
**A QUALITATIVE ANALYSIS ON THE CAUSES
AND CONSEQUENCES OF INDOOR AIR
POLLUTION IN THE SLUM AREAS OF
CHITTAGONG**

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ACKNOWLEDGMENTS

This project was funded by Asian University for Women and we want to express our gratitude to the University authority. We also want to thank Professor Mukesh Gupta who has supervised us throughout the project providing us with his valuable guidance and suggestions.

ABSTRACT

While air pollution has been a matter of scrupulous concern because of its irreparable drawbacks, indoor air pollution is often disregarded as harmful as outdoor air pollution. As a result of the detrimental impacts of indoor air pollution, people, especially residents of poorer households, staying at home for a substantial amount of time are exposed to toxic reagents (for example- carbon dioxide and carbon monoxide) that exacerbates their health problems. The idea of this research is to assess Indoor Air Quality (IAQ) in the slum areas of Chittagong, Bangladesh, and highlight distinct problems faced by the residents of those residences, relating to indoor air pollution. The field research is conducted in the households of four slums areas of Chittagong which are socially and culturally diverse in background and have various practices of household maintenance such as cooking practices with solid fuels, biomass, electricity, LPG, charcoal etc. Other practices include use of insect repellent, improper waste management and ventilation system. Findings of this study provoked emergence of several health issues and degraded standard of living, pertinent to the sources and consequences of indoor air pollution there. Interviews of the members of those households in the slums based on survey questionnaire have included the quotidian issues that they combat pertaining to indoor air pollution.

Keywords: Indoor Air Quality (IAQ), Indoor Air Pollution, LPG (Liquefied Petroleum Gas), Survey Questionnaire

INTRODUCTION

Air pollution has found its way inside the houses of people via different means. According to World Bank (2014), nearly 3 billion of the world's poorest still rely on solid fuels (wood, animal dung, charcoal, crop wastes and coal) burned in inefficient and highly polluting stoves for cooking and heating. This is likely to be the largest origin of indoor air pollution.

Incessant exposure to the smokes released while cooking or using smoke-releasing materials (mosquito coil and cigarettes) give rise to indoor air pollution. The term indoor air pollution (IAP) focuses specifically on the pollution initiated in domestic household. OECD (2015) refers indoor air pollution to chemical, biological and physical contamination of indoor air. The incidence of IAP is high in poverty-stricken area, particularly slums. This issue is inextricably linked to poverty (Bruce et al., 2006). The poor have to utilize fossil fuels and inefficient stoves. The health and economic condition of the households attribute in keeping the people in poverty thus acting as an impediment in having a fruitful transition. Households generally ascend the energy ladder once their socioeconomic conditions improve (Bruce et al., 2006). They use fuels and appliances that are more efficient, clean, and convenient but more expensive as well (Bruce et al., 2006). Women and children in the slums are primarily affected as they stay longer in the house. In houses with restricted ventilation (conventional in developing countries), exposures experienced by household members, particularly women and young children who spend a large proportion of their time indoors, have been measured to be many times higher than World Health Organization (WHO) guidelines and national standards (Bruce et al., 2006).

According to Smith (1987), smoke released from coal and biomass emit various health-impairing pollutants including particulate matter (PM), carbon monoxide (CO), sulfur oxides, nitrogen oxides, aldehydes, benzene, and polyaromatic compounds . These pollutants mainly affect the lungs by causing inflammation, reduced ciliary clearance, and impaired immune response (Bruce et al., 2000). Vrijheid et al. (2012) confirms that air pollution may impair neurodevelopment. The presence of a gas cooker at home during pregnancy is associated with slower mental development (Vrijheid et al., 2012). A smaller number of studies have found that indoor air pollution from biomass fuels (IAP) and passive smoking are also risk factors for TB and its sequelae (Lin et al., 2007). There is consistent evidence that the susceptibility of chronic obstructive pulmonary disease and acute respiratory infections in childhood elevates due to indoor air pollution (Bruce et al. 2000). Bruce et al. (2000) states that due to modernization, there has been as a switch from biomass fuels to petroleum products and electricity. As a result, the ubiquity of all the above mentioned risk factors of indoor air pollution has made it a common phenomenon in the slum households.

METHODOLOGY

Our first step during this research was to identify the reasons and consequences of indoor air pollution from previous researches. We accumulated all the information and narrowed down to the main reasons why indoor air pollution is so prevalent, especially in slums. Subsequently, we configured a questionnaire which included all the necessary questions required to understand the situation of the households in terms of indoor air pollution. The questionnaire included personal information about the interviewee like jobs, salary, age, period of stay in the area, physical problems and daily habits. It also included questions about the structure and condition of the house and the materials used to build walls, roof and floor. Choosing the sample area was our next step. Since this was a qualitative research, we used a sample size of four slums and interviewed five households from each of them. The four slums, we chose for our survey are Chittagong Railway Slum, Khejurtola Slum, Taktar Pole Slum and Lalkhan Bazar Slum. The slums varied highly in terms of geographical location, diversity of people, and facilities received by the slum dwellers. With the permission of the interviewees, we took records of their personal information including the financial condition of the families and health-related problems they have been facing. Later on, we sorted the data from the survey and did a qualitative analysis of the information found from the survey in the above mentioned four slums.

RESULTS

Major findings from the survey have been added below to illustrate the common scenario of Indoor Air Pollution in the slums of Chittagong and to find out linkages between the exposure and consequences of Indoor Air Pollution in the slum households of Chittagong.

According to previous discussions, exposure of Indoor Air Pollution is influenced by cooking practices, ventilation system, usage of insect repellents and some other practices and is thought to be responsible for several health problems, lower standard of living and some other problems. So, the necessary data derived from each of the slums we visited for interviewing people has been mentioned in the table separately and discussed thoroughly.

Table 1: Information Collected from Railway Slum

Parameters	Household 1	Household 2	Household 3	Household 4	Household 5
Number of Members	4	5	2	4	3

Cooking Practice	Gas Stove (Natural Gas)	Gas Stove (Natural Gas)	Gas Stove (Natural Gas)	Gas Stove (Natural Gas)	Gas Stove (Natural Gas)
Ventilation	Bad	Very Bad	Not Good Not Bad	Bad	Very Bad
Insect Repellents	Mosquito Coil/Net	Aerosol	Mosquito Net	Mosquito Coil	Mosquito Net
Number of Smokers	0	0	1	0	0
Major Health Issues	Skin Disease	Diabetes, Pneumonia	Coughs	High Blood Pressure	Allergy
Living Standard Measure	Extremely Poor	Poor	Middle-Cla ss	Poor	Poor

Table 2: Information Collected from Khejurtola Slum

Parameters	Household 1	Household 2	Household 3	Household 4	Household 5
Number of Members	3	1	2	4	4
Cooking Practice	Gas Stove (with LPG)	Gas Stove (with LPG)	Mud Stove (with Straw)	Mud Stove (with Straw)	Mud Stove (with Straw)
Ventilation	Not Good Not Bad	Bad	Not Good Not Bad	Very Bad	Not Good Not Bad
Insect Repellents	Mosquito Net	Mosquito Net	Mosquito Coil	Mosquito Coil	Mosquito Coil
Number of Smokers	0	1	0	1	1
Major Health Issues	Skin Disease	Skin Disease	Ear Problem	Respiratory Diseases	Coughs, Continuous Fever
Living Standard Measure	Extremely Poor	Poor	Poor	Extremely Poor	Extremely Poor

Table 3: Information Collected from Taktar Pole Slum

Parameters	Household 1	Household 2	Household 3	Household 4	Household 5
Number of Members	6	4	2	3	4
Cooking Practice	Mud Stove (with Straw and Wood)	Gas Stove (with Natural Gas)	Gas Stove (Natural Gas)	Gas Stove (with Natural Gas)	Mud Stove (with Straw and Wood)
Ventilation	Not Good Not Bad	Bad	Very Bad	Bad	Bad
Insect Repellents	Mosquito Net	Mosquito Net	Mosquito Coil	Mosquito Net, Mosquito Coil	Mosquito Coil, Mosquito Net
Number of Smokers	1	0	1	0	0
Major Health Issues	Body Pain, Coughs	Anemia, Skin Disease	Hormonal Problem & Skin Disease	Body Pain	Asthma, High Blood Pressure

Living Standard Measure	Extremely Poor	Poor	Poor	Poor	Extremely Poor
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Table 4: Information Collected from Lalkhan Bazar Slum

Parameters	Household 1	Household 2	Household 3	Household 4	Household 5
Number of Members	3	4	4	4	4
Cooking Practice	Mud Stove (with Straw)	Mud Stove (with Straw)	Gas Stove (Natural Gas)	Gas Stove (Natural Gas)	Gas Stove (with Natural Gas)
Ventilation	Bad	Very Bad	Not Good Not Bad	Not Good Not Bad	Bad
Insect Repellents	Mosquito Coil, Mosquito Net	Mosquito Net, Mosquito Coil	Mosquito Net	Mosquito Net	Mosquito Coil
Number of Smokers	1	1	2	1	1
Major Health Issues	N/A	Eye Problem, Skin Disease	High Blood Pressure	High Blood Pressure, Diabetes	Respiratory Diseases
Living Standard Measure	Poor	Poor	Middle-Class	Poor	Poor

DISCUSSIONS

It is found from our survey that Indoor Air Quality (IAQ) varies a lot in households of different income and different areas. Some other practices such as cooking practice, tobacco smoke exposure, ventilation system, use of insect repellents and so on also keep an impact in this issue.

Firstly, cooking practice of a household often plays a vital role in maintaining Indoor Air Quality (IAQ) of the households. Traynor et al. (1987) found out that wood burning stoves are responsible for increasing concentration of Carbon Monoxide, Nitrogen Oxides, Formaldehyde, Total Suspended Particles, Submicron Suspended Particles and so many other toxic chemicals. On the other hand, gas stoves are one of the major sources of nitrogen dioxide (NO₂), Organic Carbon Compounds and some other hazardous gases as it burns carbon compounds and nitrogen compounds (Gauderman et al., 2000). Therefore, judging several evidence of experts' researches, it is quite clear that using fuel based stoves is responsible for indoor air pollution and when the certain household is situated in a congested and crowded area just like the slums of Chittagong it is quite tough to maintain good air quality in the households, as the pollutants released from the stoves directly enter into the

household. So, connecting with our field research, cooking practice is responsible for indoor air pollution in the slums of Chittagong.

Secondly, tobacco smoke exposure is another inhibitor of Indoor Air Pollution. Mueller et al. (2011) pointed out that tobacco smoke release some particles that degrade indoor air quality. If they aren't ventilated properly, they initiate the production of cancer cells gradually. It can also be proved right from our field research. We found out that in the slums, the smokers are discouraged by their family members to smoke inside the households, as it seems physically problematic for the family members. To explain it in the language of academicians, this type of discouragement is happening to keep themselves away from 'Passive Smoking'. As the hazardous gases released from tobacco affect the people staying around, keeping the indoor air free from such chemicals is quite important and so we have seen no smokers to smoke inside the households.

Then, scarcity of good ventilation system in the households of the slums of Chittagong is another reason that promotes indoor air pollution in the slum households. Researchers prioritized a household's ventilation rate for maintaining the household's IAQ. For a well-ventilated household,

$$C_{in} = C_{out} \quad (1)$$

Here,

C_{in} = Indoor Concentration

C_{out} = Outdoor Concentration

Q = Outdoor Air Ventilation Rate

S = Indoor Contaminant Source Strength

R = Rate of Removing Contaminant by Filtration, Air Cleaning and Other Mechanism

(Persily & Levin, 2011)

In a badly ventilated household, $S > R$ or, $S - R > 0$

As a result, $C_{in} - C_{out} > 0$

$$\text{or, } C_{in} > C_{out} \quad (2)$$

From Eq. (2), it is quite clear that if a household is not well-ventilated (when $S \gg R$), the concentration of the contaminants inside the household is higher than outside. And from our visit to the slums, we were surprised seeing that most of the slum household has no window, as the rooms are too small to make enough space for keeping one window. As a result, Indoor

Air Quality has a more chance of degrading faster than Outdoor Air Quality due to lack of air flow and due to not being well ventilated.

A final way of initiating indoor air pollution is frequent use of Insect Repellent and it is a common phenomenon in the slum dwellers which might cause huge degradation in the Indoor Air Quality (IAQ) of the slum households. Exposure of hazardous chemicals through mosquito repellents gradually affects the eyes, skin and other parts of the body (Khan & Saxena, 2012). And from our survey, we have also noticed that the white section of the eyes of the people who have more tendency to use chemical insect repellent is little yellow and some of them had to face many other respiratory or skin diseases. The slum dwellers who stay at home for more time duration have more possibilities to be affected by the detrimental effects of insect repellents.

For the consequences of indoor air pollution, our survey mainly focused on the impacts of indoor air pollution in the living standard of the slum dwellers and on their health.

To measure the living standard in the result section, we have followed World Bank's update on measuring poverty line (World Bank Group, 2014). According to the World Bank, international poverty line denotes a maximum income of 1.90\$ per day per person, where in lower middle income class poverty line is 3.20\$ per day per person and in upper middle income class poverty line is 5.50\$ per day per person (2014). So, this measurement was used to decide the living standard of the interviewed households. Here, in Table 1-4, the living standard of the members of the household was decided from the income of the family. If the average income per person is under 1.90\$ per day the household was treated as extremely poor; otherwise poor or rich. And such hierarchy based on income is a result of indoor air pollution in some cases, as an indoor air pollution affected household hardly has enough money to ensure a better lifestyle. Even if they have financial capacity, they have lack of environmental supports from surroundings. This is why, lower living standard is an indirect but dominant effect of indoor air pollution.

Apart from the effects of Indoor Air Pollution in the living standard of the family, another major effect of this is the health effects. As discussed in the introduction with brief literature review that health problems such as coughs, bronchitis, respiratory diseases, skin diseases etc. are often found due to prevalence of indoor air pollution. A case study from Kenya found higher prevalence of respiratory diseases in the congested households with low IAQ (Ezzati and Kammen, 2001). In fact, households of developing countries with lower income are more

exposed to contaminants and such contaminants cause higher frequency of respiratory diseases mixed with the air (Smith and Mehta, 2003; Pandey, Boleij, Smith and Wafula, 1989). Our survey in the four slums also proved that contaminated indoor air is weakening the immune system of the slum dwellers which gradually causes the exposure of several diseases. Other than that, from our interviewees, we came to know that the patients of diabetics and higher or lower blood pressure feel truly suffocating to stay home for a long time and they often need to go outside to breathe from comparatively fresher air. Therefore, even without considering a control or comparison, by connecting the literatures with our findings in terms of higher frequency of respiratory diseases and worsened immune system, we can say that health hazards are a serious consequence brought by indoor air pollution.

CONCLUSIONS

Indoor air pollution is a matter of huge concern for the slum dwellers of Chittagong because the slums are excessively populated and life standard of people is degrading very fast there. Degradation of Indoor Air Quality is initiated by several ways, as we have discussed and it is causing severe detrimental health effects lowering life standard. So, it is quite urgent to bring technological and scientific changes in the lives of the slum dwellers to fight successfully against indoor air pollution.

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