases during the reference period of last 15 days preceding the date of survey.
Airborne disease (ABD): it comprises diseases such as tuberculosis and acute respiratory diseases for which information was asked for the reference period of last 365 days and 15 days preceding the date of survey.
Social groups: it is an interaction indicator combining the caste and religion variable to provide a better representation of the marginalized and deprived community.

The household environment factors include the following facilities at household level which may have some linkages with infectious diseases:

Flush toilet facility: it refers to the septic tank/flush system type of latrine facility.
Modern cooking fuel: it comprises of the types of fuels such as LPG, bio-gas, and electricity used for cooking in the household.
Drinking water: it comprises the safe source of drinking water such as bottled water and tap water.
Drainage facility: it comprises the secure method of drainage as covered-Pucca/Cemented and underground drainage facility.

This study utilizes bivariate and multivariate statistical analyses to assess the level of different infectious diseases. Correlation coefficient (Pearson's correlation coefficient) has been used to show the major indicators responsible for different infectious diseases. Changes in the basic amenities/household environment have also been assesed between two points of time from 2004 to 2014.

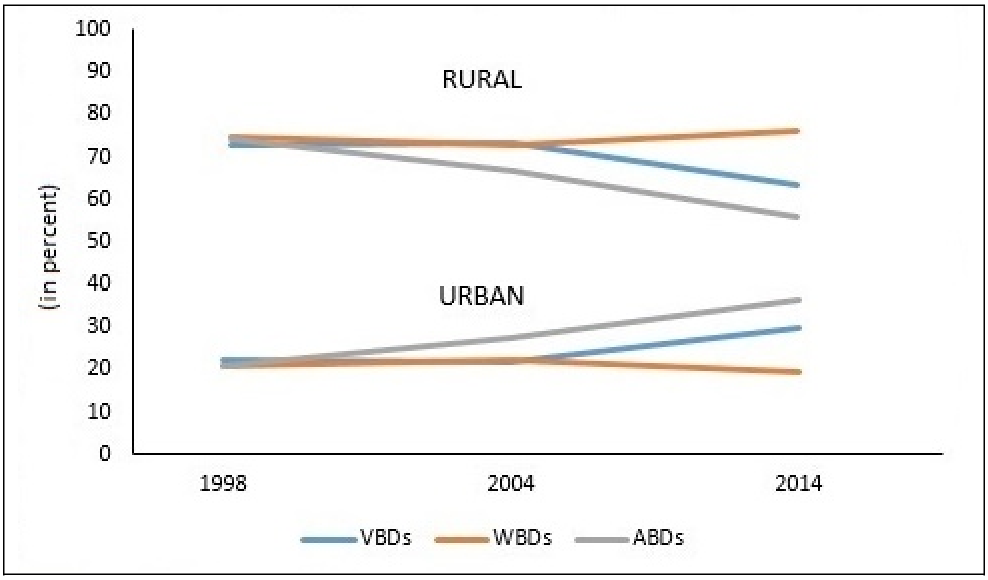
States are categorized according to the availability of these basic services by convergence and divergence criteria. *Convergence* will show those civic amenities among states whose percentages have improved and are getting closer towards the utmost level (i.e., 100 per cent) during the period of two rounds of the survey. On the other side, *divergence* will show those civic amenities among states whose percentages have been declining and diverting opposite from the utmost level.

Further, three models of logistic regression have been analysed to see the relationship between the response variable (0 or 1) and predictor variables. The logit relationship explains the constant effect of a predictor X on the likelihood that one outcome will occur. It explains how much the odds increase multiplicatively with a one-unit change in the independent variable. It is used to compare the relative odds of the occurrence of the outcome of interest (e.g., disease), given exposure to the variable of interest (e.g., background characteristics). The odds ratio can also be used to determine whether a particular exposure is a risk factor for a particular outcome, and to compare the magnitude of various risk factors for that outcome. Hence, to get an intuitive sense of how things are changing, we need to focus on odds ratio.

III. Results and discussion

Figure 1 presents the distribution of prevalence of various infectious diseases between rural and urban India at three different times. Here, it can be observed that the share of urban areas for the prevalence of the infectious disease has increasing trend over the period except WBDs. While the share of urban area for overall prevalence of WBDs was 19.5 per cent in 2014 which had decreased around 1.4 percentage point by the year 2004. The share of urban areas for the prevalence of VBDs and ABDs showing an increasing trend over the period however, the share of urban area for the waterborne diseases is slightly declining from late 2004.

Figure 1: Distribution of the prevalence of infectious disease in rural and urban India



Source: 1998, 2004, 2014 rounds of NSS.

Table 1 presents the correlation coefficient which shows the association of the infectious disease with its major determinants. It is observed that above primary education is negatively correlated with all types of infectious diseases. The flush toilet facility is showing an inverse association with VBDs and ABDs and positive correlation with WBDs. The utilization of modern cooking fuel is negatively correlated with ABDs and positive but low association with VBDs and WBDs. The coefficient value of safe water utilization indicates a positive association with VBDs and WBDs while it is negatively correlated with ABDs.

Table 1: Correlation coefficients for infectious diseases with major correlates in urban India

	VBDs	WBDs	ABDs
Above primary education	-.067	-.066	-.089
Flush toilet	-.218	.236	-.407
Modern cooking fuel	.137	.015	-.336
Safe water	.057	.148	-.191
Covered/underground drainage	.242	.281	.279

Source: 71st Round of NSS data.

Relative change in the basic amenities in urban India during 2004 to 2014

We have seen that basic household amenities are associated with the prevalence of infectious diseases in urban India. Therefore, it becomes necessary to see the relative changes in the availability of basic household amenities over the period from 2004 to 2014. Table 2 shows that in urban India, the availability of flush toilet facility has increased by 6 percentage points and access to safe water by 3 percentage points from 2004 to 2014. Moreover, the availability of covered drainage facility increased by 15 percentage points and utilization of modern cooking fuel by 15 per cent points.

The availability of flush toilet facility varied considerably from one state to another, like Mizoram followed by Arunachal Pradesh, Jammu & Kashmir, Himachal Pradesh and Nagaland show subtantial improvement by 37, 32, 31, 24 and 24 percentage points respectively. In Uttarakhand followed by Kerala, Sikkim, Delhi and Bihar flush toilet facilities have declined by 29, 12, 4, 3 and 2 percentage points respectively. Besides, Himachal Pradesh followed by Meghalaya, Mizoram, Sikkim, and Telangana are reaching towards convergence side whereas Kerala followed by Tripura, Karnataka, Odisha and Manipur go to divergent side in accessing the flush toilet facility. Utilization of modern cooking fuel is significantly increasing in some states like Tamil Nadu followed by Arunachal Pradesh, Telangana, Meghalaya and Gujarat by 30, 29, 28, 26 and 26 percentage points respectively, whereas in Nagaland followed by Jharkhand it declined by 9 and 6 percentage points respectively. Besides, states like Delhi followed by Arunachal Pradesh, Telangana, Sikkim and Goa are reaching towards convergence side whereas Jharkhand followed by Chhattisgarh, Kerala, Bihar and West Bengal go to divergence side in accessing the modern cooking fuel.

Access to safe water has significantly increased in Mizoram, followed by Nagaland, Manipur, Haryana and Andhra Pradesh by 26, 21, 20, 13 and 13 percentage point respectively. Bihar, Uttarakhand, Tripura, Jammu & Kashmir and Rajasthan show a remarkable decline by 13, 10, 6, 6, and 5 percentage points respectively. States like Sikkim, Telangana, Maharashtra, Arunachala Pradesh, Tamil Nadu and Himachal Pradesh are reaching towards convergence side whereas Bihar followed by Kerala, Assam, Jharkhand and Uttar Pradesh go to divergence side in the utilization of safe water. The availability of covered drainage facility significantly increased in Andhra Pradesh followed by Punjab, Himachal Pradesh, Kerala and Gujarat by 45, 32, 31, 28 and 26 percentage points. Its coverage reduced in Sikkim followed by Uttarakhand, Jharkhand, Goa and Manipur by 13, 8, 7, 6 and 5 percentage points over the period. Besides, states like Gujarat followed by Punjab, Andhra Pradesh, Telangana, and Maharashtra reached towards convergence side whereas states like Nagaland followed by Manipur, Tripura, Mizoram, and Arunachal Pradesh go to divergence side in the availability of covered drainage facility.

Risk of onset of infectious diseases in different subgroups in urban India

The logistic regression analysis has been conducted to analyse the risk of onset of different infectious diseases by the background characteristics in urban India. The first logistic regression model deals with vectorborne diseases, second model deals with waterborne diseases and third model deals with airborne diseases. The odds coefficient of sex indicates that females are at significantly higher risk of every type of infectious disease.

The interaction variable social group is created with caste and religion and it is observed that each social group has a higher risk of VBD. Non-OBC Muslim groups have 14 per cent less risk compared with STs. Also, the regression model for ABD indicates that SCs and OBCs Hindu are at higher risk of getting infection as compare with STs. The level of education plays an important role in the prevention of infectious diseases. The rising level of education reduces the risk of VBD and ABD infection significantly. However, in the context of WBD infection, reverse pattern is observed. Age is another significant predictor which indicates that with the growing age, risk of each type of infectious disease significantly reduces. Odds ratio for toilet facilities depicts that utilization of flush toilet significantly reduces the risk of WBD and ABD by 40 and 10 per cent respectively in urban India. The covered / underground drainage facility does not show any

Table 2: Basic amenities in urban areas of Indian states between 2004 and 2014

Region	States	Flush Toilet		Modern Cooking Fuel		Safe Water		Covered/ Underground Drainage	
		2014	2004	2014	2004	2014	2004	2014	2004
North	Jammu & Kashmir	81.32	50.57	79.83	50.92	88.95	95.07	41.12	27.42
	Himachal Pradesh	93.73	69.48	85.25	61.07	89.36	93.78	56.44	24.88
	Punjab	85.02	70.78	95.7	66.73	72.13	76.01	70.72	38.37
	Uttarakhand	65.19	94.50	54.88	53.11	84.18	94.08	39.00	46.73
	Haryana	73.14	73.59	83.09	92.9	89.03	75.58	60.05	43.37
	Delhi	78.84	81.51	49.9	45.03	88.58	87.01	62.19	61.45
East	Rajasthan	71.83	67.04	89.29	35.72	80.8	85.25	51.86	38.56
	Bihar	65.27	67.69	97.46	86.6	17.74	30.95	42.42	31.90
	West Bengal	68.8	69.04	30.38	21.8	60.87	58.1	29.48	24.65
	Jharkhand	77.78	74.68	68.84	54.2	45.04	46.93	22.14	28.82
	Odisha	62.08	55.00	84.39	69.59	54.21	48.98	28.71	23.38
North-east	Sikkim	90.52	94.83	88.91	71.17	100	98.81	9.48	23.22
	Arunachal Pradesh	74.01	42.3	82.21	56.54	89.81	88.07	9.30	4.13
	Nagaland	88.75	67.15	84.95	73.67	66.08	44.63	1.27	4.25
	Manipur	62.76	48.61	87.96	76.49	82.69	62.5	1.51	6.18
	Mizoram	90.82	53.63	82.93	60.76	76.24	49.83	8.56	7.14
	Tripura	42.9	37.22	43.98	49.64	52.62	58.78	4.17	0.65
	Meghalaya	91.05	71.44	79.54	54.71	83.23	87.45	29.26	7.75
	Assam	84.46	71.87	51.01	47.38	37.77	32.25	14.49	7.52
Central	Chhattisgarh	64.02	56.69	77.34	60.13	74.53	68.57	36.16	30.38
	Madhya Pradesh	68.57	62.87	73.04	46.79	66.15	65.74	50.00	36.72
	Uttar Pradesh	76.19	57.66	78.32	84.66	46.55	40.82	51.04	37.89
West	Gujarat	79.25	74.45	88.13	88.00	86.33	88.26	81.74	55.03
	Maharashtra	83.41	69.54	84.41	62.11	91.59	91.43	70.11	55.04
	Goa	63.76	63.86	89.92	88.70	80.25	83.25	32.17	38.67
South	Andhra Pradesh	83.26	69.19	85.32	69.4	85.05	72.48	70.66	25.41
	Karnataka	61.92	61.39	71.36	63.45	89.02	82.96	69.02	44.11
	Kerala	40.25	52.87	91.00	63.47	32.84	35.09	53.98	25.93
	Tamil Nadu	72.91	71.13	60.63	46.96	89.65	77.13	59.74	40.07
	Telangana	88.88	81.03	55.65	46.97	98.31	87.57	70.65	62.33
Union territories	Daman & Diu	97.69	73.97	83.77	92.57	98.26	84.36	89.85	69.08
	D & N Haveli	91.45	76.69	59.58	44.82	62.71	64.72	73.43	39.47
	Chandigarh	88.64	94.47	79.63	78.91	99.93	99.62	79.92	93.68
	Lakshadweep	49.68	64.82	82.34	52.82	45.74	6.94	54.02	9.04
	Puducherry	79.02	60.37	69.31	50.91	92.52	85.54	15.93	37.98
	A & N Islands	91.16	91.89	84.68	83.99	99.27	99.82	13.43	18.16
Total		73.59	67.48	74.59	59.03	72.73	70.16	56.27	41.18

Table 3: Results of logistic regression analysis presenting the odds ratio of different infectious diseases for different sub-groups in urban India, 2014

Background characteristics	VBD		WBD		ABD	
	OR	*[95% CI]*	*OR*	*[95% CI]*	*OR*	*[95% CI]*
Sex						
Male®						
Female	1.173***	1.171-1.175	1.370***	1.363-1.378	1.054***	1.052-1.056
Social groups						
STs®						
SCs	1.143***	1.137-1.148	0.596***	0.589-0.603	1.007**	1.000-1.014
OBC Muslim	1.281***	1.275-1.288	0.452***	0.446-0.458	0.821***	0.814-0.827
OBC Hindu	1.217***	1.212-1.223	0.507***	0.502-0.513	1.150***	1.143-1.158
FC Hindu	1.369***	1.362-1.375	0.503***	0.497-0.508	0.938***	0.932-0.945
Other Muslim	0.864***	0.860-0.869	0.745***	0.735-0.754	0.908***	0.901-0.915
Others	1.495***	1.486-1.504	0.138***	0.133-0.143	0.950***	0.941-0.959
Education						
Below primary®						
Primary-middle	0.936***	0.934-0.938	1.413***	1.402-1.424	0.848***	0.846-0.851
Sec/Higher Sec/Diploma	0.715***	0.713-0.717	1.784***	1.769-1.800	0.922***	0.919-0.926
Graduate & above	0.462***	0.460-0.463	1.297***	1.282-1.312	0.747***	0.743-0.750
Age Group						
0-4 years®						
6-14 years	0.530***	0.528-0.531	0.240***	0.238-0.242	0.459***	0.457-0.461
15-59 years	0.319***	0.318-0.319	0.208***	0.206-0.209	0.364***	0.363-0.365
60+ years	0.248***	0.247-0.249	0.374***	0.370-0.378	0.355***	0.353-0.357
Household size						
1-2 people®						
3-5 people	0.570***	0.569-0.572	0.366***	0.363-0.369	0.754***	0.751-0.757
6-9 people	0.351***	0.350-0.353	0.390***	0.386-0.393	0.543***	0.540-0.545
+ 9 people	0.290***	0.289-0.292	0.163***	0.160-0.165	0.514***	0.511-0.518
Toilet						
No flush ®						
Flush toilet	1.012***	1.010-1.014	0.606***	0.602-0.610	0.886***	0.884-0.889
Drainage facility						
No/Open drainage ®						
Covered drainage	1.194***	1.191-1.196	1.102***	1.095-1.109	1.400***	1.396-1.403
Safe water facility						
No safe water®						
Yes	0.920***	0.919-0.922	0.806***	0.801-0.811	1.191***	1.188-1.194
Cooking fuel						
Traditional®						
Modern	0.759***	0.757-0.760	0.982***	0.975-0.989	0.978***	0.975-0.982
Others	0.940***	0.937-0.943	1.000	0.989-1.010	1.171***	1.165-1.177
Wealth quintile						
First®						
Second	0.697***	0.694-0.699	0.982***	0.811-0.826	1.333***	1.327-1.340
Third	0.913***	0.911-0.916	1.000	0.987-1.004	1.363***	1.356-1.369
Forth	1.006***	1.003-1.009	0.982***	1.093-1.114	1.262***	1.255-1.268
Fifth	0.881***	0.878-0.884	1.000***	0.828-0.846	1.369***	1.362-1.376
Major regions						
North-east®						
North	1.721***	1.709-1.732	2.278***	2.217-2.341	18.252***	17.533-19.000
East	1.126***	1.119-1.134	4.562***	4.444-4.683	28.487***	27.368-29.652
Central	1.209***	1.201-1.217	4.043***	3.938-4.150	21.131***	20.300-21.995
West	1.080***	1.073-1.087	1.530***	1.490-1.572	26.270***	25.238-27.344
South	1.556***	1.546-1.566	1.177***	1.146-1.209	25.388***	24.390-26.426
Pseudo R^2	0.045		0.057		0.027	

Note: ® refers Reference Category, *** p-value < 0.01, **p-value < 0.05.

significant association with any infectious disease. The accessibility of safe water shows significantly low level or risk associated with WBD and VBD. The use of modern cooking fuel significantly reduces the risk of an infectious disease. The odds ratio testifies that risk of VBD and WBD infection is significantly low in affluent quintile group compared with the poorest quintile. Moreover, the risk of ABD infection significantly increases with the rising level of wealth compared with the first quintile. The risk of ABD is significantly 1.4 times higher in the fifth quintile compared with the first category. It is observed that the northern region has significantly 1.7 times more VBD risk followed by the south and central regions in comparison with the north-eastern region. In the case of WBD infection the eastern region has significantly 4.5 times more risk followed by the central, north and western regions compared with the north-eastern region. The risk of ABD infection is significantly 28.4 times more in the north followed by the west, south and central region compared with the north-east region.

IV. Summary and conclusion

The analysis drawn from the three rounds of NSS shows the increasing trend for the share of urban area for infectious diseases compared with the rural counterpart over the period. Reduction in the share of rural area for prevalence of infectious diseases could be the result of the comprehensive effort of NRHM (NHM, n.d.). On the other hand, empirical evidence shows that along with urbanization, population pressure is increasing in recent decades. Consequently, it creates pressure on available basic infrastructure, particularly in slum areas which are inhabited by the poor, marginalized and vulnerable groups with limited access to quality health care, communication and other essential amenities (Ansari, 2009). All these phenomena create grounds for spreading infectious diseases and their burden is mainly borne by urban poor.

The correlation coefficient is derived with an empirically proved determinant of health indicators. Among them, the availability of covered/underground drainage system is positively correlated with each type of infectious disease. It is noteworthy that covered drainage system has a positive effect on health (Kumar & Joseph, 2012), but during drain blockage water comes to the surface and creates an unhygienic situation. Further, accessibility to safe drinking water emerges as a positively associated factor with waterborne diseases. These findings highlight that despite a better accessibility to safe water and flush toilet, the risk of infectious diseases is high because of unhygienic practices in urban areas (UNICEF, n.d.)

Women are at a higher risk of getting an infectious disease than men because of biological differences, social inequities, and cultural norms (Gerberding, 2004; Bellamy, 2004). Education is a major determinant of health, and the analysis has proved that with the rising level of education, the risk of infectious diseases decreases considerably. Evidence indicates that with growing age, the risk of infectious diseases reduces. In other words, the 0-4 age group, i.e., children are much vulnerable to infectious diseases because of their weak immune capacity. Studies have also shown that indoor air pollution is a major public health problem in developing countries (Mishra, Retherford & Smith, 2002). In India, several hundred thousand women and children die prematurely because of indoor air pollution. Asthma, tuberculosis and acute respiratory infections (ARI) are some major infectious diseases associated with indoor air pollution. Cooking within the home without any separate room for kitchen coupled with the use of polluting cooking fuel (i.e., biomass or charcoal) are a common contributing factor for ARI among children and women who reside inside home most of the time. Consequently, children suffer from ARI, fever and diarrhoea. Prolonged exposure to these diseases might lead to lung cancer, adverse pregnancy outcome, cataract and blindness. Also, pneumonia and diarrhoea emerge as leading causes of death in children under five years old (Bassani et. al., 2010). However, the household size reflects that with increasing number of family members, the risk of infectious diseases is significantly reduced. This inverse relation between household size and infection diseases is empirically proved (Wickens, Crane, Pearce & Beasley, 1999) and it assumed that the main reason for it may be because of the household structure, birth order, siblings, gender and parental age (Strachan, 2000). Economic status of people is the next major determinant of health. With increment in the level of income, the effect of infectious diseases is significantly reduced except air borne diseases. Here, income shows an inverse relationship with ABD, and the probable reason for this association is high reporting of ARI because of awareness of air pollution in the urban environment. The other probable reasons of high ABD are related with living space, poor ventilation, use of improper combustion appliances (cause of nitrogen dioxide) or use of improper heating appliances (cause of carbon dioxide) in the homes, smoking habits, etc. (Krieger & Higgins, 2002; Arcus-Arth & Broadwin, 2009). Further neighbourhood factors such as poor air quality because of housing proximity to sources of vehicle exhaust emissions places such as major roads, bus depots, airports, and trucking routes play as a catalyst for ABD infection (Perlin, Wong, & Sexton, 2001).

The prevalence of infectious diseases is positively associated with the degree of urbanization across different zones of India. Empirically it is proved that with the high degree of urbanization and rising industrialization, several problems like ambient air pollution may affect every urban dweller. Noticeably, other problems like contaminated drinking water, lack of sanitation facility, or indoor air pollution exist in the developing world and may disproportionately affect a group of some people than others (Steckel, 1999; Szreter, 2004; Halweil & Nierenberg, 2007).

Therefore, the present study concludes that infectious diseases are significantly prevalent in urban India, though many studies have also shown that mostly the small and medium sized towns are at higher risk (Bhagat, 2013). Large sections of urban India urge for better living condition, improvement in domestic hygiene and targeted public health interventions. As urban centres offer incredible opportunities for diseases, so it is important to have well-planned strategies to control vector, water, and air borne diseases. There should be targeted awareness approach for people to have domestic hygiene and sanitation practices. The Central Pollution Control Board and National Green Tribunal should implement their programmes effectively to make environment clean and green in urban parts. Although several government health plans are run to prevent and cure these diseases, there is still an urgent requirement to implement them.

V. Limitation of the study

The findings of this study need to be interpreted in view of the following limitations. Since household survey methods are not a very useful way to capture the prevalence of diseases and their etiological factors accurately, many diseases, especially vectorborne diseases are likely to get recorded as ‘unspecified fevers’. Consequently, VBD is not strictly comparable across different rounds due to non-uniformity in the classification. The number and size of the room are significant in terms of determining the risk of infectious diseases. But due to unavailability of this information, it is difficult to calculate the household density to capture the congestion problem. Therefore, the association of household size with infectious disease may be crude. Despite these common limitations of self-reported morbidity prevalence, this study provides a good assessment of the prevalence of various infectious diseases and their association with household environment in urban India.

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