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ASSESSMENT OF INDOOR AIR QUALITY AT SELECTED SCHOOLS ALONG CUET TO BAHADDARHAT ROAD IN CHATTOGRAM

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ABSTRACT

Indoor air pollution has been a significant an health concern, especially for the children. Breathing clean air at Schools is essential for children's healthy development, but due to use of marker, air freshener, aerosol and vehicular emission from nearby roads, the indoor air quality of schools may be polluted. In this study, the indoor air quality of ten selected Schools along CUET to Bahaddarhat road in Chattogram was assessed from March 2019 to May 2019. A questionnaire survey was also conducted in study area for about 100 number of people mostly 60 students, 20 teachers & 20 guardians. The maximum average concentration of $PM_{2.5}$ and PM_{10} were found 81.1μg/m^3 and 313.1 μg/m^3 respectively at school in S4 locations. The minimum concentration of $PM_{2.5}$ was found in S7 locations (42.3μg/m^3) and that for PM_{10} was also found in S1 location (121.7μg/m^3). As the study is related to very short exposure and there is no standard for indoor air quality of Bangladesh, ambient air quality standards of Bangladesh was used for comparison. The average concentration of PM_{10} for all schools were exceeded threshold value of ambient air quality of Bangladesh. At the schools of S2, S4 & S6 location the mean concentrations of $PM_{2.5}$ were exceeded. This study also shows that the indoor $PM_{2.5}$ and PM_{10} concentration were higher at the schhols adjacent to roadside.

Keywords: *Indoor air quality, Children, PM2.5, PM10, Health.*

1. INTRODUCTION

Indoor Air Quality (IAQ) corresponds to the air quality, all across buildings and structures, particularly as it relates to the occupants ' health and convenience. Due to its adverse effects on human health, indoor air quality (IAQ) has been increasingly worried in latest years (Nagendra & Harika, 2010). Since most of the individuals spend 80 - 90% of their time indoors, excellent indoor air quality is very crucial to everyone (Arif, Katafygiotou, Mazroei, Kaushik, & Elsarrag, 2016). Outdoor air pollutants not only influence the environment, but also our health. Air quality in schools is of particular concern as kids are prone to poor air quality and issues with indoor air can be subtle and do not always have readily recognizable health and well-being effects (USEPA, 1996). Children seem to be more susceptible to the consequences of air pollution than older people because they breathe faster, their lungs are larger in direct proportion to their body size and are not fully formed so that pollutants can become more localized in their systems (Bennett, Zeman & Jarabek, 2008). In Bangladesh, the main education system is divided into three levels: Primary Level (Class 1–5); Secondary Level (6-10) or (9-12 at some schools). There is no middle school system in Bangladesh. Generally, both type of blackboard and whiteboard are used for demonstrating the lecture.

There is sustained proof that indoor air pollution expands the danger in developing nations of chronic obstructive pulmonary disease and acute respiratory diseases, particularly in kids under the age of five (Bruce, Perez-Padilla & Albalak, 2000). Indoor air pollution is liable for 2.7 percent of the global disease burden, according to the World Health Report 2002 (WHO, 2002). Failure to retard indoor air pollution may improve students and staff's chances of long-term and short-term health issues ; decrease teacher productivity; and degrade the teaching climate and convenience of the student (Ismail, Sofian, & Abdullah, 2010). The cause of indoor air pollution is a combinatory effect of physical, chemical and biological factors, and the adequacy of ventilation in the environment. Several researches on this subject over the years have demonstrated both qualitative and quantitative differences in IAQ, highlighting an rise in pollutants and their concentrations.

Research suggests that the Indoor Environmental Quality (IEQ)-wellbeing relationship is complex. A variety of indoor variables such as thermal, visual, acoustic and chemical can affect occupants ' well-being (Apte, Fisk & Daisey, 2000; Jantunen, Hanninen, Katsouyanni, Knoppel, Kuenzli, Lebret, Maroni, Saarela, Sram & Zmirou, 1998; WHO, 2002). These relationships can sometimes be very complicated and can affect individuals both in the short and long term (Babisch, 2008; Fisk, Lei-Gomez & Mendell, 2007; Lewtas, 2007). Concerns like sick building syndrome (SBS), building related disease, and pollutants have an effect on occupants ' general productivity. Studies have connected mental health and diseases which are not readily recognizable in the brief term but which could be significant long-term problems (e.g. cardiovascular diseases, asthma-related problems and obesity) to IEQ (Houtman, Douwes, de Jong, Meeuwsen, Jongen, Brekelmans, Nieboer-Op de Weegh, 2008; Jaakkola, Quansah, Hugg, Heikkinen & Jaakkola, 2013).

Children in Bangladesh, like other countries devote the second largest percentage of their day indoors at school, making classrooms a significant contributor to the exposure of children to air pollution. The objectives of this paper are to measure the concentrations of different indoor air pollutants at schools along CUET to Bahaddarhat road in Chattogram, to compare the measured concentrations with relevant standards, and to suggest ways to reduce the exposure of school children to undesirable pollutants.

2. METHODOLOGY

Indoor air quality was measured in ten classrooms at different schools along CUET to Bahaddarhat road by using Handheld Air Quality Analyzer from March 2019 to May 2019. Before using, the Air Quality Analyzing device is calibrated. The locations of selected schools were introduced in the Table 1. In all locations air quality were measured for three times- morning, noon and afternoon and averaged that data. The data was collected for five times during the study periods.

Table 1: Description of Study Area

No.	Name of Schools	Locations	
		Latidude	Longitude
S1	CUET Primary School	22.464914	91.969029
S2	Pahartali ideal kildergarden school	22.459104	91.964427
S3	Uttar dewanpur government primary school	22.456229	91.954146
S4	Goschi high school	22.447621	91.939965
S5	Noapara high school	22.440104	91.908952
S6	Uttar burischar Government primary school	22.433103	91.870164
S7	Kuyaish burischar sammilani high school	22.407418	91.860325
S8	Poschim Mohora Government primary school	22.402251	91.867835
S9	Hajera Taju school & college &	22.378317	91.854012
S10	Ekhlasur Rahman Government primary school	22.368277	91.845637

A simple questionnaire survey has also been conducted among 100 people (60 students, 20 guardians & 20 staffs) who stay there daily. The questions mainly covered the health problems associated with indoor air pollution. Though, it was important to ask about the classroom comfort levels: ventilation, lighting facilities, cleanliness, temperature, and humidity among the students, teachers and gurdians.

3. RESULTS & DISCUSSION

The survey has been conducted among 100 students, guardians & staffs. The students belonged to the age group of 10–16. From the data of the survey, a pie chart was figured out. The information of Figure 1 shows that, the largest area resembles about 63% of people got sick, 26% didn't get sick and 11% people were not sick due to air pollution but family members of them were sick. It is very difficult to relate the sickness with PM pollution at school as the children are more exposed by fuel combustion emission at home. For justifying this more details study is needed.

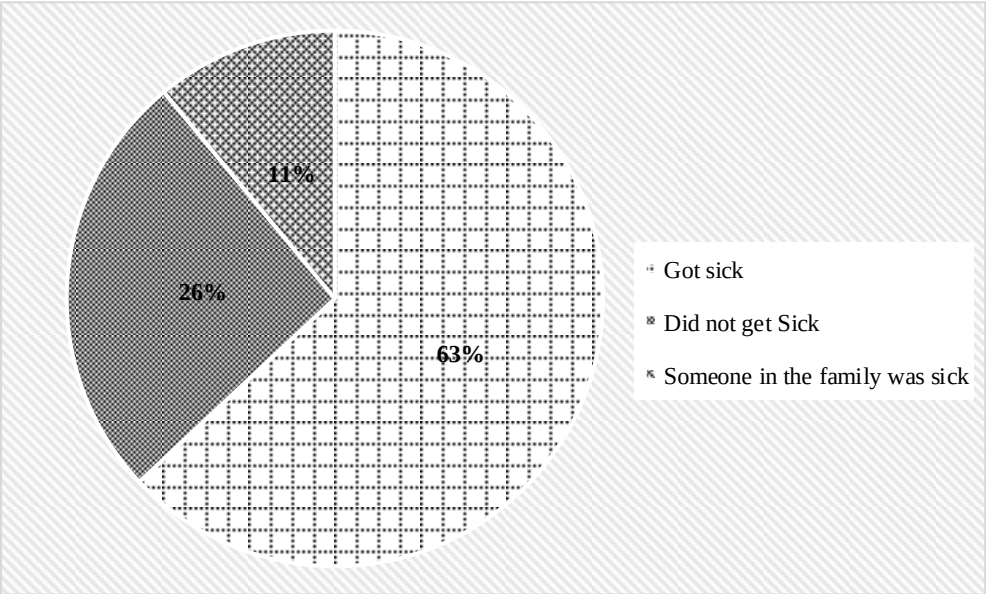

Figure 1: Information of questionnaire survey

The average concentration of $PM_{2.5}$ and PM_{10} were figured out in Figure 2 and Figure 3 respectively. The average maximum $PM_{2.5}$ and PM_{10} concentrations inside the school building were found to be 81.1 $\mu g/m^3$ and 313.1 $\mu g/m^3$, respectively. These values exceed the threshold value recommended by National Ambient Air Quality Standard (NAAQS). The maximum average concentration of $PM_{2.5}$ was found at the school in S4 locations and minimum concentration was recorded at the school in S7

locations which was 42.3μg/m^3. If the National Ambient Air Quality Standard (NAAQS) is considered, in 6 out of 10 schools' indoor air quality in terms of $PM_{2.5}$ were found poor.

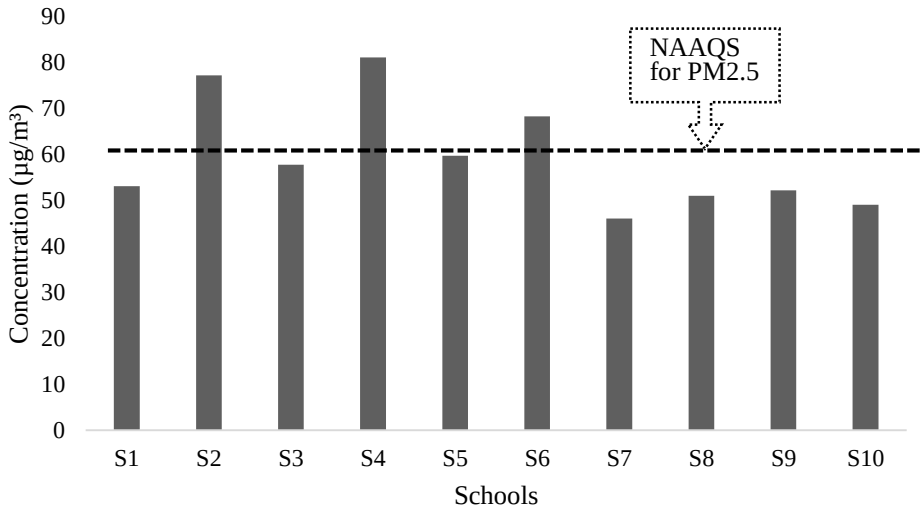

Figure 2: Average concentration of $PM_{2.5}$ at several selected schools.

The maximum and minimum concentration of PM_{10} were found at classroom of schools in S4 and S1 locations respectively (Figure 3). The average concentration of PM_{10} for all schools was exceeded threshold value of National Ambient Air Quality Standard (NAAQS).

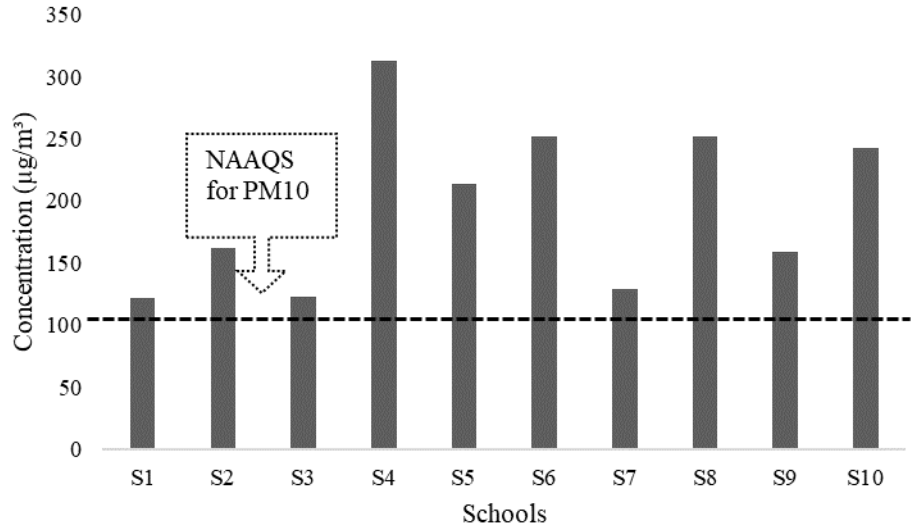

Figure 3: Average concentration of PM_{10} at several selected schools.

4. CONCLUSIONS

In this study, the IAQ in ten classrooms at different schools along CUET to Bahaddarhat road have studied. The IAQ parameters, namely $PM_{2.5}$ and PM_{10} have been measured by using Handheld Air Quality Analyzer from March 2019 to May 2019 in the study region. The results show that The average maximum $PM_{2.5}$ and PM_{10} concentrations inside the school building were found to be 81.1 μg/m^3 and 313.1 μg/m^3, respectively. The average concentration of PM_{10} for all schools were exceeded threshold value of ambient air quality of Bangladesh. At the schools of S2, S4 & S6 location the mean concentrations of $PM_{2.5}$ were exceeded. This study also shows that the indoor $PM_{2.5}$ and PM_{10} concentration were higher at the schhols adjacent to roadside.

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