

Abstract:-

The indoor environmental condition is badly affected by cooking smoke circulated within the house, bad sanitary condition within the house, improper dumping and storing of household solid waste in the house, noise beyond critical level, open, dirty and stagnant drainage system around the house, shortage of living space in the house, use of bio-fuels, etc..

People spend about 80 percent time in the indoor environment (house, office and vehicles), which is very much sufficient to effect the people's health condition. In urban areas most of the households are suffering from the bad condition of indoor-environmental quality that effect health of human being of varying income group. A calm and tranquil home environment is conducive to the healthier life. Quality

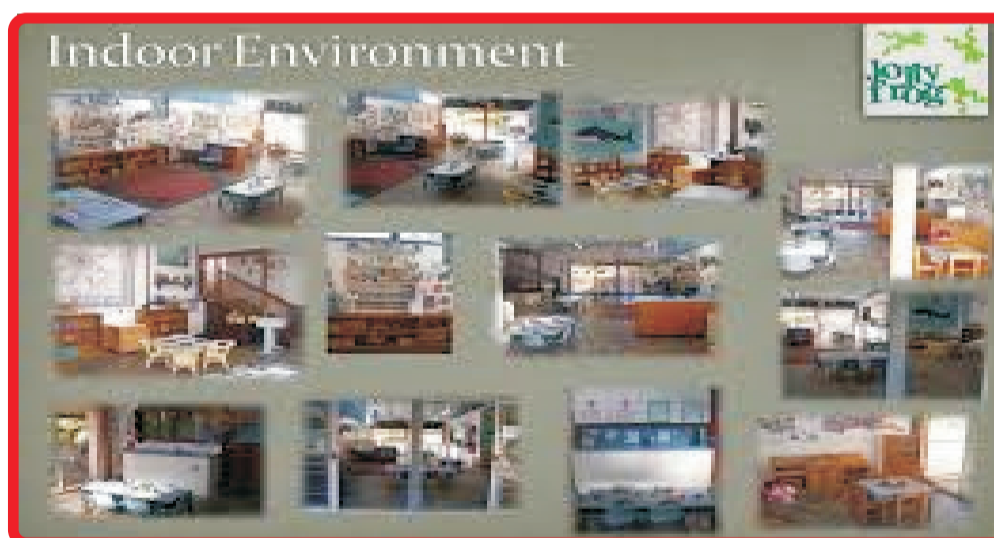
UNSAFE INDOOR ENVIRONMENT AND VULNERABLE INCOME GROUP IN URBAN HABITAT- KOLKATA (INDIA

of their lives depends on clean, decent, safe home environment in which people live and raise family.

The present study aims at finding the quality of indoor environmental condition across the households of different income and socio-religious group in Kolkata Municipal Corporation. In the present study an attempt has been made to analyze the relationship between indoor environmental condition and associated human health.

Keywords:

I n d o o r environment, vulnerable group, environmental quality.



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INTRODUCTION

Environment refers to everything that surrounds us. It determines our lives or activities in some way or other. Environment consists of various forms such as physical environment, social environment, economic environment, cultural environment and urban environment. There is a growing awareness and common concern in the world about the increasing degradation of the global environment.

As per World Health Organization European Centre for Environment and Health (WHO/ECEH, 2000a) exposures in indoor spaces contribute a substantial to total air exposure. Most of the people in urban centres spend more than 80 percent of their time in indoor environment, either at home or work place (Hodgson et al., 1997; USEPA, 2000).

Quality of the indoor environment bears a significant role to human health and human well being. The need to control over the indoor air quality has been addressed by the WHO/ECEH (2000b) as 'The right to healthy indoor air', derived from fundamental principles in the field of human rights.

Indoor environmental condition is determined by housing condition, food contamination, household living space etc. But currently people are more concerned of global environmental phenomena but less bothered of indoor environment which is called as Indoor Environmental Condition. People are seldom aware of the environment of their homes which creates the greatest and most immediate influence on their lives, their health and well being even in the mega cities of developing economy like India. In India, on an average, a person spends at least 16 hours a day inside the home. A healthier indoor environment needs a clean, decent, safe home in which people live and raise a family. When the quality of the drinking water at home is bad, the health effects are likely to be far more severe than those arising from river pollution. Smoky kitchens, poor sanitary facilities, dumped solid waste inside and outside the homes, contaminated food, insecticides used within the house, high level of noise inside the homes, dirty drainage and stagnant water around the house etc. degrade the indoor environmental condition which is likely to be more critical to people's health than the broader based environmental degradation (Agarwal, 2001).

Huge number of people migrates from rural areas to the cities every year, in search of employment and other related economic activities. This has put severe strain on the urban civic amenities that consequences outdoor environmental degradation in general and declination of housing sanitation, water supply, unhealthy living space within the house, etc in particular. However, indoor environmental condition in slum area is more endangered as well as non-conducive for flourishing of health and mind. About one fifth of India's population lives in slums, half of the household reside in dwellings measuring less than 20 sq. metres, about one third lives in insanitary conditions and nearly one third do not have safe drinking water. The available water supply is far from adequate, creating a problem in all towns and cities (Bhide, 1972).

The indoor environmental quality is determined by many factors such as availability and quality of bathroom and toilet, per room population density, location of kitchen and its ambience, frequency of floor cleaning, hygienic status of house, ventilation facility, people awareness to the adverse impact of bad indoor environmental condition, etc. The other determining factors of indoor environment quality includes garbage and solid waste storage, household domestic waste, household pests, indoor smoking, mode of water storage, water logging around house etc. (Wolkoff, 1995).

OBJECTIVES

Following are the important objectives of the study

- to analyse indoor environmental condition in slum and in non-slum area,
- to determine various factors affecting indoor environmental condition,
- to identify vulnerable income group to the indoor environmental related health problems,
- to examine associated human health diseases the consequent upon indoor environmental condition,

DATABASE AND METHODOLOGY

The analysis of present work is mainly based on the empirical observation and primary data collected through a well designed questioner and direct interview with the respondents of the sampled households. 5 percent of slum households were selected at random from Topsia and 5 percent of non-slum households at random from Narkeldanga of Kolkata Metropolitan Corporation (KMC) totalling 100 and 93 households respectively for present study. Information regarding the frequency of occurrence of health diseases or health problems of total surveyed population since five years back has been collected from the respondents on the basis of recalling method. For understanding whether or not indoor environment is at risk due to poor indoor air quality respondents were asked the questions as;

1. Does the space feel oppressive or stale when entered from the outdoors?
2. Do cooking odors linger for several times?
3. Is there condensation on the windows or walls during the winter?

Answer 'yes' to any of the questions have assured of the prevalence of poor indoor environmental quality within the house.

Quantitative information has been presented in percentage and average form for lucid and easy comprehension of underlying facts and realities.

STUDY AREA

Kolkata is located in the eastern part of India at 22° 33' N and 88° 20' E. Spread roughly north-south along the east bank of the Hooghly River, Kolkata sits within the lower Ganges delta of eastern India; the city's elevation is 1.5 to 9.0 m (5–30 ft). Much of the city was originally a wetland that was reclaimed over the decades to accommodate a burgeoning population. Kolkata has total population 4486679 persons, of which male 2362662 persons and female 2124017 persons. Among them total slum population accounts for 1457273 which is 32.48 percent (Census of India 2011). Its population density is 24,252 /km² (62,810/sq mi). This represents a decline of 1.88 percent during 2001–11 from the last decade. The sex ratio of the study area is 899 females per 1000 males—lower than the national average 940 (Census of India 2011). The ratio is depressed by the influx of working males from surrounding rural areas, from the rest of West Bengal, and from neighboring states, mainly Bihar, Uttar Pradesh, and Orissa; these men commonly leave their families behind and literacy rate of 87.14 percent exceeds all-India average of 74 percent. Total population of Kolkata urban agglomeration is 14,112,536 persons in 2011 accounting a decadal increase of 7.6 percent much lesser than 19.0 percent during 1991–2001 and 19.9 percent during 1981–1991.

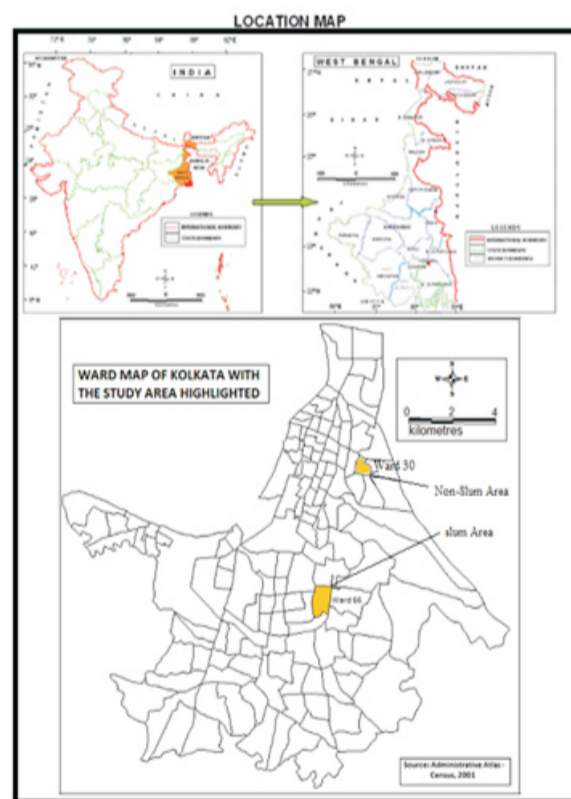


Figure 1 Location of Study Area

ANALYSIS AND DESCRIPTION

Socio-economic profile of sampled households

Table 1 illustrates five income categories of all sampled households under study. Following table reveals that out of 86 sampled households of very low income group with monthly per capita income Rs. <1500, 78 percent are slum households however, remaining 22 percent are observed in non-slum area. On the other hand 100 percent households of both high and very high income groups have been accounted from non-slum area (Narkeldanga).

In low (Rs. 1500–3000) and medium (Rs. 3001–6000) income groups the share of non-slum households are lower than slum households.

Table 1
Distribution of sampled households among different income groups, Topsia (Slum area) & Narkeldanga (Non-slum area), Kolkata, 2012

Income group	Monthly per capita income (Rs.)	Total sampled households		Slum households		Non-slum households	
		Number	%	Number	%	Number	%
Very low	Less than 1500	86	44.55	67	77.90	19	22.10
Low	1500-3000	65	33.67	27	41.53	38	58.47
Medium	3001-6000	24	12.43	6	25	18	75
High	6001-120000	13	6.73	0	0	13	100
Very high	More than 12000	5	2.59	0	0	5	100
Total		193	100	100	51.81	93	48.19

Source: Primary survey, 2012

A bigger share of slum households is observed in very low and low income group, however high and very high income groups are dominated by non-slum households, which is the manifestation of economic poor condition of slum people in Kolkata metropolitan city.

House type

House type is also an important criterion of determining indoor environmental quality. Type of house can be assessed by the building materials of house, such as bricks, cement, mud, thatch etc. Table 2 reveals higher percentage of kucha houses among the households of very low income group, and least percentage of houses are pucca, while as highest as 60.46 percent of houses are mixed of brick, mud and thatch. However a glaring feature is observed in the very low income group also, wherein no single kucha house is found in the non-slum area in contrast to the 34.32 per cent of sample slum houses are kucha.

Table 2
Percentage of Sample households with their type of house, Kolkata, 2012

Income Group	Total (in %)			Slum area (in %)			Non-slum area (in %)		
	Kucha	Pucca	Mixed	Kucha	Pucca	Mixed	Kucha	Pucca	Mixed
Very low	26.74	12.79	60.46	34.32	4.47	61.19	0	42.1	57.89
Low	9.23	27.69	63.07	18.51	22.22	59.25	2.63	31.57	65.78
Medium	0	54.16	45.84	0	33.33	66.66	0	61.11	38.89
High	0	84.61	15.38	0	0	0	0	84.61	15.38
Very high	0	100	0	0	0	0	0	100	0

Source: Primary survey, 2012

Note: kucha house - houses made of mud and thatch, pucca house- concrete houses

In very high income group 100 percent of sampled houses are pucca in both slum and non-slum area. Again income level is a factor of house type, since higher percentage of pucca house and lower percentage of kucha house is observed as with the increase of monthly per capita income of household. It is also observed that the proportion of kucha houses is more in slum area than in non-slum area.

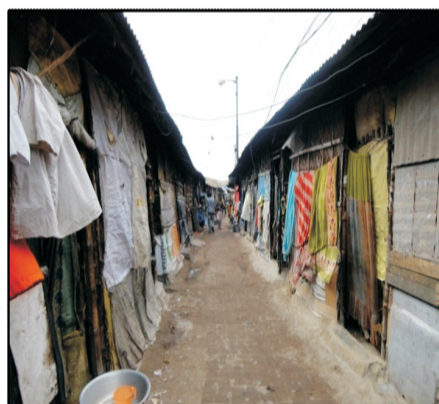


Figure 3 Housing Type in Slum Area

ASSESSMENT OF INDOOR ENVIRONMENTAL CONDITION

Indoor air is condition depends on the presence or absence of air pollutants in buildings. There are many different types of air pollutants that can severally damage indoor environment, and they come from various sources. Three most important elements that determine the indoor air people breathe when they are inside are,

1. Adequate ventilation air,
2. Airborne contaminants
3. Indoor air temperature and relative humidity

Most of the people spend a minimum of 12 hours per day inside the home and workplace, and the most vulnerable members of society i.e., infants, the elderly and those with chronic diseases spend 90

percent or more of their time indoors. Indoor environmental quality encompasses the quality of all comfort and health factors in the interior environment.

Indoor environmental condition whether or not contaminated can be understood while people of the building experiences headaches, itchy, watery or burning eyes, feelings of confusion or dizziness, breathing difficulties, nasal congestion, dry, sore throat and/or drowsiness

Place of cooking

It is observed that cooking location is another manifestation of economic wealth of the households. Cooking of food in the sleeping room increases air temperature and while beyond the tolerable limit badly damage indoor ambience and causes various health problems mainly to infants. Table 3 reveals an empirical observation of the location of cooking place in the sample households of slum and non-slum area.

Table 3
Percentage of sampled households with or without separate kitchen for cooking, Kolkata, 2012

Income group	Total (in %)		Slum (in %)		Non-slum Area (in %)	
	With	Without	With	Without	With	Without
Very low	24.42	75.58	23.88	76.12	26.32	73.68
Low	27.69	72.30	25.92	74.08	28.94	71.05
Medium	83.33	16.66	66.66	33.33	88.89	11.11
High	100	0	0	0	100	0
Very high	100	0	0	0	100	0

Source: Primary survey, 2012

In the sample study area 23.88 percent of very low income slum household do have separate kitchen however 76.12 percent do not have it. Very low monthly per capita income affect in non-having separate kitchen among non-slum households too (Table 3). In the high and very high income group 100 percent households do have separate kitchen. It can be inferred that income level is the factor of having or not having the separate kitchen within the households.

Ventilation facility in the house

Ventilation involves introducing exterior air into the interior space while exhausting stale interior air to the outside. A variety of common strategies and technologies can be used, including operable windows and exhaust fans. The purpose of ventilating interior spaces is to introduce targeted amounts of outside air to dilute or reduce contaminants that cannot be controlled at the source and to remove used or contaminated air from the space. Higher level of fresh air, which enhances human well-being and comfort and contributes to increased productivity, are often targeted in sustainable projects.

Proper ventilation system in the house determines the indoor environmental condition directly. Proper ventilation is the way to control indoor environmental quality (Cochet et al. 2002).

Table 4 reveals very poor ventilation facility in the households of very low income group. More than 88 percent of the households of the very low income group do not have ventilation facility in their house. Household ventilation facility has been observed to be better in the economically better off households since more than 92 percent and 100 percent households of the high and very high income groups respectively are having ventilation facility in their house that can maintain the indoor environment. However, the scenario is quite different over slum and non-slum area as 3.46 per cent of very low income slum households do have ventilation facility while of the same income group 26.31 percent non-slum households do have the same. It can be extracted from the empirical observation that economically well-off households are capable of maintaining the indoor environmental quality.

Table 4
Percentage of sampled households with or without ventilation facility in the room, Kolkata, 2012

Income group	Total (in %)		Slum(in %)		Non-slum area (in %)	
	With	Without	With	Without	With	Without
Very low	11.62	88.38	3.46	96.54	26.31	73.68
Low	20	80	7.81	92.19	23.68	76.31
Medium	41.66	58.33	13.33	86.66	44.44	55.55
High	92.30	7.69	0	0	92.3	7.69
Very high	100	0	0	0	100	0

Source: Primary survey, 2012

Shortage of living space within the house

Population density within the house poses a serious crisis in maintaining healthier indoor environmental condition. Shortage of living space is more acute in the slum area than in the non-slum area. It is observed that only 8.95 percent slum households of very low income group have recorded household-population density less than 2 persons per 100 sq. feet of floor while this figure is quite different in the non-slum area (Table 5). An insight into the figure will reveal higher crowdie slum households than the non-slum households while the figure is quite different over different income group of households. Here is again a manifestation of income factor in household population density is observed.

Table 5
Population density within household, Kolkata, 2012

Income group	Average density (person per 100 sq feet of house floor)		Percentage of households with average household density (person per 100 sq. feet of house floor)					
			< 2 person		3-5 persons		> 5 person	
	Slum	Non-slum	Slum	Non-slum	Slum	Non-slum	Slum	Non-slum
Very low	5	3	8.95	52.63	65.67	31.57	25.37	15.78
Low	4	3	14.81	47.36	74.07	47.36	11.11	5.26
Medium	3	2	33.33	72.22	66.66	22.22	0	5.55
High	0	1	0	100	0	0	0	0
Very high	0	1	0	100	0	0	0	0

Source: Primary survey, 2011
Shortage of bed room

The average persons per room denote the relation between the floor area of the house and the family member living in the households.

Further a severe problem of shortage of bed room for sleeping in the house is observed from the present investigation which is witnessed in the Table 6. Shortage of living room is more severe problem among the lower income households, however high and very high income households witnessing quite better in this regard (Table 6). Again, slum households are more sufferer of shortage of living room. More than 49 percent and 51 percent of slum households of very low and low income groups respectively have recorded 4 to 5 persons per room for living. Though no one slum household has been accounted from very high income group, 100 percent of non-slum households of this income category have witnessed 1 person for one bed room.

Table 6
Person per room in sampled household, Kolkata, 2012

Income group	Average person per room	1 person per room		2-3 persons per room		4-5 persons per room		> 5 persons per room	
		Slum	Non-slum	Slum	Non-slum	Slum	Non-slum	Slum	Non-slum
Very low	4	0	0	23.88	26.31	49.25	57.89	26.86	15.78
Low	3	0	0	37.03	50	51.85	31.57	11.11	18.42
Medium	2	0	16.66	66.66	50	33.33	27.77	0	5.55
High	1	0	84.61	0	15.38	0	0	0	0
Very high	1	0	100	0	0	0	0	0	0

Source: Primary survey, 2012

Fuel use for cooking

In the study area people uses mainly three types of fuel such as coal, kerosene and gas, for cooking purpose. The study reveals a clear cut transition of fuel use over different income group-wise households. Half of the World's population and more than 95 percent population of poor countries use solid fuels (Duflo, et al. 2008). Economic status is observed as determining factor of type of fuels used for cooking purposes. Biomass fuels are commonly used by mostly poor people (Baldwin, 1986 and Leach, 1992).

It is observed that household income is a factor of use of unhealthy fuel for cooking purposes. Majority of the households of very low (59.30 percent) and low income (66.15 percent) groups uses kerosene however very few of them use gas (Table 7). Since higher income allows household to afford for the use of gas, more than 92 percent and 100 percent households of high and very high income group uses gas for cooking (Table 7). Use of kerosene for cooking releases carbon (C) and carbon monoxide (Co) which severally damage and pollute the indoor environment, mostly observed in the very low and low income group households.

Table 7
Percentage of Sampled households using different types of fuel, Kolkata, 2012

Income Group	Total			Slum (in %)			Non-slum (in %)		
	Coal	Kerosene	Gas	Coal	Kerosene	Gas	Coal	Kerosene	Gas
Very low	26.74	59.30	13.95	32.83	56.71	10.44	5.26	68.42	26.32
Low	13.84	66.15	20	25.92	66.66	7.40	5.26	65.78	28.95
Medium	8.33	45.83	45.83	16.66	66.66	16.66	5.5	38.89	55.55
High	0	7.69	92.36	0	0	0	0	7.69	92.36
Very high	0	0	100	0	0	0	0	0	100

Source: Primary survey, 2012

A little variation of fuel use has been observed among slum households of different income groups. Majority of households of all three income groups (i.e., very low, low and medium and no one slum household is recorded in high and very high groups) are reportedly use kerosene, however a very meagre portion of them use gas for cooking (Table 7). 32.83 percent and 25.92 percent slum households of very low and low income group respectively are not a little fraction that uses coal of which burning smoke is unhealthy for human for cooking, however a very little fraction of non-slum households (5.26% of each) of corresponding low income group uses it (Table 7).

A remarkable disparity in the use of cooking fuel is observed among the non-slum (general) households over different income groups which reflect, again the reason of economic variations over the sample households. More than 68 percent and 65 percent non-slum resident households of very low and low income group uses kerosene respectively, that of only 26.32 percent and 28.95 percent households can afford for gas. A reverse scene is observed among higher income group of non-slum resident households, i.e., more than 92 percent of high income and 100 percent of very high income households uses gas for cooking (Table 7). No one of high and very high income households use coal for cooking.

Study reveals, higher income non-slum resident households are quite non-vulnerable to eye itching problem associated with the burning of coal, though a little proportion of lower income households are vulnerable to it. However, a sizeable portion of slum resident households are likely to be in danger of attacked by diseases associated with burning smoke of coal (Table 7).



Figure 4 Cooking with bio-fuel inside the house in slum area



Figure 5 Use of gas for cooking inside the house in non-slum area

Mode of Storage of household wastes

Dumping or storing of solid wastes inside the house premises can severally damage the healthy indoor environment.

Majority of sample households of each very low, low and medium income group, use to store domestic wastes in closed containers within the house. Proportion of households that dump their domestic wastes in open container is more among slum resident households than that of non-slum resident households.

Table 8
Household using mode of storage of waste materials within household,
Kolkata, 2012

Income group	Total		Slum (in %)		Non-slum (in %)	
	In open container	In closed container	In open container	In closed container	In open container	In closed container
Very low	41.86	58.14	35.82	64.18	36.85	63.15
Low	59.54	60.46	44.44	55.56	26.32	73.68
Medium	25	75	33.33	66.66	22.23	77.77
High	0	100	0	0	0	100
Very high	0	100	0	0	0	100

Source: Primary survey, 2012

Water logging surrounds the house premises

It is worthy to assess the household's surrounding environmental condition as it also significantly influence indoor environmental condition and human health. Water logging surrounding the house is one of the important determinants of indoor environment quality and occurrence of human diseases.

Diarrhea is defined by the World Health Organization as having three or more loose or liquid stools per day, or as having more stools than is normal for that person (WHO, 2009). It is a common cause of death in developing countries and the second most common cause of infant death worldwide. The loss of fluids through diarrhea can cause dehydration and electrolyte disturbances such as potassium deficiency or other salt imbalances. Contaminated food and water are common causes of diarrhoea. Water logging contaminated water, which indirectly spread diarrhea. Typhoid fever is spread by the ingestion of the bacteria in contaminated food or water. Consumption of unsafe drinking water and inadequate sanitary conditions also contribute in increasing rate of typhoid fever (Shah, 2003). Water logging make water contaminated and unsafe for drinking purpose, so typhoid is increased with the increased of water logging. Malaria is a mosquito-borne infectious disease of humans and other animals caused by parasitic protozoans (a type of unicellular microorganism) of the genus Plasmodium. Commonly, the disease is transmitted via a bite from an infected female Anopheles mosquito, which introduces the organisms from its saliva into the person's circulatory system. In the blood, the protists travel to the liver to mature and reproduce. Malaria causes symptoms that typically include fever and headache, which in severe cases can progress to coma or death (wikipedia). Usually in logged water Anopheles mosquito's breeding capacity is higher which indirectly spread malaria over the area.

Table 9
Household facing water logging problem around the house premises,
Kolkata, 2012

Income group	Slum (in %)		Non-slum (in %)	
	Exist	Do not exist	Exist	Do not exist
Very low	94.73	5.27	17.91	82.09
Low	84.21	15.78	29.62	70.37
Medium	79.22	20.78	33.33	66.66
High	0	0	0	100
Very high	0	0	0	100

Source: Primary survey, 2012

Table 9 reveals that in slum area irrespective of economic layer most of the households are vulnerable to diseases like typhoid, malaria, diarrhoea etc. associated with water logging (Table 9). It is observed in the empirical study that, those are economically affluent, could have develop the land

surrounding their housing premises so that water can drain into lower areas. In the non-slum area, economic factor is manifested in the percentage of non-slum households that do face the problem of water logging surround the houses (Table 9). Table 9 reveals that 100 percent of sampled non-slum households are free from the problem of water logging around their house premises.

Bathroom and toilet facility

Bathroom and toilet is another important determinant of indoor environmental quality. The empirical observation further explains household economic condition is determining factor of availability and quality of bathroom and toilet facility within house premises. On an average, 100 percent of sampled households of both high and very high income groups are having bathroom facility within their house, however only 11.62 percent of very low income group households don't have the same (Table 10).

A terrible condition due to prevalence of poor economic condition has been observed in the slum area in respect to in-house bathroom facility. Table 10 reveals that, no household of very low income group do possess bathroom facility within the house premises leading the people of these households to depend on small-open public water body where they take bath together with domestic animals like pigs, goats, cats and dogs. Only 33.33 percent of medium income group households are having in-house bathroom facility in the study area.

Table 10
Households having bathroom within house, Kolkata, 2012

Income group	Total		Slum (in %)		Non-slum (in %)	
	Have	Have not	Have	Have not	Have	Have not
Very low	11.62	88.38	0	100	52.63	47.36
Low	35.38	64.62	22.22	77.77	44.73	55.26
Medium	54.16	45.84	33.33	66.66	61.11	38.88
High	100	0	0	0	100	0
Very high	100	0	0	0	100	0

Source: Primary survey, 2012

In-house bath room facility is quite better in the non-slum residency more than 52 percent of very low income households do have their bathroom within house premises however cent percent high and very high income households enjoys with in-house bathroom facility (Table 10), since they are economically affluent and can afford for having it.

Table 11
Households having toilet within house premises, Kolkata, 2012

Income group	Total		Slum(In %)		Non-slum(In %)	
	Have	Have not	Have	Have not	Have	Have not
Very low	5.81	94.18	0	100	26.31	73.68
Low	13.84	86.16	3.70	96.29	21.05	78.94
Medium	25	75	16.66	83.33	27.78	72.22
High	100	0	0	0	100	0
Very high	100	0	0	0	100	0

Source: Primary survey, 2012

Same and similar disparity is observed among the households of different income level in possessing of toilet facility (Table 11).

It is noticed that like poor condition of bathroom facility, status of toilet facility within the house premises is observed in slum area. In very low income slum households toilet facility is observed completely absent and the people of these households use open defecation for the purpose. However, only 3.7 percent and 16.66 percent sampled slum households of low and medium income group respectively possess toilet within their house (Table 11).



Figure 6 Standard among the poor toilet in slum area



Figure 7 Slum people are waiting for municipal water

Though very little percentage of non-slum households of very low, low and medium income groups do have in-house toilet facility, cent percent non-slum households of high and very high income group do have it (Table 11).

Indoor Smoking

Indoor smoking badly damages the calm, quite and tranquil indoor environmental quality leading to the occurrence of different health problems. But the status of health hazardous indoor smoking has been empirically observed in two different nature of human habitats i.e., slum and non-slum area.

**Table 12
Households facing problem of indoor smoking, Kolkata, 2012**

Income group	Total (in %)		Slum (in %)		Non-slum (in %)	
	Facing	Not facing	Facing	Not facing	Facing	Not facing
Very low	77.90	22.10	83.58	16.41	57.89	42.1
Low	64.61	35.39	70.37	29.63	60.52	39.47
Medium	41.66	58.33	33.33	66.66	44.44	55.55
High	39	61	0	0	39	61
Very high	20	80	0	0	20	80

Source: Primary survey, 2012

Table 12 reveals, very low income group of slum households that are experiencing indoor smoking accounts for 83.58 percent that 57.89 percent in non-slum residency. It is observed from the following table (Table 12) that economically poor households are facing indoor smoking problem more than the higher income households in both slum and non-slum area.

Ventilation of Indoor Smoke

The smoke which is inside the house at cooking time, smoking or the outside smoke coming inside the house has to go out. The smoke in moving and circulating within the house is a risk factor to many

human diseases like respiratory disease, heart disease, etc.. Ventilations, windows and doors are the three ways by which the indoor smoke can go out of the house, which are absent in most of the slum households of low and very low income groups, in Kolkata.

Table 13 further witnesses the circumstance of exit capacity of indoor smoke consequent upon the level of household economic status.

Table 13
Percentage of sampled households with exit capacity of smoke,
Kolkata, 2012

Income group	Total		Slum (In %)		Non-slum (In %)	
	Goes through ventilation	Remain inside	Goes through ventilation	Remain inside	Goes through ventilation	Remain inside
Very low	77.90	22.10	11.95	88.05	42	58
Low	52.30	47.70	37.04	62.96	44.65	55.35
Medium	62.50	37.5	33.33	66.66	62	38
High	100	0	0	0	100	0
Very high	100	0	0	0	100	0

Source: Primary survey, 2012

Majority of the slum houses are suffering from the acute problem of indoor smoke which remain inside the house, though the scenario is quite better among higher income slum households. More than 88 percent of very low income slum households are suffering from the problem of indoor smoke circulated inside the house, however it is observed 58 percent in the non-slum residency (Table 13). Surprisingly, 100 percent of both high and very high income non-slum households, due to having good ventilation experiences efficient exit of indoor smoke (Table 13).

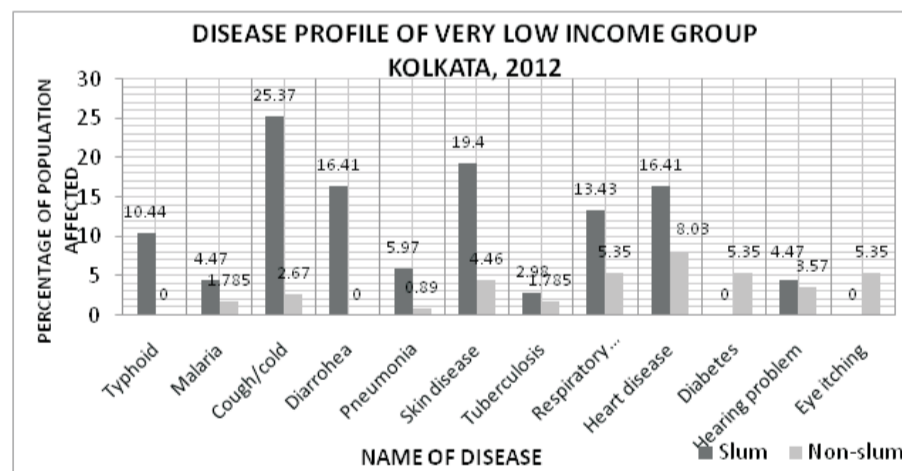
Disease Profile

It is observed from the analysis that all types of diseases are reportedly more prevalent in slum households than in non-slum households irrespective of income group. Cough/cold, diarrhoea, pneumonia, skin disease, respiratory illness and heart diseases are prominent in very low income group of slum population. In low income group cold, pneumonia and respiratory illness are more common. Heart diseases, diabetes and eye itching are common among the low income households in non-slum are

Table 14
Percentage of sample households reportedly suffering from frequent occurrence of health problems in family members, Kolkata, 2012

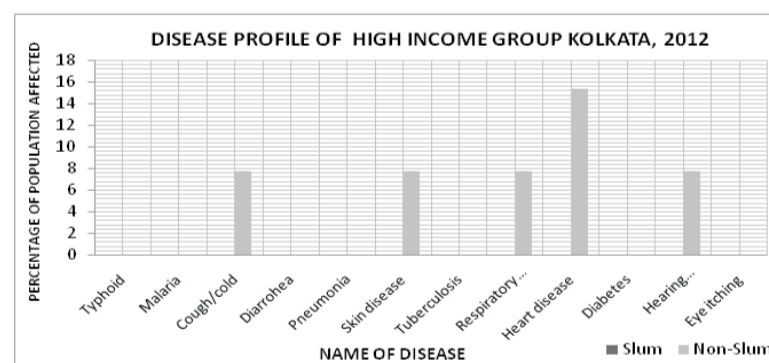
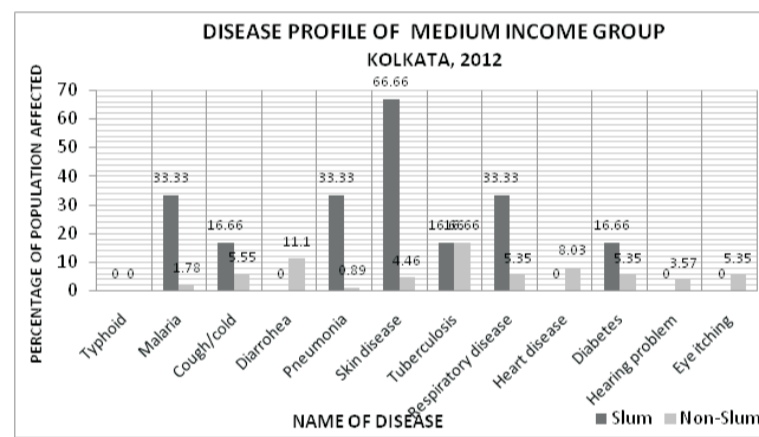
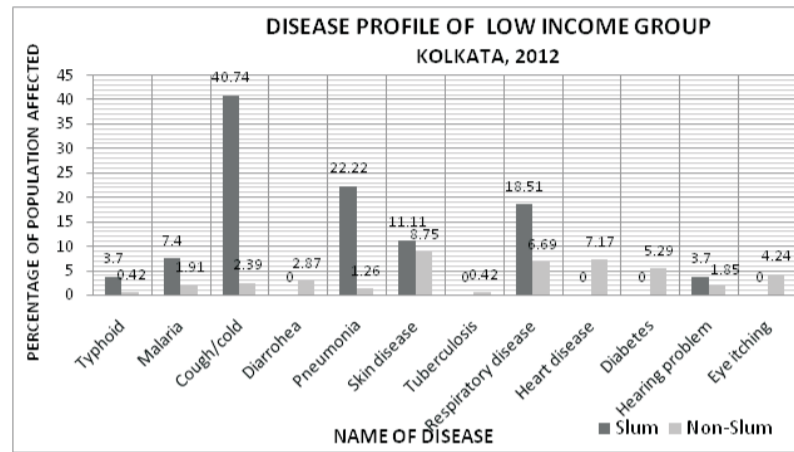
Very low income group			Low income group		
Type of Diseases	Slum	Non-slum	Type of Diseases	Slum	Non-slum
Typhoid	10.44	0	Typhoid	3.70	0.42
Malaria	4.47	1.785	Malaria	7.40	1.91
Cold	25.37	2.67	Cold	40.74	2.39
Diarrhoea	16.41	0	Diarrhoea	0	2.87
Pneumonia	5.97	0.89	Pneumonia	22.22	1.26
Skin disease	19.40	4.46	Skin disease	11.11	8.75
Tuberculosis	2.98	1.785	Tuberculosis	0	0.42
Respiratory illness	13.43	5.35	Respiratory illness	18.51	6.69
Heart disease	16.41	8.03	Heart disease	0	7.17
Diabetes	0	5.35	Diabetes	0	5.29
Hearing problem	4.47	3.57	Hearing problem	3.70	1.855
Eye itching	0	5.35	Eye itching	0	4.24

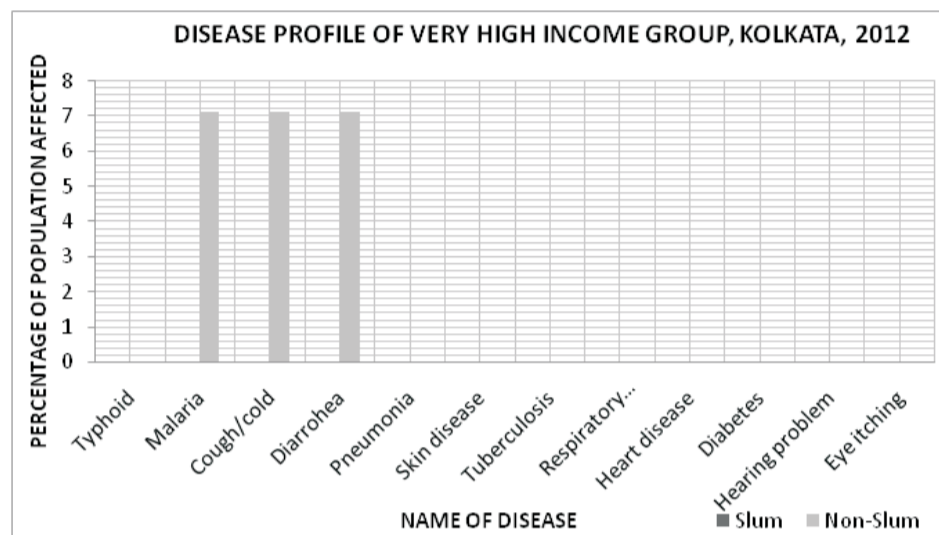
Medium Income Group			High Income Group		
Type of Diseases	Slum	Muslim	Type of Diseases	Slum	Non-slum
Typhoid	0	0	Typhoid	0	0
Malaria	33.33	1.78	Malaria	0	0
Cold	16.66	5.55	Cold	0	7.69
Diarrohea	0	11.10	Diarrohea	0	0
Pneumonia	33.33	0.89	Pneumonia	0	0
Skin disease	66.66	4.46	Skin disease	0	7.69
Tuberculosis	16.66	16.66	Tuberculosis	0	0
Respiratory illness	33.33	5.35	Respiratory illness	0	7.69
Heart disease	0	8.03	Heart disease	0	15.38
Diabetes	16.66	5.35	Diabetes	0	0
Hearing problem	0	3.57	Hearing problem	0	7.69
Eye itching	0	5.35	Eye itching	0	0
Very high Income Group					
Type of Diseases	Slum	Non-slum			
Typhoid	0	0			
Malaria	0	7.14			
Cold	0	7.14			
Diarrohea	0	7.14			
Pneumonia	0	0			
Skin disease	0	0			
Tuberculosis	0	0			
Respiratory illness	0	0			
Heart disease	0	0			
Diabetes	0	0			
Hearing problem	0	0			
Eye itching	0	0			



Source: Table 14

Fig. 8





Source: Table 14

Fig. 12

Table 14 reveals that frequency of diseases varies over income groups. Among very low income group households with monthly per capita income less than Rs.1500, more than 19 percent slum households are reportedly suffering from skin problem, that of more than 16 percent from heart diseases, more than 13 percent from respiratory diseases and very few suffer other health problems, however only 8.03 percent non-slum households have been reported to suffer from heart diseases and 5.35 percent non-slum households have reported to suffer respiratory diseases.

Again people of low income group are most vulnerable to different diseases associated with indoor unhealthy environment. Among low income group slum households, about 41 percent have reported some of their family members suffer cough and cold problem, that of pneumonia 22.22 percent and respiratory disease 18.51 percent. However, of the same income group only 8.75 percent non-slum households are suffering from skin diseases and 7.15 percent from heart diseases.

Slum households of medium income group are equally more vulnerable to the diseases associated with indoor air pollution than non-slum households. Near about 67 percent of slum households experience skin problem, while 33.33 percent each of malaria, pneumonia and respiratory diseases. Of the same income group 16.66 percent of non-slum households experience tuberculosis problem, diarrhoea 11.10 percent, heart diseases 8.03 percent.

Since no sample slum household have found in high or very high income group, the present section deals with explaining the disease profile of non-slum households without comparing it with former. Among high income group, 15.38 percent non-slum households are reportedly suffering from heart diseases, 7.79 percent from each cough, skin disease and hearing problem. Surprisingly households of very high income group do not experience any selected diseases except 7.14 percent households experience malaria, cough and diarrhoea each, because they can afford for maintaining the indoor ambience and are aware of unhealthy environment and associated diseases.

SUMMARY AND CONCLUSION

It comes to conclude that from the foregoing analysis is that income level is main causative factor of maintaining indoor environment. A close relationship between income, household indoor environment and risk factors with varying degree has been examined in both slum and non-slum area. The household environment i.e. housing bathroom and sanitation conditions, household water supply, drainage of water, garbage and solid waste, shortage of living space have greatest and most immediate influence on the human life. Per capita household income is found in the analysis a *raison d'être*. With the decrease of monthly per

capita income of household environmental conditions becoming unhealthier leading to frequent appearance of various health problems like, diarrhoea, respiratory disease, and cold/cough. From the analysis it has come to be true that, slum dwellers of all level of income are under the threat of indoor environment born diseases. Therefore, slum households can be taken as target group and slum area in particular as target area for the planning of better and sustainable indoor environment.

Increased attention to indoor environmental quality will provide a number of benefits to occupants. The health and well-being of occupants improves as colds and infectious diseases spread less widely. Most vulnerable people who spend the most time indoors must be protected from hazard.

REFERENCES

1. Agarwal, K.C., (2001), Environmental pollution –causes, Effects and Controls, Nidhi Publisher (India), Bikaner, p.5
2. Baldwin, S. (1986), Biomass Stoves: Engineering Design, Development and Dissemination, VITA and PU/CEES Report No. 224, Arlington, VA and Princeton, NJ
3. Bhide, A.D. et.al. (1972), Quantity and Quality of refuse from Kolkata city, Indian Journal of Environment and Health, Vol 14, pp, 80-87.
4. Census of India, (1991), Ministry of Home Affairs, Government of India, New Delhi.
5. Census of India, (2011), Ministry of Home Affairs, Government of India, New Delhi.
6. Cochet C, Nibel S, Nagy L 2002, Integration of occupational health criteria in the design and assessment of sustainable buildings – application to indoor air. Proceedings: Indoor Air 2002, Monterey, California, pp. 936-941
7. Duflo, E., Greenstone, M. and Hanna, R., (2008), Indoor air pollution, health and economic well being, Mimeo, MIT, Cambridge, pp. 1-22.
8. Hodgson M.J., Oleson B. and Fountain M. (1997) Environmental Acceptability in an Environmental Field Study. in: Healthy Buildings/IAQ '97 Vol. 1, pp.195-200
9. Leach, G., (1992), The Energy Translation, Energy Policy, 20 (2), pp.116-123
10. US EPA, (2000) Healthy Buildings, Healthy People: A Vision for the 21st Century, Draft Report. Office of Air and Radiation
11. Wolkoff . P., (1995), Volatile organic compounds – sources, measurements, emissions and the impact on indoor air quality, Indoor Air (Suppl. 3). pp. 1-73.
12. World Health Organisation (2000a) WHO/ECEH Air Quality and Health, A Summary Report for the Years 1996-2000, WHO Newsletter No. 26
13. World Health Organisation (2000b), The Right to Healthy Indoor Air. Report on a WHO Meeting, Bilthoven, The Netherlands, European HEALTH 21 targets 10, 13.
14. Shah, S. M., et al (2003), Prevalence and correlates of diarrhea, Indian Journal of Pediatrics, Vol. 70, pp. 207-211, (Retrieved from www.ncbi.nlm.nih.gov/pubmed/12785290 on 22/08/2013)
15. World Health Organization (2006), Typhoid vaccine (Initiative for Vaccine Research), Geneva, (Retrieved from http://www.who.int/vaccine_research/diseases/diarrhoeal/en/index7.html on 21/08/2013)

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