A Study of Risk Factors Associated with Poor Water and Sanitation in Srinagar City, Jammu and Kashmir

Dr. Shanawaz Ahmad Baba
Department of Geography and Regional Development
University of Kashmir, Srinagar

Abstract - This paper seeks to investigate the risk factors associated with inadequate water and sanitation conditions in the different income households of Srinagar city. The study is based on primary sources of data collected with the help of well structured questionnaire/schedule from 1500 households during 2013. This study identifies the 8 main water supply and sanitation related risk factors and occurrence of 6 associated diseases. The study show that most of the low and lower middle income households were exposed to all the associated risk factors of water and sanitation. The study points to the need of creating awareness amongst the low and lower middle income households about the waterborne diseases.

I. INTRODUCTION

Water and sanitation is one of the primary drivers of public health. Diseases related to unsafe drinking water, poor sanitation and lack of hygiene are some of the most common causes of illness and death among the people especially in the developing countries. Water and sanitation related sicknesses put severe burdens on health services and keep children out of school. About 2.1 billion people use source of drinking water contaminated with faeces, putting them at the risk of contracting cholera, dysentery, typhoid etc. Nearly 1.6 million deaths every year can be attributed specifically to these health determinants. Contaminated drinking water is estimated to cause more than 500 000 diarrheoal deaths each year and is a major factor in several neglected tropical diseases including intestinal worms, schistosomiasis and trachoma. About 4.5 billion global population lack safely managed sanitation (WHO and UNICEF, 2107). Approximately 1.3 billion people in the developing world lack access to adequate quantities of clean water, and nearly 3 billion people are without adequate means of disposing of their feces. In India, during the period of 2014 to 2016, 39.5 million people have been affected due to waterborne diseases like cholera, typhoid, acute diarrheoal diseases and viral hepatitis (Ministry of Health and Family Welfare, GOI). Near about 1.5 million children die of diarrhea alone and 73 million working days are lost due to waterborne diseases each year. The impact of inadequate water and sanitation services falls primarily on the poor. Badly served by the formal sector, the poor make their own, often inadequate, arrangements to meet basic survival needs. Many fetch water from long distances or end up paying high prices to water vendors for very small quantities of water. The clear need for basic water and sanitation services for the poor assumes even greater significance when the linkages with other dimensions of poverty are considered. Human waste poses a tremendous social cost through pollution of rivers and groundwater.

Water and sanitation remains one of the biggest challenges in Srinagar city with the unprecedented urbanization, population growth and spatial expansion of the city. Improving water supply and sanitation is the key to reduce waterborne diseases. Hundreds of millions of the city dwellers have no alternatives but to use contaminated water or at least water whose quality is not guaranteed. About 180 MGD of sullage and sewerage will be directly draining into various water bodies by 2012 therefore increasing the burden of waterborne diseases (UEED). Keeping all these into consideration Srinagar city has been selected as study area.

II. DATABASE AND METHODOLOGY

The study is mainly based on primary sources of data which were collected through city/household surveys with the help of questionnaire interviews. The survey was conducted during the years 2012 and 2013. All the analysis has been done on the basis of income categories. The following methods were adopted for the study (Baba, 2015)

- The sample has been selected from the 9 different neighbourhoods. The 34 administrative municipal wards of Srinagar city were grouped into 9 neighbourhoods identified on the basis of income-wise dominance in the wards (low income (< Rs 5000 per month), lower middle (Rs 5,001 – 15,000), upper middle (Rs 15,001- 25,000) and high income (>25,000); population density (very low(<2,000 persons/sq km), low(2,001-5,000), medium (5,001 – 10,000) and high(> 10,000); household density (very low(<500 households/sq. km), low (501-1,000), medium(1,001-1,500), and high(>1,500) and physiographic conditions (eastern and north-eastern lake and mountainous areas; central highly congested residential/commercial areas; west, south and south-western low lying plain areas of Jhelum and marshy wetlands, north and north- western agricultural field areas and south- eastern hilly and plateau areas). About 50 per cent of the wards from each neighbourhoods were randomly selected and from each of the selected wards, > 2 per cent of the total households were selected for sampling and collecting information. The total sample size consisted of 1,500 households belonging to different income groups [239 (16 per cent) high income (> Rs 25,000 per month, 168 (11 per cent) upper middle (Rs 15,001 to 25,000 p.m), 624 (42 per cent) lower middle (Rs 5,001 to 1,5000 p.m) and 469 (31 per cent) low income (< Rs 5,000 p.m). (Table 1)

Table 1: Design for survey adopted for the selection of the sample from the different neighbourhood environmental conditions in Srinagar city

Hh=Households L= low/lower

S. No	Neighbourhood	Ward Number	Total wards	Selected wards (50% of the total wards)	Total No. of Hhs in the selected wards	Household proportion (%age)	Selection of Sample 2 percent of total Hhs
1	**Low income with high density (LI/HD)**	9,10,18,23,24,28	6	3 (9,18,23)	15,075	22.0	304
2	**Low income with very low density (LI/VLD)**	1,3	2	1 (3)	5,665	8.30	128
3	**Lower middle income with high density (LMI/HD)**	2,4,5,7,8	5	2 (5,7)	10,955	16.05	245
4	**Lower middle income with low density (LMI/LD)**	13,34	2	1 (34)	4,656	6.82	105
5	**Upper middle income with medium density (UMI/MD)**	6,11,12,20,21,22,29,31	8	4 (12,20,22,29)	16,278	23.83	363
6	**Upper middle income with low density (UMI/LD)**	19,25,26	3	1 (19)	3,548	5.19	81
7	**Upper middle income with very low density (UMI/VLD)**	27	1	1 (27)	3600	5.27	82
8	**High income with low density (HI/LD)**	30,32,33	3	1 (33)	2,967	4.35	68
9	**High income with very low density (HI/VLD)**	14,15,16,17	4	2 (14, 15)	5,523	8.09	124
Total Wards			**34**	**16**	**68,267**	**100.00**	**1,500**

I=income M= Medium/middle
D= density H= high/higher
U=upper Hhs = Households

Source: (i) Srinagar Municipal Corporation, Srinagar 2011
(ii) IRS-ID LISS III + PAN Imagery of Srinagar city 2008
(iii) Based on Field Survey, 2012-13

- Information regarding the water supply and sanitation conditions were gathered from 1,500 households from the 9 different neighbourhoods with the help of questionnaire interviews.

- Risk factors associated with poor water and sanitation were identified; data regarding the occurrence of specific waterborne diseases were collected from the sampled respondents and later confirmed from various government/private hospitals and clinics.
- Karl Pearson's Correlation Coefficient (r) method was applied to calculate the existing relationship between the housing conditions and the frequently occurring air borne diseases.

$$r = \frac{\Sigma xy - \frac{\Sigma x \Sigma y}{N}}{\sqrt{\Sigma x^2 - \frac{(\Sigma x)^2}{N}} \sqrt{\Sigma y^2 - \frac{(\Sigma y)^2}{N}}}$$

Where, r = coefficient of correlation
x, y = the two given variables
n = number of observation

Student's 't' test technique has been chosen to identify the significant relationship between the variables at 1 % and 5% level of significance.

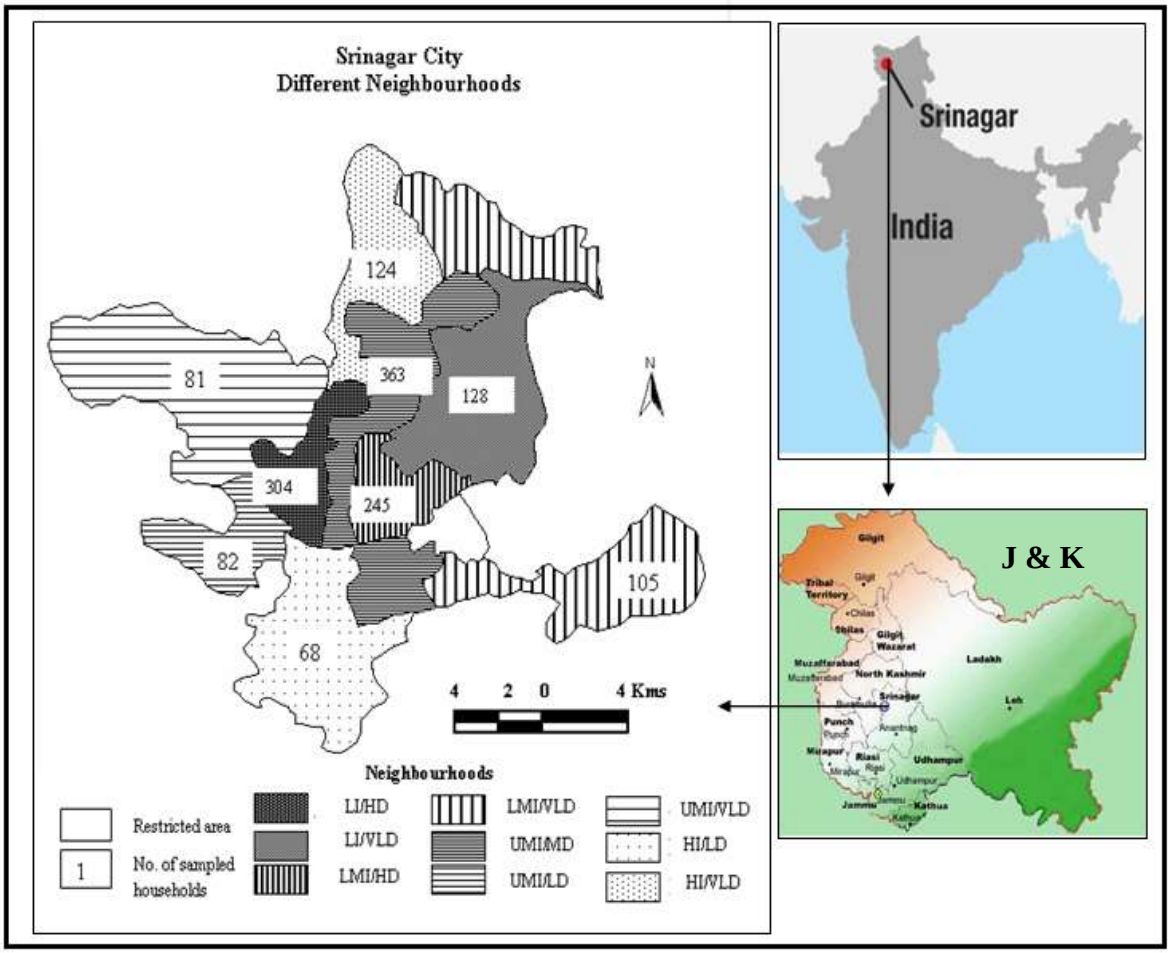
$$t = r\sqrt{\frac{n-2}{1-r^2}}$$

Where, t = calculated value of 't' in the test of significance
n = number of observations
r = computed value of coefficient correlation

III. Results and Discussions

Srinagar (33º53'49" and 34º17'14" N latitudes and 74º36'16" and 75º01'26" E longitudes), the city of lakes is the summer capital of Jammu and Kashmir, spreads over in the heart of the oval shaped Valley of Kashmir at an average elevation of about 1,585 metres above mean sea level was selected as the study area (fig. 1). Srinagar is often known as the 'Venice of East' because of its picturesque features, lakes and waterways which have bestowed unparallel scenic beauty. It is famous throughout the world for its tourist attraction. The city receives high influx of tourists both from India and abroad. Being the capital city and largest urban settlement, it has become the hub of major administrative, political, economic, commercial and other activities. The city has received rapid growth of urban population which has increased 9 times and its size has increased 20 times

Fig 1: Location map of Srinagar City, J & K



Hh=Households
I=income
D= density
U=upper
L= low/lower
M= Medium/middle
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Source: (i) Srinagar Municipal Corporation, Srinagar 2011
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during 1901 and 2011. It constitutes 53 per cent of the urban population of the Valley and 27 per cent of the state. In this paper an attempt has been made to investigate the health implications of poor water and sanitation conditions in Srinagar city – various types of risk factors associated with poor water and sanitation were identified and then their implications on the health of residents has been assessed.

Socio-economic conditions of the sampled households of Srinagar City

A wide variation was observed in the socio-economic conditions of the sampled respondents belonging to different income groups have been presented in Table 2 (i) and (ii). A perusal of this table shows that mostly the respondents were muslims, married, belonging to higher age group, educated (up to high school, inter and graduate level), employed (in business, government and miscellaneous jobs), had large families (5 to 10 members) living in the same house. There were only few migrants and rest were permanent residents living in the same and neigbourhoods for more than 30 years.

A wide variation in the housing conditions of the sampled respondents belonging to different income groups presented in table 2 (iii) was observed. Nearly half of the respondents were living in dilapidated housing conditions, 39 per cent in semi-*pucca* houses and 12 per cent in *kutcha* houses. Nearly 81 per cent of the *kutcha* houses were made of wood and asbestos/I.G sheets. Although few had many rooms but households occupied only 1 or 2 rooms. Mostly they were using a combination of fuels – modern and traditional and one fourth cooked in a multipurpose room or in open space outside their home. Household surveys have revealed a positive relationship between the socio-economic conditions of the respondents/households and choice of house in which they lived.

Table 2: Income-wise socio-economic and housing characteristics (in per centages) of the sampled respondents of Srinagar city (2012-13).

(i) Religion, age, marital status, family type and size

Income Groups	No. of sampled households	Muslims	Age in years				Marital status	Family Type		No. of family members		
			15-24	25-34	35-44	>45	Married	Nuclear	Joint	< 5	5—10	> 10
High	239	86.2	22.18	19.67	22.59	35.6	65.69	45.54	51.46	20.5	66.95	12.55
Upper middle	168	95.83	14.88	27.98	23.21	33.9	67.86	57.14	42.86	33.93	58.33	7.74
Lower middle	624	99.2	15.38	27.4	28.21	29	70.19	60.09	39.91	29.81	65.7	4.49
Low	469	100	8.74	26.44	31.98	32.8	75.05	78.46	21.54	39.23	58.64	2.13
Total	**1,500**	**97**	**14.33**	**25.9**	**27.9**	**31.8**	**70.74**	**63.33**	**36.33**	**31.73**	**62.87**	**5.4**

(ii) Educational and occupational status

Income Groups	No. of sampled Households	Educational status		Levels of education							Occupational status	
		E	UE	P	M	HS	IM	Gr	PG	Pr	Em.	Uem.
High	239	89.96	10.04	-	1.39	26.5	15.82	34.88	10.7	10.7	47.7	52.3
Upper middle	168	78.57	21.43	1.51	13.6	27.3	19.7	21.97	12.12	3.79	36.91	63.09
Lower middle	624	57.21	42.79	3.64	26.9	32.5	18.21	14.57	2.8	1.4	39.91	61.06
Low	469	37.53	62.47	9.09	42.6	27.8	7.39	13.07	-	-	43.07	56.93
Total	**1500**	**58.67**	**41.33**	**3.52**	**21.8**	**29.3**	**15.68**	**20.34**	**5.57**	**3.75**	**41.4**	**58.6**

(iii) Type of house

Income Groups	No. of sampled Households	House Type			If kutcha		If *pucca*	
		Kutcha	*Pucca*	Semi-*pucca*	W/A	M/B	B/C/A	CC/A
High	239	-	88.7	11.3	-	-	19.34	80.66
Upper middle	168	1.19	67.86	30.95	-	100	50	50.00
Lower middle	624	5.77	52.72	41.51	63.89	36.11	57.75	42.25
Low	469	30.91	17.7	51.39	85.52	14.48	75.9	24.10
Total	**1500**	**12.20**	**49.2**	**38.6**	**80.33**	**19.67**	**47.56**	**52.44**

E- Educated UE- Uneducated P- Primary M-Middle HS- High School IM- Intermediate Gr- Graduate PG- Post Graduate Pr- Professional

Em. – Employed W/A- wooden /asbstos M/B – mud brick B/C/A- Brick/cemented/asbestos CC/A – Concrete/ asbestos

Source: Based on field survey, 2012-13

Identified water and sanitation related risk factors

Risk factors associated to water and sanitation are unwanted consequences which are related to some activity and plays catalyzing role by its probability. An assessment of linkages between water and sanitation related factors and associated diseases has been summarized in this part. Regular supply of good quality of water in sufficient amount and provision of adequate sanitation and waste collection and disposal all strongly contribute to the overall health. Men's health is affected by the ingestion and use of

contaminated water, lack of sanitation, lack of drainage and accumulation of waste. The use of contaminated water for drinking and cooking purposes has led to the occurrence of diarrhoeal diseases, typhoid, jaundice, cholera, worms etc. Insufficient amount of water for bathing, use in toilet and washing clothes has probably contributed to the occurrence of skin and eye infections.

Water and sanitation services are the basic necessities of a community and they play an important role in improving health and quality of life. Supply of adequate quantity and quality of water is a pre-requisite for facilitating domestic and other miscellaneous services and better hygienic practices. Household conditions was not same in the different income groups. On the basis of household surveys the risk factors associated with water and sanitation condition which have direct or indirect health impacts have been identified **[Table 3],**

1. Inadequate water supply
2. Water quality problem
3. Indoor water storage in open containers
4. Toilet sharing
5. Excreta disposal in garbage/open drains/water bodies
6. Inadequate waste disposal/accumulation
7. Inadequate drainage

Table 3: Income-wise distribution of sampled respondents (in per centages) in Srinagar city (2012-13) according to identified poor water and sanitation related risk factors

Income Groups	No. of sampled house-holds	In-adequate water supply	Water quality proble m	Indoor water storage in open con-tainers	Toilet sharing (> 6 persons per toilet)	Excreta disposal in open drains/water bodies	Inadequate waste disposal/ accumulation	Inadequate drainage	Total average of 7 risk factors	Exposure of households to number of risk factors
High	239	46.86	38.91	--	31.02	16.74	18.39	50.26	**28.88**	6
Upper middle	168	56.55	36.91	1.38	58.33	40.61	43.57	53.82	**41.60**	7
Lower middle	624	62.98	45.19	19.74	65.70	43.87	51.83	86.61	**53.70**	7
Low	469	65.25	47.12	38.34	58.64	49.47	65.45	92.98	**59.61**	7
Total	**1,500**	**57.91**	**42.03**	**14.87**	**53.42**	**37.67**	**44.81**	**70.92**	**45.95**	7

Source: Based on field survey, 2012-13

An adequate supply of easily accessible, potable water is central to households welfare and pre-requisite to good hygiene and sanitation. Many health problems are linked to water quality, availability, ease of access and provision for disposal. Many city dwellers have no alternative but to use contaminated water or at least water whose quality is not guaranteed. Of the total sample, nearly 60 per cent reported of irregular supply it means inadequate supplies for use in domestic work, washing and personal hygiene. Eye and skin infections are very difficult to control without sufficient supplies of water. Half of the sampled households reported of water quality problems. So, most of the households were using contaminated water. Evidences from bacteriological quality of water suggests that water quality from piped system is generally good, but it is often contaminated due to poor storage in open containers

Table 4: Income-wise distribution of sampled the respondents (in per centages) in Srinagar city (2012-13) according to most frequently occurring waterborne diseases.

Income Groups	No. of sampled households	Frequently occurring waterborne diseases						
		Diarrheoal diseases	Typhoid	Helminthic infections	Skin infections	Eye infections	Jaundice	Average
High	239	55.77	17.84	10.88	11.20	10.38	13.92	20.00
Upper middle	168	78.93	35.26	28.06	19.12	14.34	10.74	31.08
Lower middle	624	86.72	47.15	23.89	26.56	23.41	12.67	36.73
Low	469	89.68	61.89	32.89	34.78	30.17	14.74	44.03
Total Average	**1,500**	**77.78**	**40.54**	**23.93**	**22.92**	**19.58**	**13.02**	**32.96**

Source: Based on field survey, 2012-13

Of the total sampled households, 80 per cent were storing water indoors of which, 20 per cent were storing in open containers. Irregular washing of storage containers results in contamination of house water. The only neighbourhood where a majority of the respondents boiled or filtered their water were the high class residential areas. Thus, inadequate, irregular, poor quality of water and its storage in open containers has been taken as risk factor.

Sanitation facility is closely linked to potable water supply and is also an important facet of indoor environment, with important health implications. There is high incidence of toilet sharing, nearly 87 per cent of households had only 1 toilet, in nearly 53 per cent of the households 1 toilet was shared by > 6 persons. Nearly 45 per cent households reported of excreta disposal either with garbage or in open drains or in water bodies. Shared toilets are potential sites for exposure to pathogens and faecal disposal poses health risk not only to the disposing households but also for neighbourhs. Sullage consists of effluents from kitchen, bathrooms, flush toilets, etc. is mainly discharged in open drains. Open drains were the principal means of sullage disposal among 31 per cent of households surveyed and this is a health risk. Removing and safely disposing of excreta and waste water is also a critical environmental health need. Thus, toilet sharing, excreta disposal with garbage/in waste water and in drains, has been taken as risk factors.

Disease occurrence associated with water and sanitation related risk factors

The past as well as recent studies have revealed association between poor water supply and sanitary conditions with health. Inadequate water supply and sanitation conditions results in imminent health problems (Bateman et al. 1998). In Sa Paulo, reduction in infant mortality rate between 1973 to 1986 has been linked to improved water supply and sanitation (Monteirs and Benicio). Azurin and Alvero (1975) noted that provision of safe drinking water reduced the incidence of cholera by 73 % in Bacolod city, Philippines. Pickerings (1985) in his retrospective study of child mortality under 3 years in Bakan, Gambia found risk of death among households using public taps was twice higher than those that connected public taps to their houses.

The environmental related ill health cases considered with poor water supply and sanitation include diarrheoal diseases, typhoid, helminthic infections, skin infections, eye infections and jaundice. Table 4 presents a list of frequently occurring waterborne diseases as reported by the sampled respondents and doctors. These were diarrheoal diseases (78 per cent), typhoid (41 per cent), helminthic infections (24 per cent), skin infections (23 per cent), eye infections (20 per cent) and jaundice (13 per cent). An attempt has been made to establish the relationship between water and sanitation related risk factors and the occurrence of associated diseases (Table 5 and Fig. 2).

Table 5: Karl Pearsons Correlation coefficient between dependent variables (associated diseases) and independent variables (water supply and sanitation related risk factors)

Associated diseases	Poor water and sanitation related risk factors							
	X1	X2	X3	X4	X5	X6	X7	X8
Y1	.987*	.673	.763	.950*	.993**	.975*	.827	.993**
Y2	.973*	.831	.933	.800	.933	.988*	.922	.970*
Y3	.875	.469	.681	.800	.956*	.935	.635	.895
Y4	.963*	.863	.954*	.800	.908	.976*	.939	.956*
Y5	.934	.938	.900	.853	.844	.934	.937	.920
Y6	.093	.646	.594	-.300	-.098	.117	.460	.055
*. Correlation is significant at the 0.05 level (2-tailed).								
**. Correlation is significant at the 0.01 level (2-tailed).								

Risk factors

X1= inadequate water supply
X2=water quality problem
X3 =water storage in open containers
X4 = toilet sharing (> 6 persons per toilet)
X5 = excreta disposal in open drains/water bodies/fields
X6 = inadequate waste disposal/accumulation
X7= inadequate drainage
X8= water logging

Source: Based on field survey, 2012-13

Associated diseases

Y1= diarrhoeal infections
Y2 = typhoid
Y3 = helminthic infections
Y4= skin infections
Y5 = eye infections
Y6 = jaundice

Identified water and sanitation related risk factors

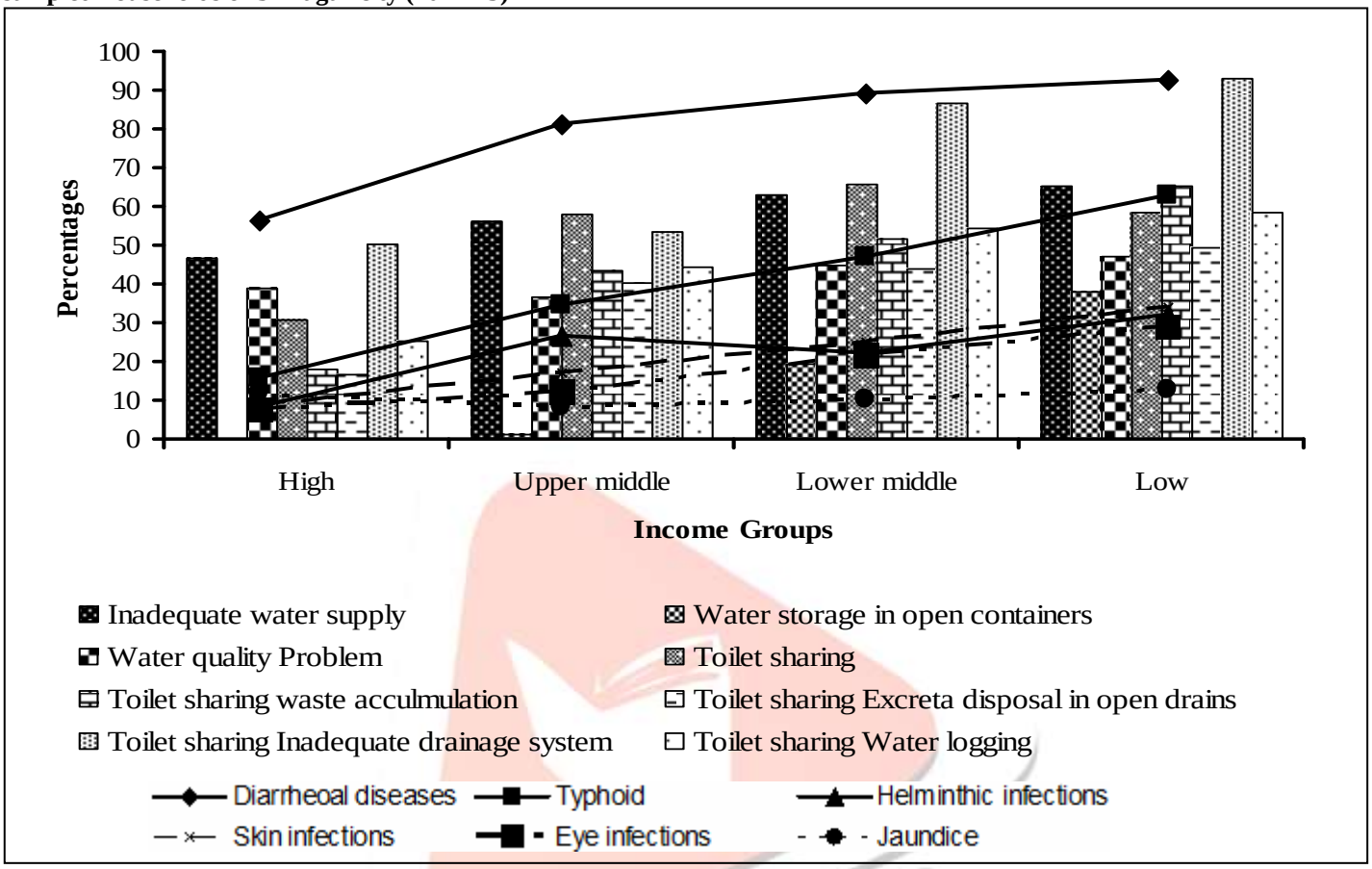
X1 Inadequate water supply
X2 Water quality problem
X3 Water storage in open containers
X4 Toilet sharing (> 6 persons per toilet)
X5 Excreta disposal in open drains/water bodies
X6 Inadequate waste disposal/accumulation
X7 Inadequate drainage
X8 Water logging

Associated diseases

Y1 Diarrhoeal diseases
Y2 Typhoid

Y3 Helminthic infections
Y4 Skin infections
Y5 Eye infections
Y6 Jaundice

Fig. 2: Relationship between water supply and sanitation related risk factors and occurrence of waterborne diseases in the sampled households of Srinagar city (2012-13)



The correlation coefficient (r) given in table 5 depicts that all the selected diseases namely, diarrhoeal diseases, typhoid, helminthic infections, skin infections and jaundice are positively correlated with the risk factors namely, inadequate water supply, water quality problem, water storage in open containers, toilet sharing (> 6 persons per toilet), excreta disposal in open drains/waterbodies/fields, inadequate waste disposal/accumulation, inadequate drainage and water logging. Their positive correlation generalized the fact that all diseases are associated with risk factors which have been taken for the present study.
A positive correlation was found between the 8 water and sanitation related risk factors, inadequate water supply (X1), water quality problem (X2) , water storage in open containers(X3), toilet sharing (> 6 persons per toilet) (X4), excreta disposal in open drains/water bodies (X5) , inadequate waste disposal/accumulation (X6), inadequate drainage (X7), water logging (X8) and the occurrence of associated diseases, diarrhoeal diseases (Y1) (r=0.967), typhoid (Y2)(r=0.987), helminthic infections (Y3)(r=0.854), skin infections(Y4)(r= 0.983), eye infections (Y5)(r=0.966) and jaundice (Y6)(r=0.194).

IV. Conclusion

In order to maintain good water quality safe for drinking, the portable water in the city must be adequately purified by the Public Health Engineering Department, Srinagar. Safe water, sanitation and hygiene at home should not be a privilege of only those who are rich or live in urban centers. These are some of the most basic requirements for human health and all governing bodies have a responsibility to ensure that everyone can access them. Once we secure access to clean and adequate sanitation facilities for all, irrespective of the differences in their living conditions, a huge battle against all kinds of waterborne diseases will be won.

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