LET KIDS BREATHE CLEAN AIR

Study on the Air Quality In and Around School

2015

An initiative of Fredskorpset, Hong Kong Polytechnic University and Clean Air Asia in association with IIT Delhi and IIT Kanpur

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Acknowledgement

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Background

Air pollution can be defined as the dull air, which can damage human health, plant and animal life. The World Health Organisation defines air pollution as "substances put into the air by the activity of mankind into concentration sufficient to cause harmful effects to health, property, crop yield or to interfere with the enjoyment of property." Outdoor air pollution (for example from road traffic, air traffic or industry), seems a more pressing problem to most people than indoor air pollution. The World Health Organisation reported in 2002 that indoor air pollution accounts for "2.7 per cent of the global burden of disease."Since the industrial revolution, the world has witnessed the rapid expansion of its metropolises. With rapidly increasing urbanization, the cities have seen unpredicted growth in dependency on motor vehicles and fossil fuels. This ultimately results in traffic congestion, road accident, air pollution, and high emission of carbon, global warming and climate change, which lead to significant economic and environmental loss. Clean air is considered to be a basic requirement of human health and for the well-being. But according to World Health Organization estimation of the year 2012, around 3,700,000 premature deaths a year were caused by outdoor air pollution. People residing in 7 out of 10 cities in Asia, breathe unhealthy air. Air pollution is recognized as a major threat to human health.

The United Nations Environment Program has estimated that globally 1.1 billion people breathe unhealthy air (UNEP, 2002). Epidemiological studies have shown that concentrations of ambient air particles are associated with a wide range of effects on human health, especially on the cardio-respiratory system (Bates, 1992; Dockery and Pope, 1994). A growing body of evidence indicates that particulate pollution increases daily deaths and hospital admissions throughout the world (Pope et al., 1995; Zanobetti et al., 2001). Thus, the association between particulate air pollution exposures and cardiopulmonary mortality appeared causally. A 2013 assessment by the WHO's International Agency for Research on Cancer (IARC) concluded that, "outdoor air pollution is carcinogenic to humans with the particular matter component of air pollution most closely associated with increased cancer incidence, especially cancer of the lungs".

Air pollution in India:

According to the latest Urban Air Quality database released by WHO most of Indian cities have the highest level of PM_{10} and $PM_{2.5}$ when it compared to other international cities. Of the 20 most polluted cities in the world, 13 are Indian. Same as Environment Performance Index (EPI) 2013 placed India at the bottom of the 132 countries. According to the journal (Sateesh.N.Hosamane, 2013), in 2007 nearly 52% (63) cities were at critical in terms of PM_{10} level ($\geq$1. 5 time limits). The air quality data generated by CPCB under the National Monitoring Program (NAMP) 2007, almost half of the city has critical level of $PM_{10.}$ And now air pollution is becoming 5^{th} largest killer in India (GBD, 2010).

Air Pollution in Delhi

Delhi the capital city of India is the most polluted city in the world when it comes to air quality (WHO, 2014). Whether India rejects WHO report, many concern organization asking the government for appropriate action. According to the study report, Delhi has an annual average of 153 microgram of small particulates ($PM_{2.5}$) per cubic meter. However CPCB data for 2013 says the PM_{10} concentration in Delhi was 273 and $PM_{2.5}$ was 112. Whether the pollution level is a little lower than WHO report, exceed the domestic standard, which is 60 and 40µg/ m3 respectively. Not only Delhi, their (WHO) recent report placed Kanpur at 9th position for being the most polluted city in the world.

According to Mejia, Choy, Mengersen and Morawska (2010) whilst the health effects of adult exposure cannot be neglected, children are more susceptible than young adults to air pollutants (Kulkarni and Grigg, 2008); therefore, their exposure is a major health concern. Published reviews on the effects of air pollutants in children's health indicate that air pollutants singly and in combination with other environmental factors have adverse effects on children and adolescents regardless of their current health status. There is evidence that the effects occur at common ambient concentrations (Raizenne et al., 1998). From a policy perspective, detecting potential health effects early can lead to more effective control of exposures and management of effects.

In this study, ambient air quality and its health impact on school kids was monitored in the schools located in Delhi and Kanpur. This study provides a scenario of air pollution level in the school area and possible measures to minimize the effect of air pollution to the student.

Objectives:

The main objective of this study is to monitor the level of air quality in and around the schools and its relation to school children in which they are exposed too. Some of the key points focused in this study are as follows:

- Assess air pollution exposure while in school and during transit to and from school to residence
- Assess lung function of student
- Recommendations to parents, teachers, schools and the Government on ways to alleviate air pollution exposure for children

Methodology

The study consists of four key activities viz.

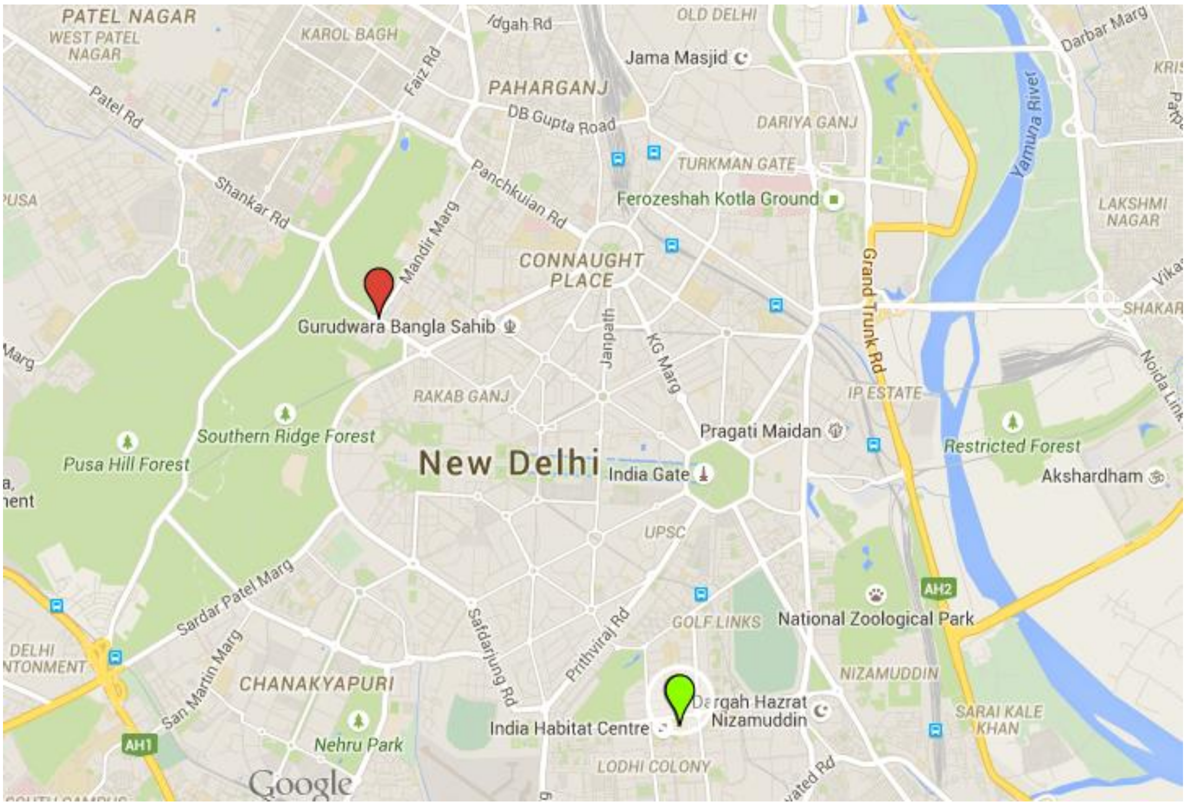
1. Selection of School
2. Questionnaire Survey
3. Lung function test
4. Air Quality monitoring

1. Selection of schools:

2 schools from each city of Delhi and Kanpur were selected on basis of student strength, location of the schools busy traffic junction, quiet neighbourhoods). The list of selected schools is given as below:

Table 1: List of selected schools

S.N.	School	Location	Location Type
1.	$School_1$	Lodhi Road, Delhi	Residential area nearby main connecting road
2.	$School_2$	CP, Delhi	Commercial area near main road
3.	$School_3$	Sahkarnagar, Kanpur	Residential area near main road
4	$School_4$	Mainawatimarg, kalyanpur, Kanpur	Quiet area, on the outskirts of Kanpur city



Source: Google maps

Location of selected schools in Delhi

Source: Google maps

<u>*Location of selected schools in Kanpur*</u>

2. Questionnaire Survey:

The questionnaire survey was conducted in all four schools to collect the basic information; focusing on the micro environment they are exposed to, the travel pattern to the school and the health record of the student. Considering that students studying in grade 9 are the ones who have been involved in many extra curriculum activities like playing football, cricket and other outdoor games and exposed to their surrounding micro-environment for a longer period, the grade 9 students were targeted for baseline survey in Delhi schools. About 42 students studying in class 9 from each school were selected for the study and only the students from Delhi participated in lung function test. The questionnaire is present in Annex 3

In Kanpur, students from grade 1 – 10 were targeted for baseline survey in schools. Students of different ages are involved in different types of activities, and their exposure to their surrounding micro-environment will also be considerably different. Keeping their activities and home environment in view, school staff was requested to select students randomly in all grades.

3. Pulmonary function test:

Pulmonary function tests (PFT) are a group of tests that measure how well the lungs inhale and exhale air. Spirometry is the most common pulmonary function tests measuring lung function, especially the volume and speed of air that can be inhaled and exhaled, over a period of time. Spirometry is an important tool used for generating pneumatographs, which are helpful to diagnose certain types of lung diseases such as asthma, bronchitis, emphysema and COPD. Spirometer (Model: Halios 401) with separate disposable mouthpiece for each student was used for pulmonary function test. Before performing the PFT, the height and weight of the child was measured with shoes removed. Each child performed forced expiratory manoeuvres while sitting with free mobility and nose closed with a nose clip to prevent passage of air through the nose. Each spirometric test was repeated 3 times to allow the choice of the best values. Using a computer assisted quantitative assessment the best manoeuvre for acceptance was determined. The data were compared with predictive values based on age, sex and height. The following spirometric parameters (absolute and relative values such as ratio of actual and predicted values) were recorded for analysis:

- Forced vital capacity (FVC), i.e. the volume of air in liters forcefully exhaled
- Forced expiratory volume at 1 second (FEV1), i.e. volume of air (in litre) forcefully exhaled in one second
- Ratio of FEV1 to FVC (FEV1 /FVC), expressed as percentage
- Forced expiratory flow at 25-75% (FEF25-75%) or maximal mid-expiratory flow

Spirometric test was carried out on 79 students from 2 schools in Delhi including students who had provided a response to the questionnaire survey.

4. Air Quality monitoring:

Major air pollutants such as PM_{10}, $PM_{2.5}$, CO, SOx, NOx and Total Volatile Organic Compound (TVOC) were monitored inside and outside of school. For inside, all adequate equipment were placed inside the selected classroom and monitored continuously for four hours and 1.5hrs for outside during the school opening and closing time when school buses and private vehicle come to drop and pick up student.

In Kanpur, air pollution parameters monitored inside school premises were PM_{10}, $PM_{2.5}$, CO, and NOx. Indoors, all adequate equipment were placed inside the selected classroom and monitored continuously for full school hours. Outside classroom air quality monitoring was conducted in the morning before start of school and in afternoon after classes end. For these outdoor samples, samplers were placed at locations where school buses and private vehicle come to drop and pick up student.

The equipment while sampling was maintained approximately at a respiratory level (i.e., 1.5 m above the ground), and also free of any direct obstructions during monitoring. The following equipment was used for monitoring different pollutants:

a. Particulate matter:

GRIMM 1.107, portable dust monitor was used for real time monitoring of PM_{10} and $PM_{2.5}$. The monitor was set for 1 minute interval for sampling.

In Kanpur, GRIMM 1108, portable particle counter and respective mass sizer was used for real time monitoring of PM_{10} and $PM_{2.5}$. The monitor was set for 1 minute interval for sampling.

Specification

	DELHI	Kanpur
Particulate matter	PM_{10}, $PM_{2.5}$, PM_1	PM_{10}, $PM_{2.5}$, PM_1
Operating Temperature	-20^{0}C to+40^{0}C	+4^{0}C to+40^{0}C
Accuracy	+/- 1µg/m^3	+/- 1µg/m^3
Sample flow	1.2 ltr/min, flow controlled	1.2 ltr/min, flow controlled
Dimension	40x40x20 cm	24x13x7 cm
Weight	15.9 kg complete with dust monitor	2.4 kg

b. Total Volatile Organic Compound (TVOC):

Tiger LTV1.0 monitor was used for the real time monitoring of TVOC at ppm (parts per million) level. The equipment was set for 1min intervals for sampling

Technical Specification:

Minimum Resolution	0.1ppm
Maximum Reading	5000ppm
Response Time	T90<2 second
Accuracy	±5% display reading ± one digit
Battery life	24 hrs continual use
Data logging	Push-to-log, 128 zones, 80,000 data points
Flow rate	220ml/min in ambient condition
Temperature	-20 to 60^{0}c
Dimension	340mm x90mm x60mm
Weight	0.72 kg

c. Carbon monoxide (CO):

The portable Testo435 with ambient CO probe was used for detecting CO. The equipment was set for 1 minute regular interval for sampling.

In Kanpur, The portable APMA-370 ambient CO monitor was used for detecting CO.

Specification:

	DELHI	**KANPUR**
Operating temperature	-20 to +50^{0}C	+4 to +50^{0}C
Dimension	220x74x46mm	430x550x221mm
Weight	428g	16Kg
Probe	Ambient CO probe	-

Measuring Range	0 to 500ppm	0 to 100ppm

d. Relative Humidity, Temperature, SO_2 and NO_2

The portable YES AIR8-channel IAQ monitor was used to measure Relative Humidity, Temperature, SO_2 and $NO_{2.}$ The equipment was set for 1 min regular interval for sampling.

Specification:

Operating temperature	5^0C to 50^0C
Humidity	0 to 99% RH non-condensing
Standard rang for NO_2	0-10ppm
Standard rang for SO_2	0-20ppm
Dimension	197x78x98mm
Weight	567g

e. Nitrogen oxides (NOx):

In Kanpur the portable APMA-370 ambient NOx monitor was used for detecting NOx.

Specification:

Operating temperature	+4 to $+50^0$C
Dimension	430x550x221mm
Weight	21 Kg
Air flow rate	0.8L/min
Measuring range	0 to 100ppm

f. Relative Humidity, Wind speed and Temperature: In Kanpur

The portable Omega air flow meter was used to measure Relative Humidity, wind speed and Temperature.

Specification:

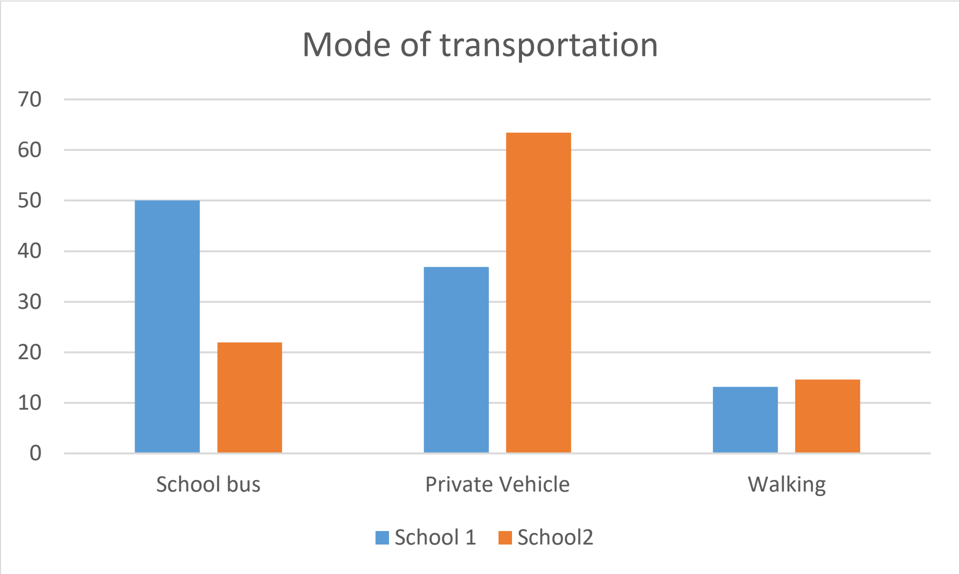
Operating temperature	-20^0C to $+60^0$C ($\pm0.6^0$C)
Relative Humidity	0 to 100% (±3%)

Results and Discussion

1. Mode of Transportation:

Based upon the information provided by the students in Delhi 50% students in $School_1$ commuted by school bus while in $School_2$, it is only 22%.Comparatively, in $School_2$, the no. of private vehicle (cars and 2 wheeler motorcycles, scooters) user students are high i.e. 63% in $School_2$ and 37 in $School_1$. On an average, from both schools, around 13% of students travel by foot, 35.98% travel by school bus and 50.13% travel by private vehicle. Auto rickshwas were considered under the 'school bus' category.

Figure 1: Mode of transportation



2. Smoking

Average for both schools 16.82% of family members smoke cigarettes inside the house. The higher percentage of student's family members' smoke inside the house was found in $School_1$ with 26.32% in comparison to $School_2$ with 7.32%.

In Kanpur, among the students surveyed collectively in both the schools, 8% of the family members smoke cigarettes inside the house. The $school_3$ has the higher percentage of student's family members smoking inside the house with 6% in comparison to $school_4$ with 4%.

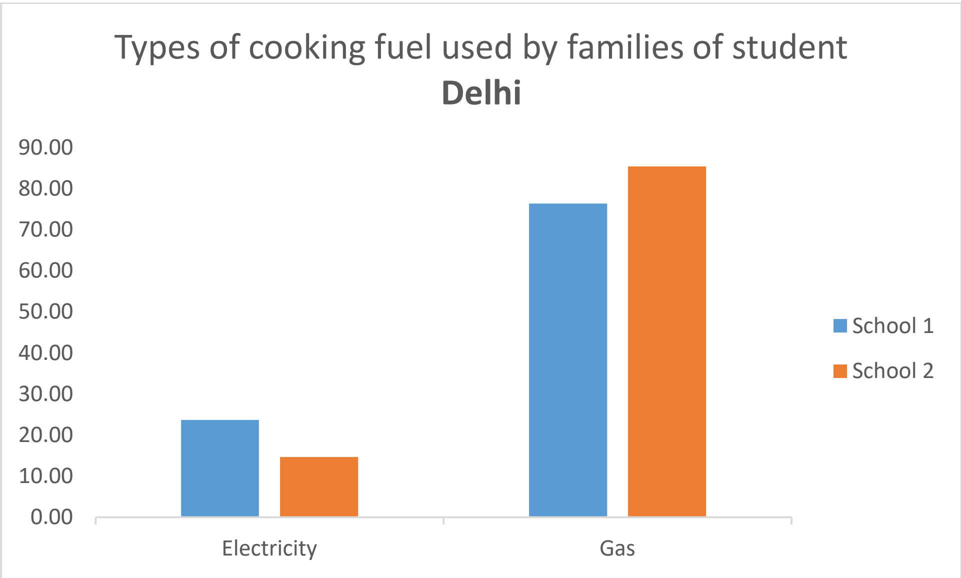
According to Environment Protection Agency, USA (USEPA), second-hand smoke contains more than 4,000 substances, several of which are known to cause cancer in humans or animals. Being a smoker is an obvious risk, but just being around people who smoke and breathing in second-hand smoke can cause problems. U.S. Department of Health and Human Services has concluded that Second-hand smoke can cause serious health problems in children and children whose parents smoke get sick more often. Their lungs grow less than children who do not breathe second-hand smoke, and they are more prone to bronchitis, pneumonia and asthma attack. The percentage of adults smoking inside the house is quite more in both the schools. The only way to protect child from second-hand smoke is to not allow smoking inside the house or separating smokers from kids, for which proper education/awareness is needed.

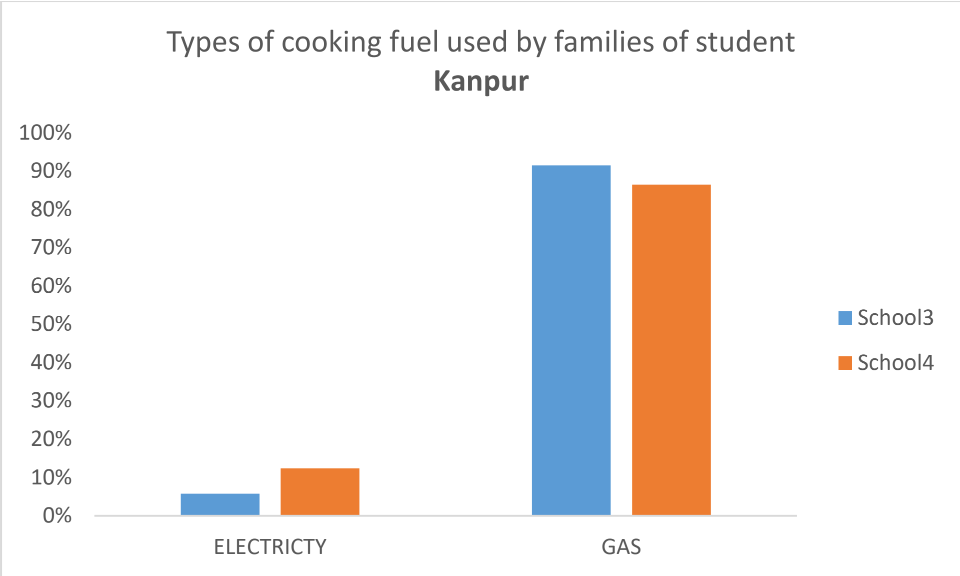
3. Cooking Fuel

Several studies have tried to assess the association between fuel use and respiratory infection morbidity and mortality. Most of them have linked use of biomass fuel, charcoal, kerosene to Acute Respiratory infection (ARI) in children. The finding of research titled "Indoor air pollution in developing countries; a major environmental and public health challenges" supports that exposure to biomass fuel smoke is responsible for a number of respiratory diseases such as ARI, Chronic Obstructive Pulmonary Disease (COPD), Tuberculosis and Asthma.

Of all the children in the analysis, approximately 19.16% of their family used electricity and around 80.84% of them used expand LPG as cooking fuel. In Kanpur, the usage of electricity (up to 10% max) is almost half that in Delhi. This is probably in keeping with power shortage in the city. A study by Speizer FE. And Ferris B. revealed that the level of oxide of nitrogen in home using gas cooking are 4 to 7 times higher than in home in which cooking is by electricity. Economically gas is cheaper than electricity and popular in urban areas like Delhi. But in respect to child health, children from homes in which gas stoves were used have greater chances of respiratory infection before two years (Ferris, p. 121). To avoid the possible health risk of children use of renewable energy is far better than using fossil fuel.

Figure 2: Types of cooking fuel used by families of student





4. Indoor air quality in households:

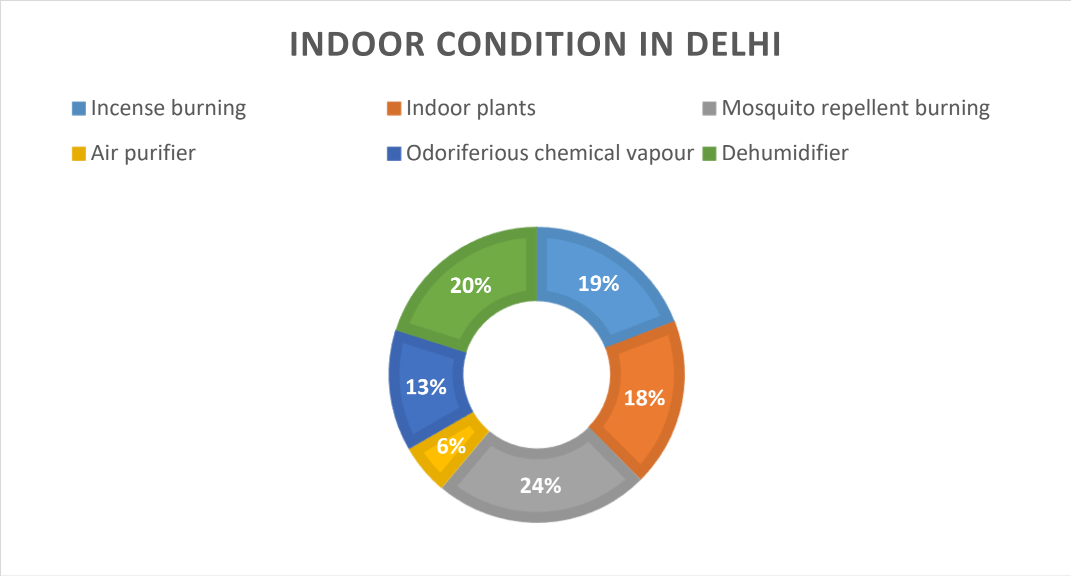
.There are various sources associated with indoor pollution such as incense burning, mosquito repellent burning, room freshener chemical vapour etc, apart from the cooking fuel. Burning of coils indoors generates smoke that can control mosquitoes and incenses are commonly used for aesthetic and religious purposes. This practice is very common in countries like India and Nepal. However, the smoke may contain pollutants that affect health . Burning one mosquito coil would release the same amount of PM (2.5) mass as burning 75-137 cigarettes. Emission of formaldehyde from burning one coil can be as high as that released from burning 51 cigarettes. Prolonged exposure may lead to accumulation in human respiratory system and lead to respiratory illnesses.(Weili Liu, Jamal H Hashim, & Zailina Hashim, 2003).

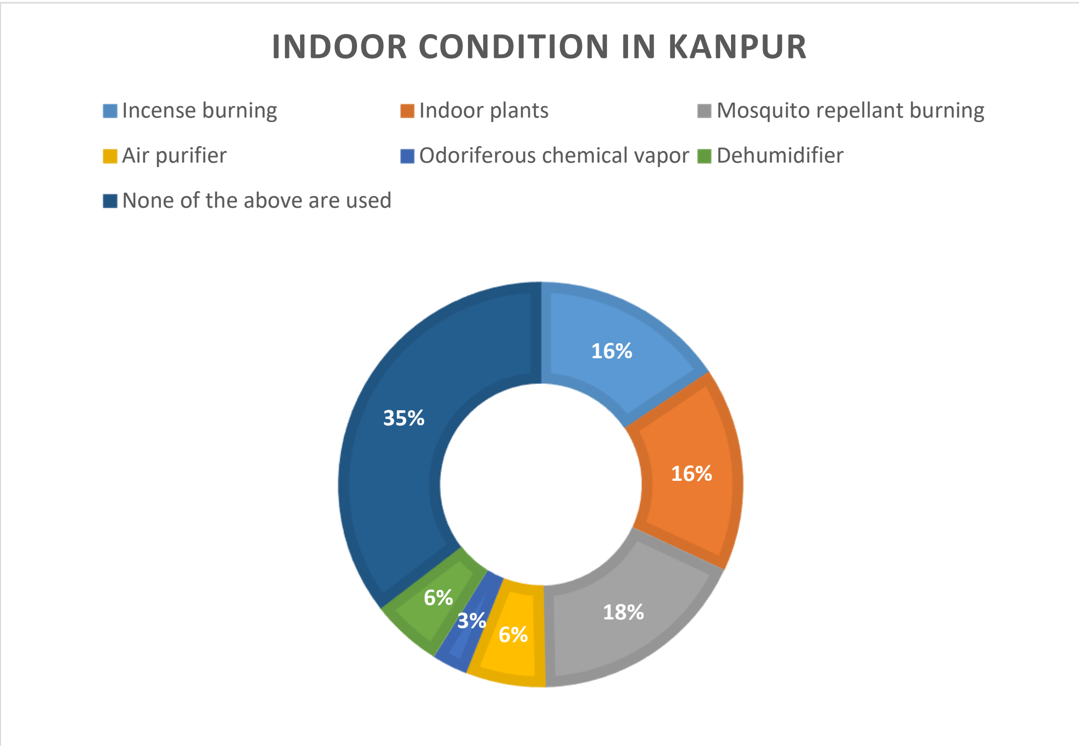
About 49.87% of households reported burning mosquito repellent coils, about 40.47% of households were found to burn incense and 28.08% use odoriferous chemical vapor inside the house for both schools.

However, 39.06% of households had indoor plant and 11.65% were using air purifier for the purpose of clean air.

In Kanpur, approximately one third of the responses received reported not using any of the processes/devices mentioned. Collectively 18% of household has reported mosquito repellent coils, 16% have reported incense burning in household. Only about 16% of households have indoor plants. Whereas 6%, 3% & 6% have reported using air purifier, odoriferous chemical vapour and dehumidifier respectively.

Figure 3: Indoor air condition





5. Condition of molds/mildew

Microbial pollution is also a key element of indoor air pollution, which comes from species of bacteria, fungi and moulds that grow indoors when sufficient moisture is available. Exposure to microbial contaminants is clinically associated with respiratory symptoms, allergies and asthma, and can affect the immunological system (WHO/Europe, 2009). In 2004 the Institute of Medicine (IOM) found there was sufficient evidence to link indoor exposure to mold with upper respiratory tract symptoms, cough, and wheeze in otherwise healthy people; with asthma symptoms in people with asthma; and with hypersensitivity pneumonitis in individuals susceptible to that immune-mediated condition. The IOM also found some suggestive evidence linking exposure to damp indoor environments in general to shortness of breath, to respiratory illness in otherwise healthy children and to potential development of asthma in susceptible individuals.

For both schools in Delhi around 15.12% of houses were found to have a presence of mold/mildew in walls and ceilings during the rainy season, 10.24% of houses were found to have it when there was continuous raining and about 7.51% was found to have the presence of mold/mildew on most days of the year.

For both schools in Kanpur, during the rainy season, around 11% of houses were found to have a presence of mold/mildew in walls and ceiling. 2% of houses have it when there was continuously raining, 3% of houses have it on most days of the year, whereas 2% of houses have their presence when humidity level is high.

Table 2: Condition of molds/mildew in the wall and ceiling

Name of School	Condition of molds/mildew		
	In the rainy season only	**When continuously raining**	**On most days of the year**
School 1	13.16	13.16	5.26
School 2	17.07	7.32	9.76
Total	15.12	10.24	7.51
School 3	18.2	3.1	5.2
School 4	8.1	2.2	2.4
Total	11	2	3

Control measures

According to Centers for Disease Control and Prevention (CDCP), mold growth can be controlled by applying the following steps:

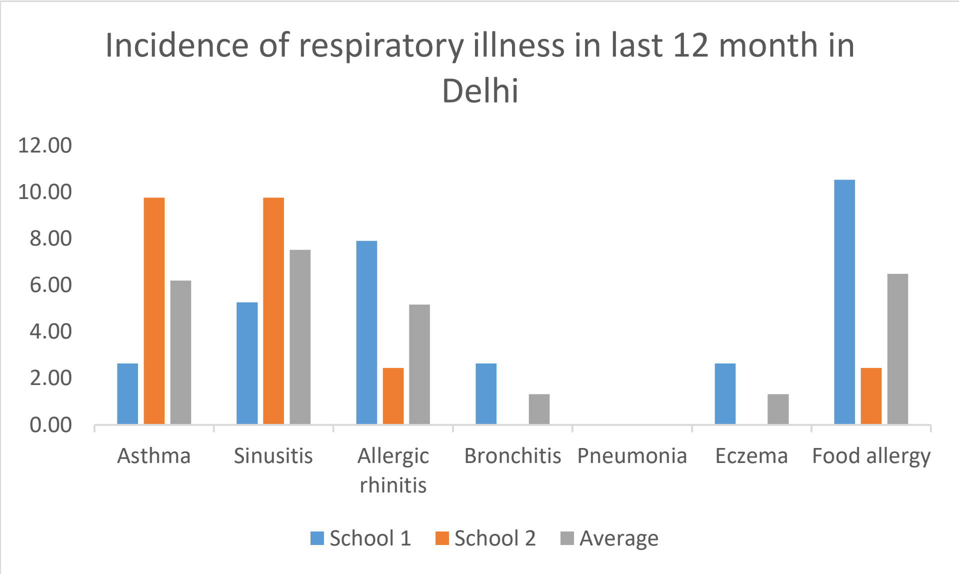
- Controlling humidity levels
- Promptly fixing leaky roofs, windows, and pipes
- Thoroughly cleaning and drying after flooding
- Ventilating shower, laundry, and cooking areas

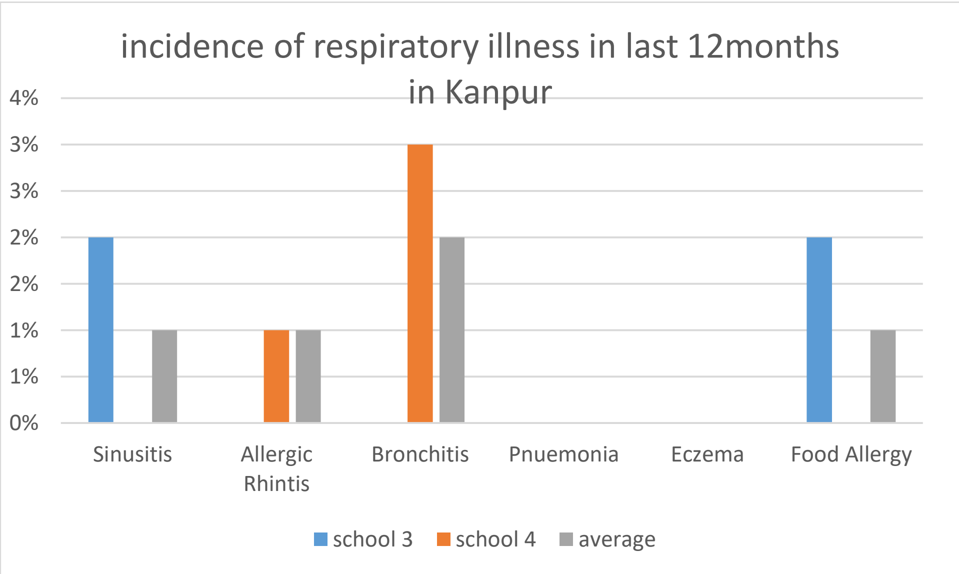
6. Child Health Record

6.1 Incidence of respiratory illness in the last 12 month

Among 79 respondents from both schools, 6.19% suffered from asthma. the asthma patient in School$_2$ was quite high than in School$_1$. In past 12 months about 7.51% suffered from sinusitis; 5.17% suffered from allergic rhinitis; 1.32% suffered from Bronchitis; 1.32 % suffered from Eczema and 6.48% of students suffered from Food allergy. The percentage distribution of students suffering from different illness in last one year is presented below in the chart. Among 113 respondents from both schools in Kanpur, 4% suffered from asthma. It is interesting to note that all the asthma patients were from school4. Only 1% suffered from sinusitis; 1% suffered from allergic rhinitis; 2% suffered from bronchitis, 1% suffered from food allergy, in past 12 months.

Figure 4: Incidence of illness in last 12 month





6.2 Incidence of Cough and Phlegm

Based upon the information provided by the students, about 44.03% suffered from a cough with a cold; 19.35% suffered from cough apart from cold and 3.95% suffered from night cough during the last year, while about 6.19% suffered from consistent cough problems for as many as 3 months in a year. In Kanpur, in past 12 months students suffered from phlegm with cold for both schools is 80% while 10 % suffered from phlegm apart from cold, 8% from night cough and 2% from cough on most days.

Table 3: Incidence of Cough

Name of School	Incidence of Cough			
	Cough with colds	Cough apart from cold	Night Cough	Cough on most days (4 or more days in a week)
School 1	36.84%	28.95%	7.89%	2.63%
School 2	51.22%	9.76%	0.00	9.76%
Average	44.03%	19.35%	3.95%	6.19%
School 3	77%	10%	10%	3%
School 4	81%	10%	7%	2%
Average	80%	10%	8%	2%

The percentage of student suffered from phlegm with cold for both school in past 12 month was 18.97% while the student suffered from phlegm apart from cold was 11.75% and only about 1.22% of student suffered from phlegm for as many as 3 months last year.

In Kanpur, in past 12 months students suffered from phlegm with cold for both schools is 71% while 8 % suffered from phlegm apart from cold and 4% from phlegm on most days.

Table 4: Incidence of Phlegm

Name of School	Incidence of Phlegm		
	Phlegm with colds	Phlegm apart from cold	Phlegm on most days (4 or more days in a week)
School 1	18.42%	21.05%	0.00%
School 2	19.51%	2.44%	2.44%
Average	18.97%	11.75%	1.22%
School 3	83%	0%	17%
School 4	67%	11%	0%
Average	71%	8%	4%

6.3 Incidence of Sneezing and Itching of the eyes

About 26% of student suffered from sneezing or a runny or blocked nose with cold in the last 12 months, while about 24% suffered from Sneezing or a runny or blocked nose a apart from cold and about 4.88% of student suffered consistent Sneezing or a runny or blocked nose on most days (4 or more days in a week).

In Kanpur, Nearly 81% of the respondents suffered from Sneezing or a runny or blocked nose with cold in the last 12 months, where 12% suffered Sneezing or a runny or blocked nose apart from without cold and about 7 % suffered from Sneezing or a runny or blocked nose on most days.

Table 5: Incidence of Sneezing or a runny or blocked nose

School	Incidence of Sneezing or a runny or blocked nose		
	Sneezing or a runny or blocked nose with cold	**Sneezing or a runny or blocked nose apart from cold**	**Sneezing or a runny or blocked nose on most days (4 or more days in a week)**
School 1	15.79%	26.32%	0.00%
School 2	36.59%	21.95%	9.76%
Total	**26.19%**	**24.13%**	**4.88%**
School 3	71%	18%	12%
School 4	86%	10%	5%
Total	**81%**	**12%**	**7%**

The percentage of student suffered from Itching of eyes for both school in past 12 month was 26% while about 18% suffered from Itching of eyes for 4 or more days in a week.

Table 6: Itching of eyes

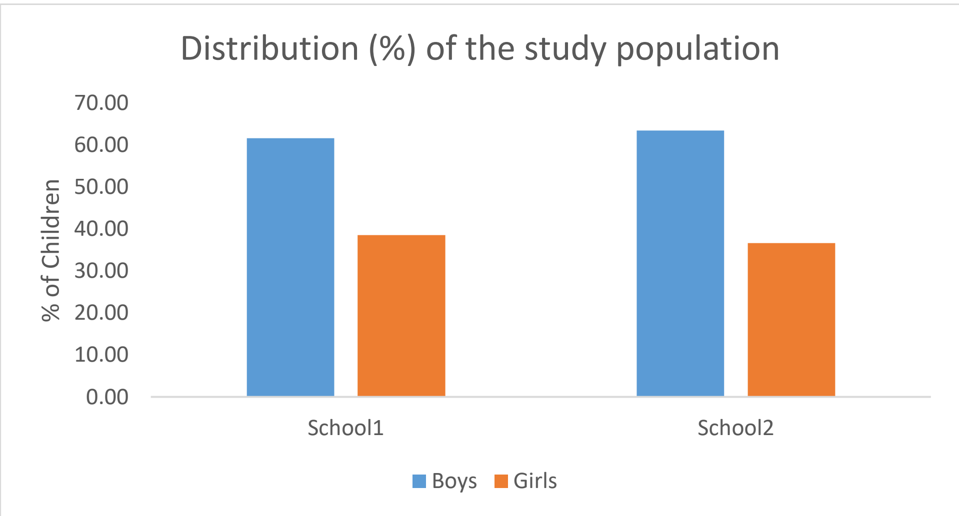
School	Itching of eyes	
	Itching of the eyes	**Itching of the eyes(4 or more days in a week)**
School 1	21.05%	5.26%
School 2	31.71%	31.71%
Total	26.38	18.49%

7. Lung Function Assessment

7.1 General Characteristics of Student

Among the total school-going children participated in this study, 62.48% were boys and 37.52% were girls as depicted in Figure 5.

Figure 5: Distribution percentage of study population in Delhi



The age of the students varied between 12 to 15 years. Around 49% of students were aged 14 followed by 45% from age of 13, 5% from age of 15 and around 1% from age of 12. The average height and weight of student was 158.39cm and 44.05kg in $School_1$, while in $School_2$ it was measured 159.93 cm and 53.90 kg respectively.

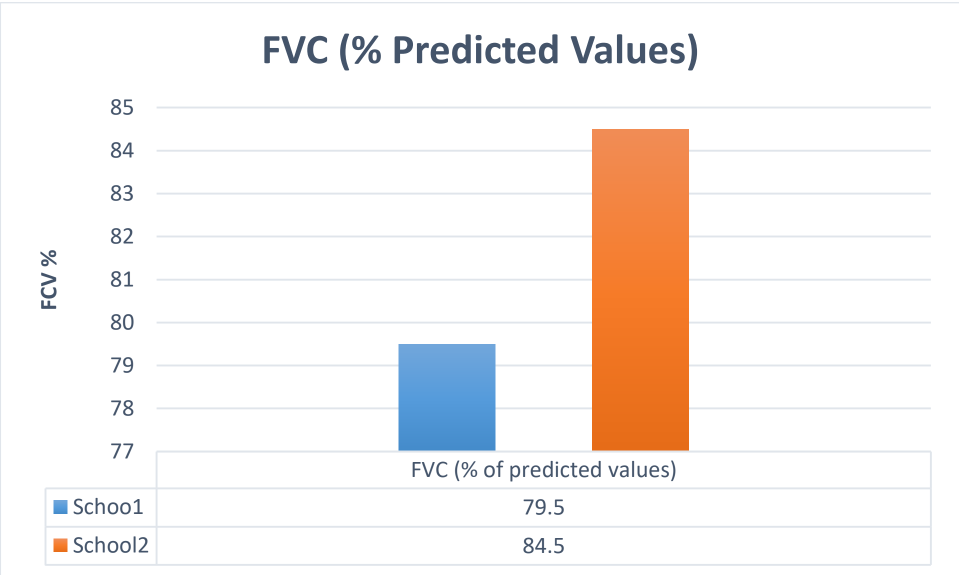
Table 7: General characteristics of student in Delhi

Name of School	**Age of Student**				**Average Height**	**Average Weight**
	12	**13**	**14**	**15**		
$School_1$	2.63	28.95	63.16	5.26	158.39	44.05
$School_2$	0.00	60.98	34.15	4.88	159.93	53.90
Total	1.32	44.96	48.65	5.07	159.16	48.98

7.2 Forced Vital Capacity (FVC)

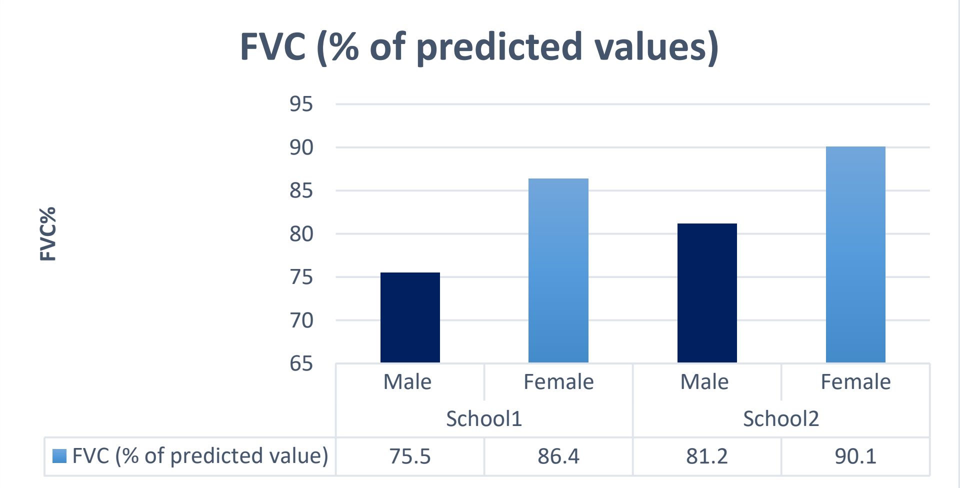
Forced Vital Capacity (FVC) is the amount of air which can be forcibly exhaled from the lungs after taking the deepest breath possible. By measuring of FVC doctors determine the patient's lung function. The average FVC value of $School_1$ and $School_2$ is given as below:

Figure 6: Forced Vital Capacity (FVC) % of predicted values



Comparatively the FVC value of $School_1$ was found significantly lower than the average value FVC value of $School_2$

Figure 7: Force Vital Capacity (FVC) % of predicted values

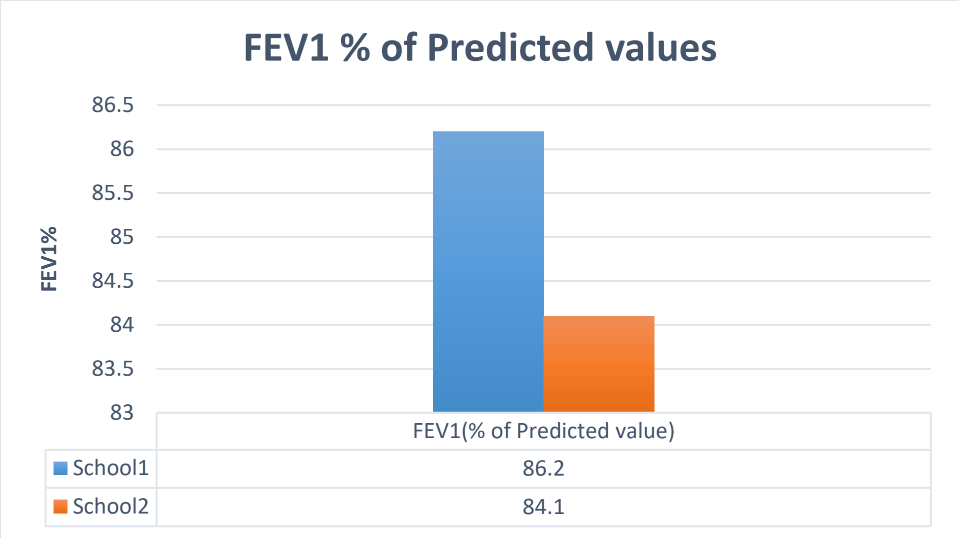


Overall, the mean FVC% of predicted value was found comparatively well in female students than male. The mean FVC% of predicted value of male students for $School_1$ was found relatively lower than female FVC % of predicted value of $School_{1.}$ In $school_2$ FVC % of predicted value for female was found 91% and for male it was found 81.2% which is relatively higher than FVC value of $School_{1.}$ According to CPCB air pollution health study report, the magnitude of FVC decrement can be classified into 4 categories: normal (>FVC 80% of predicted value), mild (FVC 60-79% of predicted value), moderate (FVC 40-59% of predicted) and severe (FVC<40% of predicted). Which means the average mean FVC% of predicted value for both schools are in mild category, except in $School_2$ FVC% of predicted value for female student.

7.3 FEV_1 – Forced Expiratory Volume in 1 Second, FEV_1 % of predicted value

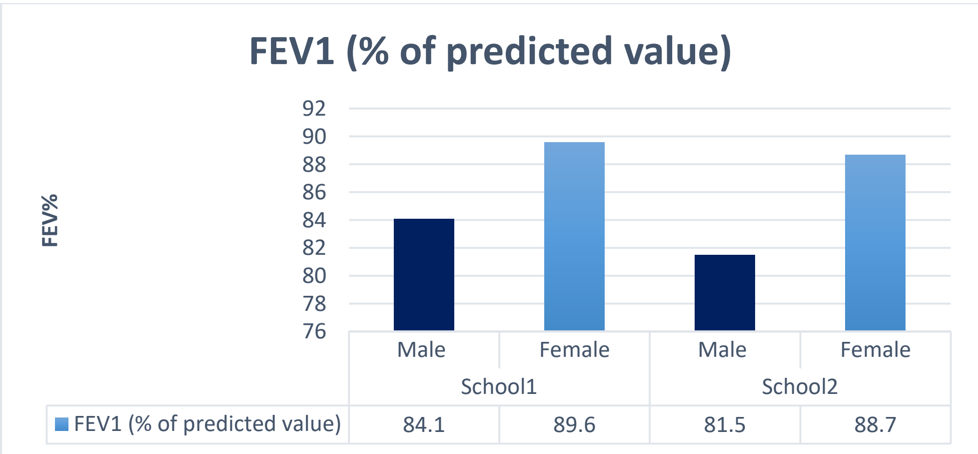
The FEV_1 is the volume exhaled during the first second of a forced expiratory manoeuvre started from the level of total lung capacity. FEV_1 is by far the most frequently used index for assessing airway obstruction, bronchoconstriction; FEV_1 expressed as a percentage of the VC (Vital Capacity) is the standard index for assessing and quantifying air flow limitation (Quanjer, n.d.).

Figure 8: Force Expiratory Volume in 1 second (FEV1) % of predicted values



The mean FEV_1% of predicted value in $School_1$ was 86.2% and 84.1% in $School_2$. In comparison of FEV_1% of predicted value revealed a high percentage value was observed in $School_1$ in all age group of both male and female students.

Figure 9: Force Expiratory Volume in 1 second (FEV1) % of predicted; comparisons between male and female students of values

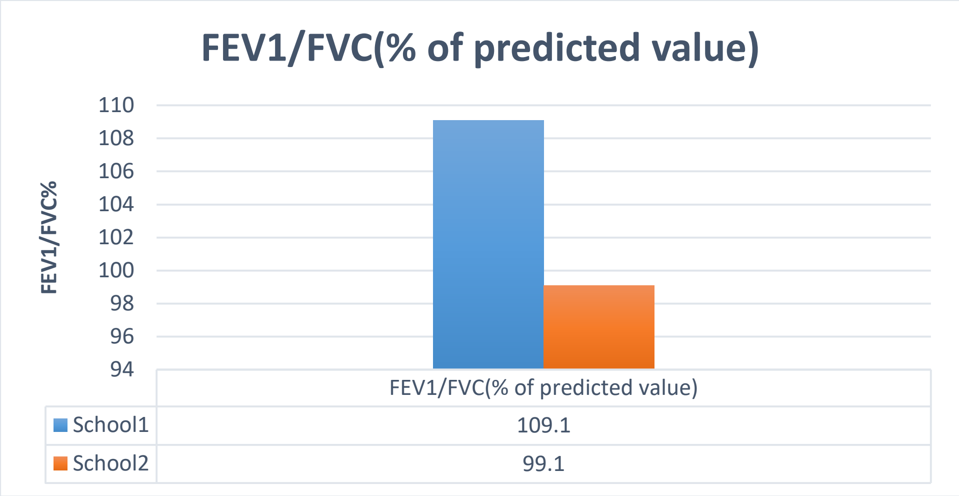


Like FVC, the FEV_1% of predicted value of male students had lowered value than female. But the magnitude of FEV_1 reduction was found above mild decrement (FEV_1% of predicted value). Therefore the average magnitude of FEV_1 reduction was much more in control.

7.4 The ration of FEV_1 and FVC

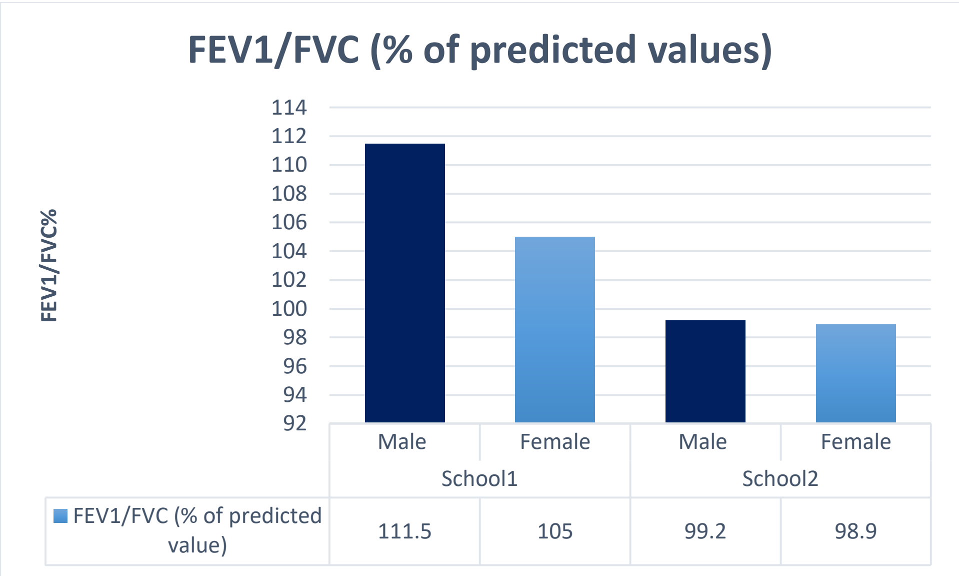
The ration of FEV_1 and FVC is a calculated ratio used in the diagnosis of obstructive and restrictive lung disease (Swanney MP, 2008). It represents the proportion of person's vital capacity that they are able to expire in the first second of forced expiration.

Figure 10: FEV1/FVC ration, comparison between two schools



Overall, $School_1$ had mean FEV_1/FVC ratio of % predicted value of 109.1% in contrast to 99.1% in $School_2$.

Figure 11:FEV1/FVC ration, comparison between two male and female students



The hallmark of obstructive type of lung function decrement is reduction in FEV_1/FVC ratio to less than 80% in compare of that, the result of both schools was observed very much in control. The detail breakdown of FVC, FEV_1 and FEV_1/FVC ratio with its hallmark is given as below in the tables.

Table 8: Comparison of FVC between two schools

School	Count	FVC			
		Normal	Mild	Moderate	Severe
$School_1$	38	55.26%	26.31%	18.42%	0%
$School_2$	41	56.09%	39.02%	4.87%	0%
Total	79	55.67%	32.66%	11.64%	0%

Table 9: Comparison of FEV1 between two schools

School	Count	FEV_1			
		Normal	Mild	Moderate	Severe
$School_1$	38	60.52%	31.57%	7.9%	0%
$School_2$	41	56.09%	29.26%	12.19%	2.43%
Total	79	58.30%	30.41%	10.04%	1.21%

Table 10: Comparison of FEV1/FVC between two schools

School	Count	FEV_1/FVC			
		Normal	Mild	Moderate	Severe
$School_1$	38	90.24%	4.88%	4.88%	0%
$School_2$	41	100%	0%	0%	0%
Total	79	95.19%	2.44%	2.44%	0%

The results of spirometry tests were compared to predicted values based on the student's age, gender, and height. Based upon the literatures, a normal result is > 80% of the predicted value. Abnormal values are:

Mild lung dysfunction—60–79%
Moderate lung dysfunction—40–59%
Severe lung dysfunction—below 40%

Based upon the result, around 56.57% students had normal FVC % of predicted value, 58.30% had normal FEV_1% of predicted value and 95.19% had normal FEV_1/FVC % of predicted value. If we compared the result between these two schools, we can concluded that students of $School_1$ has suffering more than $School_2$.

8. Air Quality in School Premises

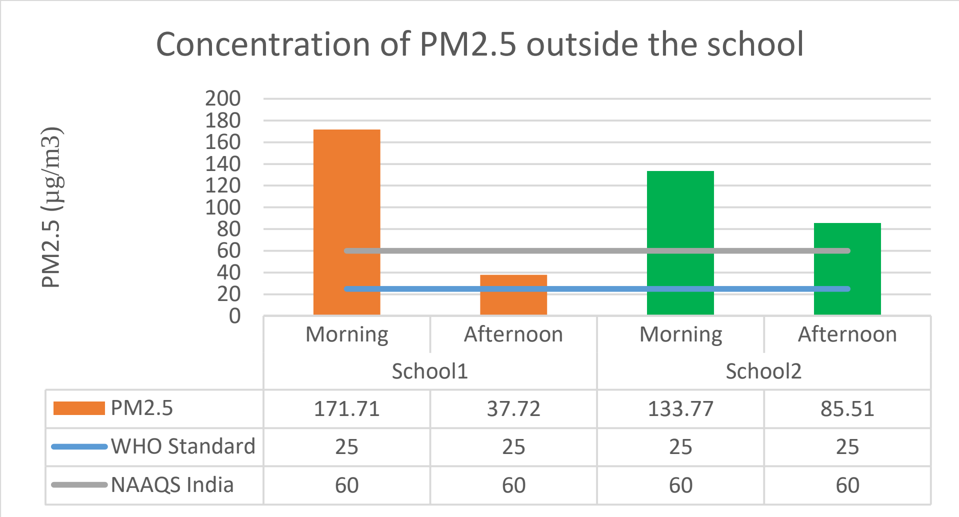
8.1 Particulate matter

Particulate matter, also known as particle pollution or PM is a mixture of very small particles. The composition of particulate matter varies with the place, season and weather conditions. Fine particulate matter is particulate matter with aerodynamic diameter that is 2.5 microns and less and is also known as $PM_{2.5}$. The particulate matter with aerodynamic diameter less than 10 microns and is called PM_{10}.In this study both $PM_{2.5}$ and $PM_{10}$was monitored in and around the school. Presented below are results from Delhi followed by results from Kanpur for all pollutants sequentially.

$PM_{2.5}$

The concentration of PM2.5 nearby the school gates during morning hours was found considerably higher than in the afternoon. Morning 7:30 am to 8:80 was the peak traffic hours for both schools, because both private and school's vehicles arrived at the same time to drop the student. In the afternoon,a relatively less number of vehicles were seen than in the morning,

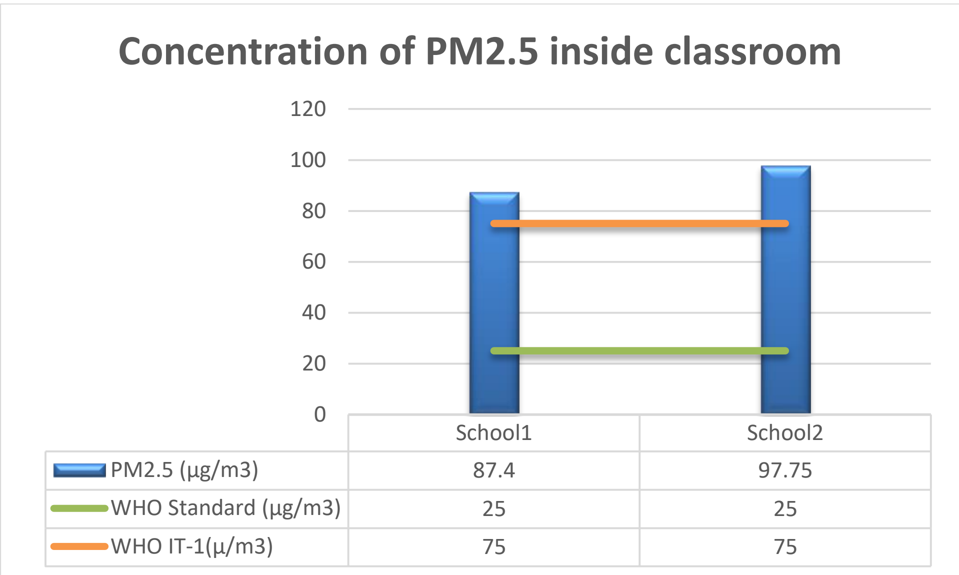
Figure 12: Concentration of PM2.5 outside school in Delhi



The concentration of $PM_{2.5}$ outside of $School_1$in the afternoon was found comparatively lower (37.72 µg/m^3) than $School_2$ and not exceeding the National Ambient Air Quality Standard, but exceeded WHO standard. The average concentration of $PM_{2.5}$ in $School_1$in the morning was comparatively higher than $School_2$which exceeded both NAAQ and WHO standard.$School_1$ which lies near about the core market area, usually have high traffic density and expected to exhibit high $PM_{2.5}$concentration in comparison to residential area.

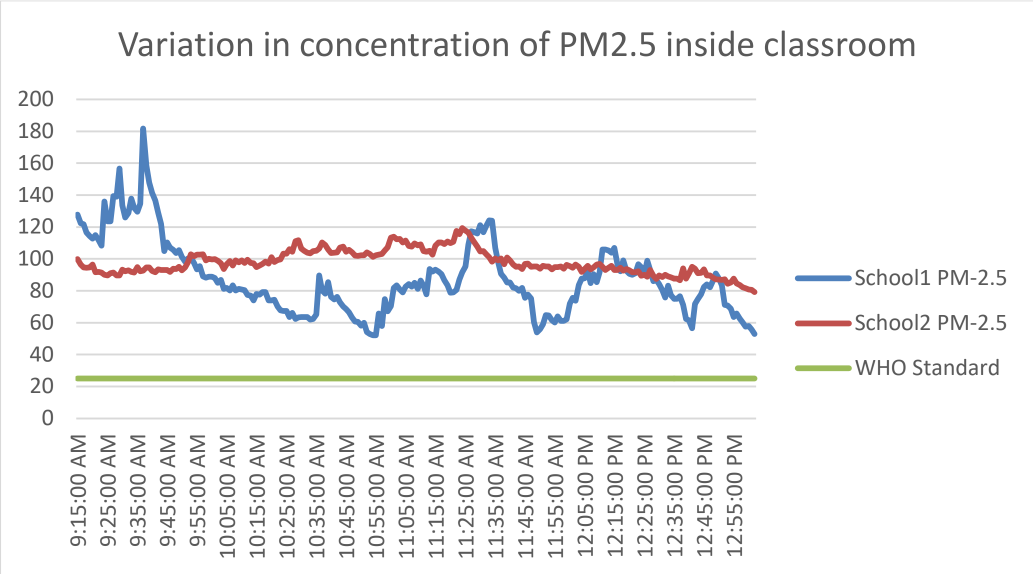
The concentration of $PM_{2.5}$ inside the classroom in both school exceed WHO guideline and Interim target-1(IT-1). The penetration of outdoor particulate and inside class movement is an important contributor to indoor $PM_{2.5}$ where size of classroom, location and furniture system can play a vital role. The classroom in $School_2$ was found relatively congested than $School_1$, there is very limited ventilation in classroom and the buildings also very closed to playground.

Figure 13: Concentration of PM2.5 inside classroom in Delhi



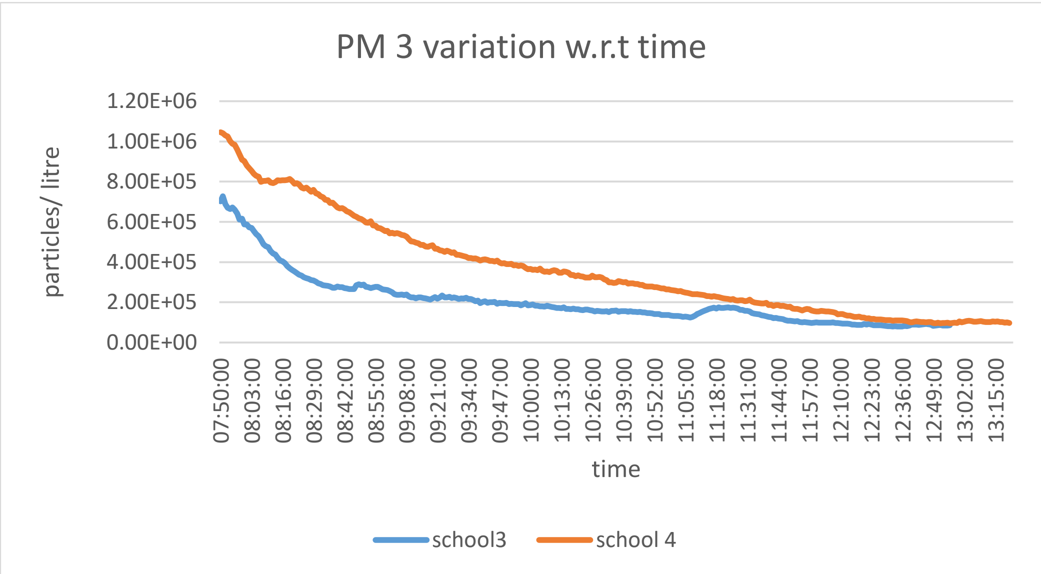
The result of indoor monitoring in both the schools showed that all the studied $PM_{2.5}$ concentration value in the classroom can be considered high in comparison with WHO guideline of 25 µg/m^3 24-hour mean. In about 4hrs continuous monitoring the $PM_{2.5}$ concentration ranged from 52 µg/m^3 to 181.7 µg/m^3.

Figure 14: The variation in concentration of PM2.5 inside classroom in Delhi



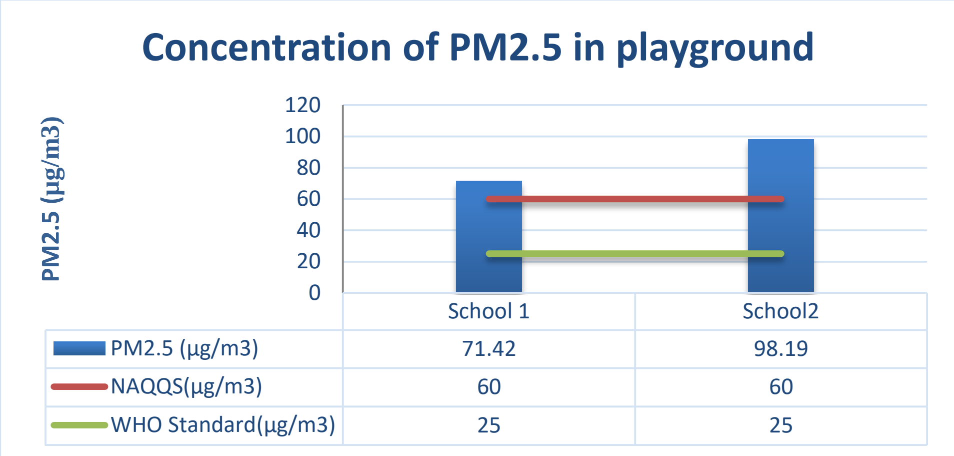
The instrument used in Kanpur provides results for particle count for fixed particle size ranges. Figure 15 depicts particle count for PM3.0.

Figure 15: variation of PM3 inside class room in Kanpur.



The particulate matter less than 3µm show a gradual decreasing trend over time. In the early hours, during start of school, levels are high and taper gradually. Levels are consistently higher inside classroom in school 4 compared to school 3. The average amount of PM3 in school 3 is $2.07*10^8$ (particles/m^3), which is less than the average $3.67*10^8$ (particles/m^3) in school 4. It must be noted here that although the levels are rather high, no standards are yet available for assessment of air quality in terms of particle counts.

Figure 16: Concentration of PM2.5 in play ground in Delhi

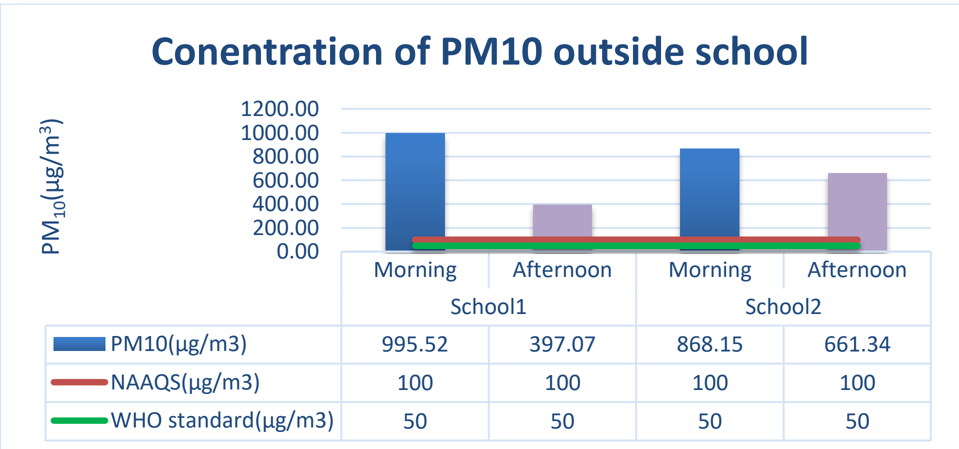


The concentration of $PM_{2.5}$ in the playground of both school was found to exceed National ambient air quality standard and WHO 24 hrs mean standard. The concentration of PM2.5in the playground of $School_1$ was found lower than in $School_{2.}$ The playground in $School_1$ is quite large lies nearby a small forest, which might be the reason for the lower concentration of $PM_{2.5}$.

PM_{10}

The concentration of ambient air pollutants with respect to an aerodynamic diameter of less than 10µg i.e. PM_{10} of two schools are given in chart. Among the two schools, the concentration of PM_{10} was almost 10 times higher than NAAQS India (100µg/m^3) and 20 times higher than WHO standard (50 µg/m^3) for 24-hr mean in $School_1$ (995.52µg/m^3). While in $School_2$ the concentration of PM_{10} was 868.15µg/m^3exceeded both NAAQ and WHO standard. However the concentration of PM_{10} in the afternoon was found relatively lower than in the morning, but exceeded both NAAQ and WHO standard.

Figure 17: Concentration of PM10 outside school Delhi



The concentration of PM_{10} inside the classroom was found to exceed both NAAQ and WHO standard (24-hrs mean). The concentration in $School_1$ was found relatively higher than in $School_{2.}$ In $School_1$ chalk was used to write on the black boards to teach and the movement of students during break time might be the reason of the high concentration of PM_{10}inside the classroom, but contribution to such a high extent seems almost impossible.

Figure 18: Concentration of PM10 inside classroom in Delhi

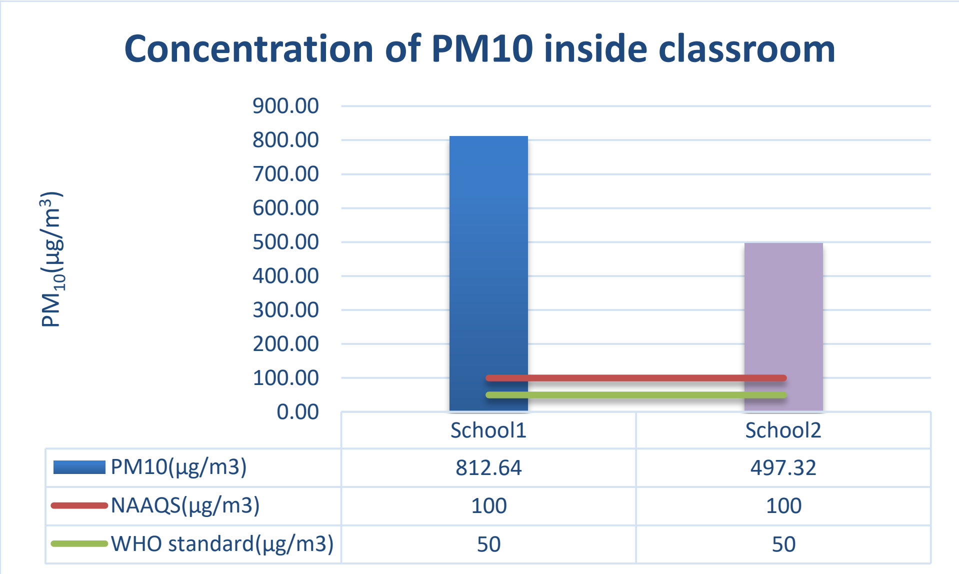
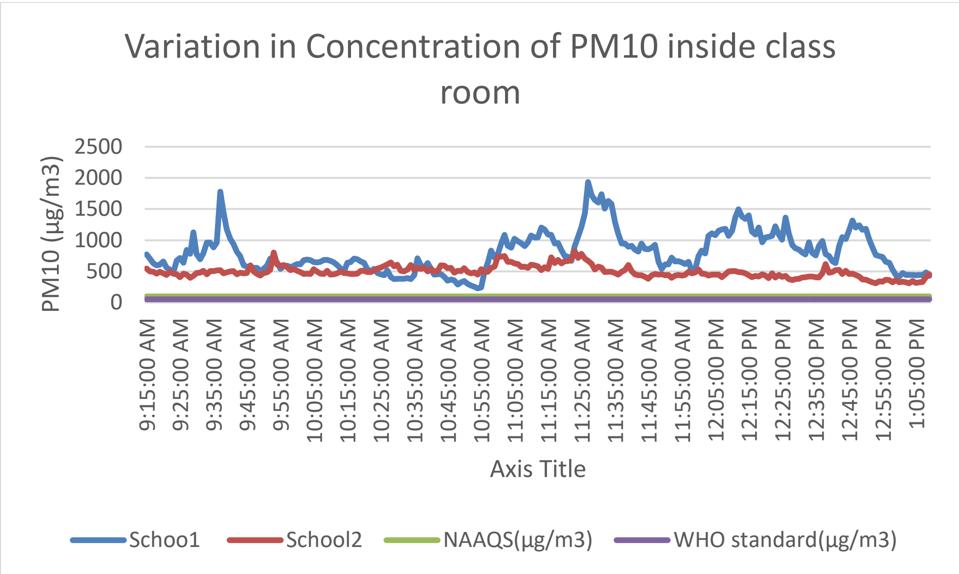


Figure 19: Variation in concentration of PM10 inside classroom in Delhi



The result of indoor monitoring in both the schools showed that all the studied $PM_{2.5}$ concentration value in the classroom can be considered high in comparison with WHO guideline of 50 µg/m^3 24-hour mean and NAAQ standard. In about 4 hrs continuous monitoring the PM_{10}concentration was ranged from 311.3 µg/m^3 to 826.6 µg/m^3 in School$_1$ and from 227.1 µg/m^3 to 1931.3 µg/m^{3}in School$_2$.

The concentration of PM_{10} in the playground of School$_1$ and School$_2$ was found almost same, but exceeded both NAAQ and WHO standard (24-hrs mean).

In Kanpur, just as in the case of PM3, the particle concentration of PM_{10} inside classroom is higher in school 4 averaging $3.68*10^8$ (particles/m^3) compared to school 3 averaging $2.08*10^8$ (particles/m^3).

Figure 20: variation of PM10 inside classroom in Kanpur

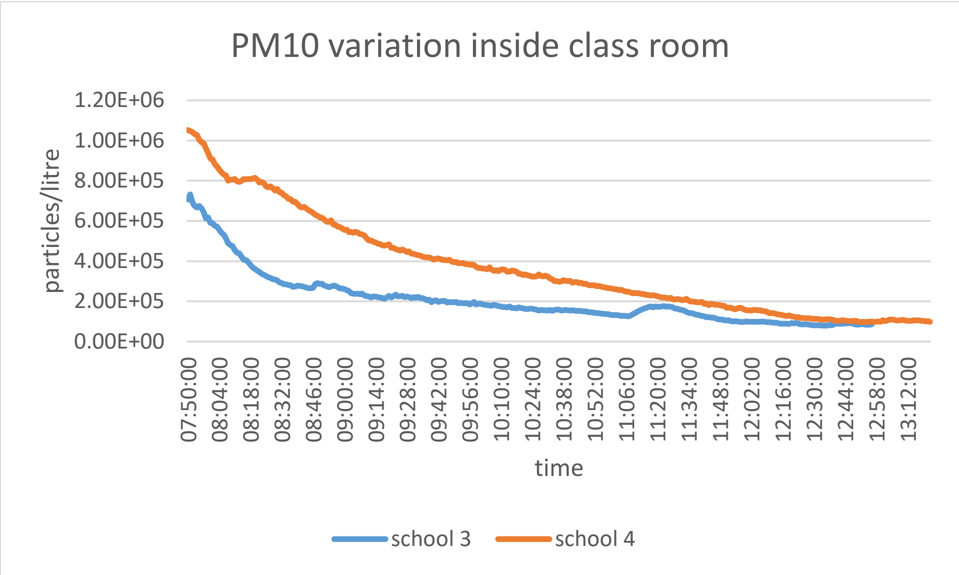
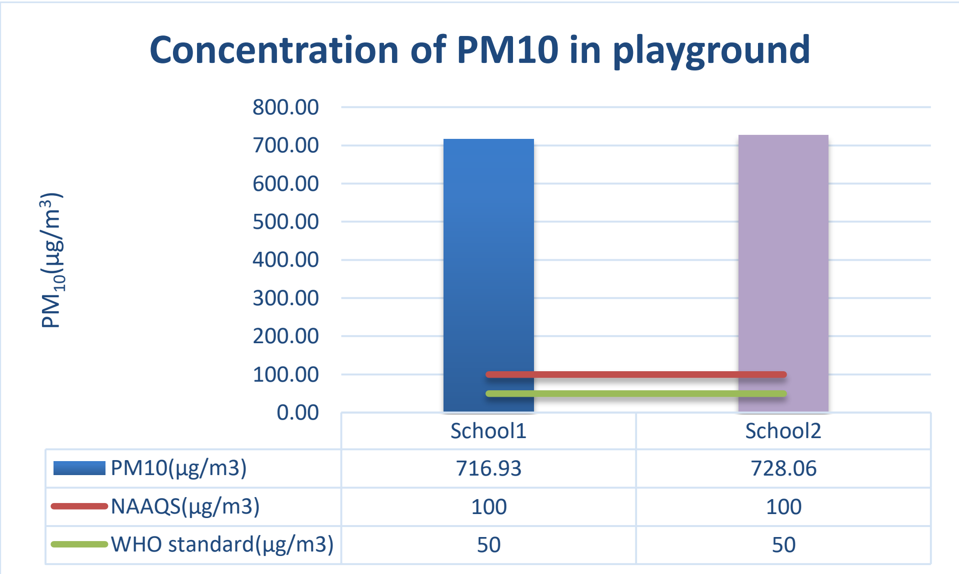


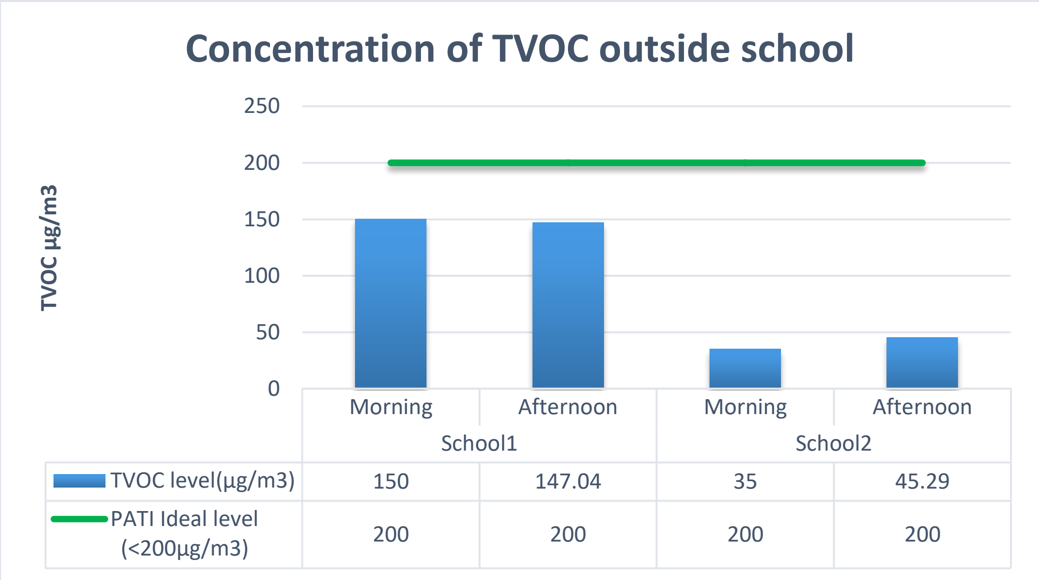
Figure 21: Concentration of PM10 in playground in Delhi school



8.2 Total Volatile Organic Compounds (TVOCs)

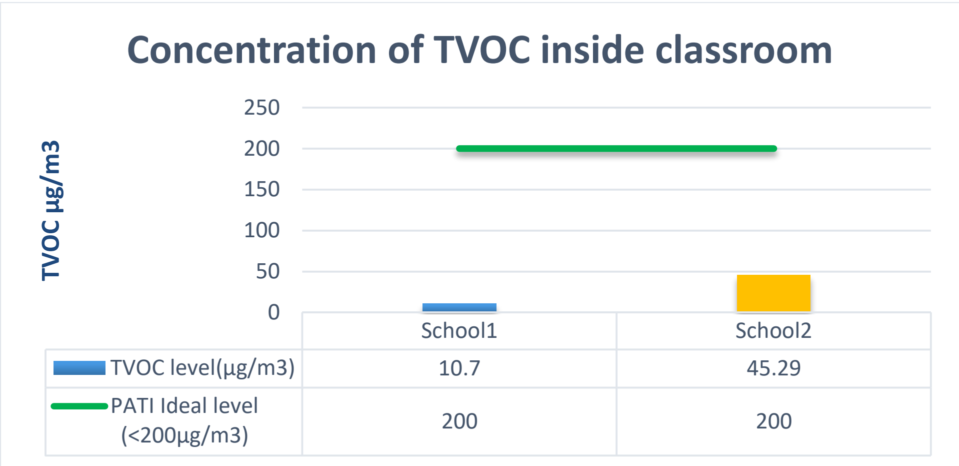
Total Volatile Organic Compound (TVOCs) is the group of organic Chemical compound present in ambient air. There is no specific standard for permissible exposure level for TVOCs. According to Prism Analytical Technologies, Inc. (PATI) the concentration of TVOC less than 200µg/m^3 is an ideal level for home or office.

Figure 22: Concentration of TVOC outside school in Delhi



Comparatively in School$_1$ the concentration of TVOC during morning and afternoon hours outside the schoo$_l$ was found higher than in School$_2$. But the concentration of TVOC in both schools were found within PATI Ideal level (<200µg/m^3).

Figure 23: Concentration of TVOC inside classroom in Delhi

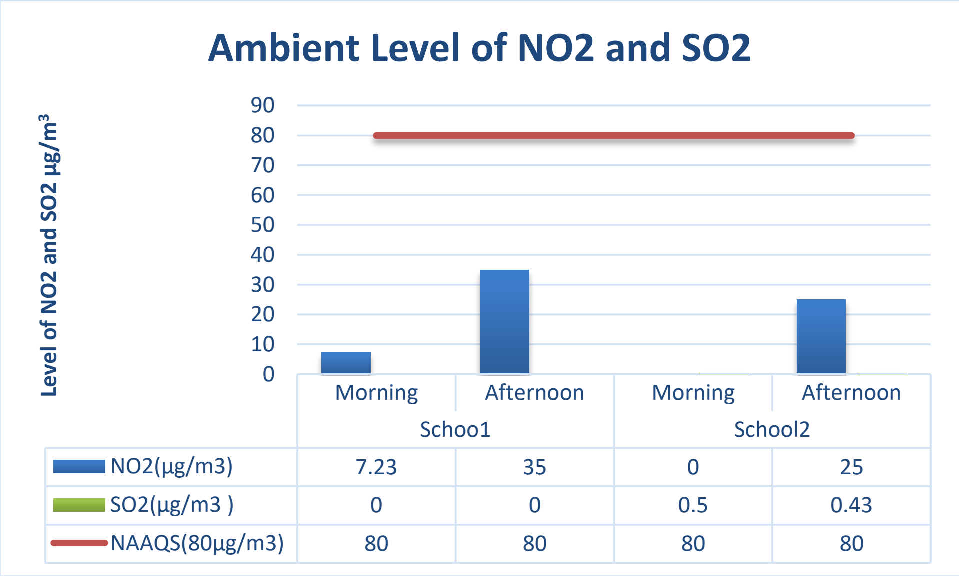


The concentration of TVOC inside the classroom was found to be within PATI Ideal level (<200µg/m^3) and below 50µg/m^3. The concentration of TVOC inside the classroom of School$_1$ was found relatively very low with a concentration of 10.7µg/m^3.

8.3 Ambient level of NO_2 and SO_2

The ambient NO_2 and SO_2 level in School$_1$ and School$_2$are given in the figure24. The ambient NO_2levels in and around the school areas varied between 0 to 35 µg/m^3.The average NO_2level in School$_1$in the morning was observed to be 7.23µg/m^{3}and 35µg/m^3 in the afternoon. While in School$_2$ the ambient level of $NO_2$was 0 and 25 µg/m^3 respectively. The level of $SO_2$was almost 0µg/m^{3}except in School$_2$ which was 25µg/m^{3}in the afternoon. The ambient level of $NO_2$and SO_2outside school was found within a NAAQ India standard of 24-hr mean (80µg/m^3 for NO_2 and 80µg/m^3 for SO_2).

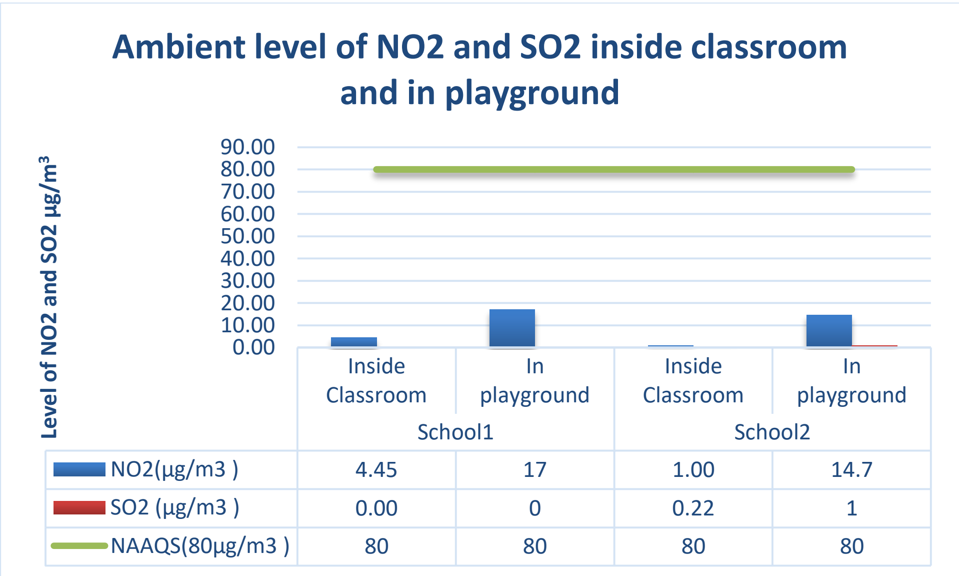
Figure 24: Ambient level of NO2 and SO2 outside school in Delhi



	Schoo1 Morning	Schoo1 Afternoon	School2 Morning	School2 Afternoon
NO2(µg/m3)	7.23	35	0	25
SO2(µg/m3)	0	0	0.5	0.43
NAAQS(80µg/m3)	80	80	80	80

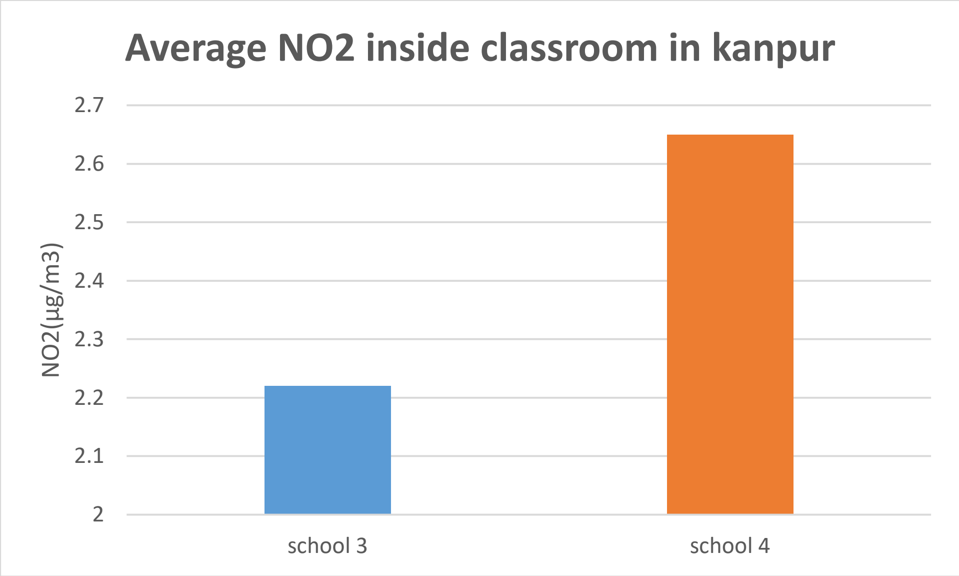
The concentration of NO_2 and SO_2 inside classrooms playground in both schools was found within NAAQ standard of 24hr-mean (80 µg/m^3 for NO_2 and 80 µg/m^3 for SO_2). Comparatively the ambient level of NO_2 was observed higher than in School$_2$, where the level of SO_2 was almost 0 µg/m^3 for both schools.

Figure 25: Ambient level of NO2 and SO2 inside classroom and in playground



	School1 Inside Classroom	School1 In playground	School2 Inside Classroom	School2 In playground
NO2(µg/m3)	4.45	17	1.00	14.7
SO2 (µg/m3)	0.00	0	0.22	1
NAAQS(80µg/m3)	80	80	80	80

Figure 26: NO2 levels inside classroom in Kanpur.

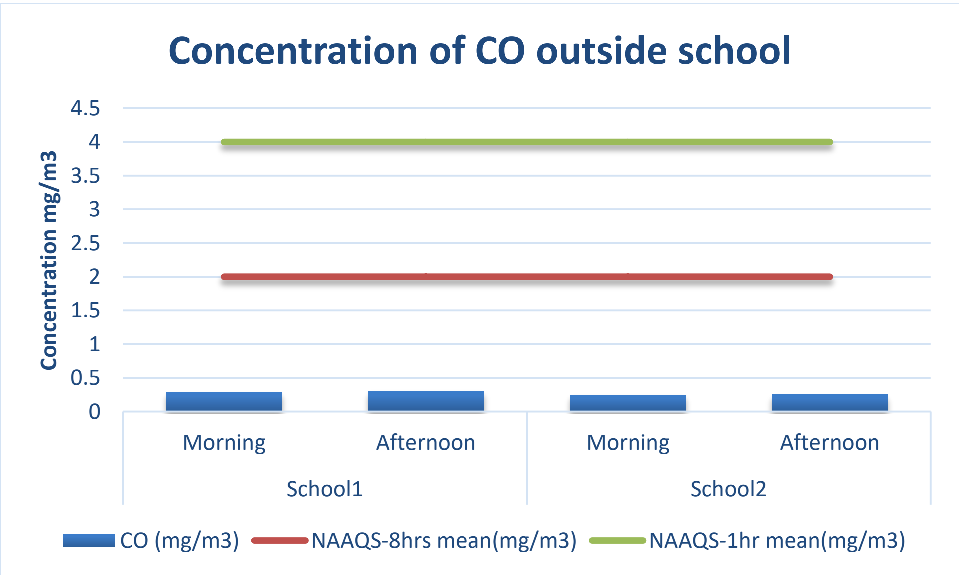


The NO_2 levels are found well below the NAAQ standards inside classroom in Kanpur.

8.4 Concentration of Carbon monoxide (CO)

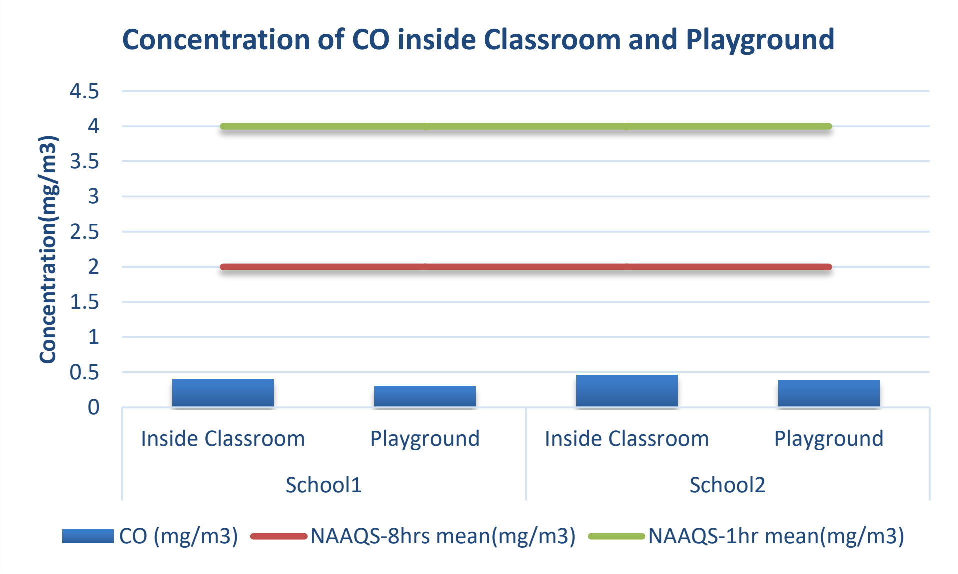
Often called the invisible killer, carbon monoxide is an odourless, colourless gas created when fuels (such as gasoline, wood, coal, natural gas, propane, oil, and methane) burn incompletely. The school paper/waste burning, vehicles and running generators are potential sources of carbon monoxide.

Figure 27: Concentration of CO outside school in Delhi



The concentration of CO outside the schools during the morning and afternoon hours was found within a NAAQS-8hrs mean (2mg/m^3) and 1hr mean (4mg/m^3) in both schools.

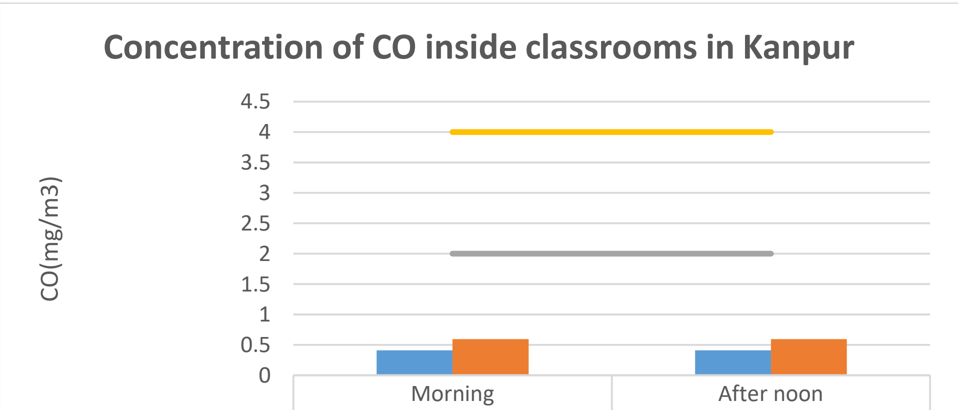
Figure 28: Concentration of CO inside classroom and in playground in Delhi



After4hrscontinuous monitoring, the concentration of CO inside classrooms in both schools was found within NAAQS 8hrs and 1hrs mean. The concentration of CO in the playground was also in NAAQS, but children are spending almost 8hrs inside the schools and a person can be poisoned by a small amount of CO over a longer period of time or by a large amount of CO over a shorter amount of time (Evarts, 2012).Young children are especially vulnerable to the effects of carbon monoxide because of their smaller bodies. Children process carbon monoxide differently than adults, may be more severely affected by it, and may show signs of poisoning sooner.

The CO levels for both schools in Kanpur are found well below the NAAQ standards inside the classroom.

Figure 29: Concentration of CO inside classroom in Kanpur



	Morning	After noon
school 3	0.4122	0.4122
school 4	0.5954	0.5954
NAAQS 8h mean	2	2
`NAAQS 1hr mean	4	4

9. Summary of Results

9.1 Summary for Delhi

Although children are particularly vulnerable to the toxic effects of air pollution because of more outdoor exposures, the study suggests that the ambient and indoor air quality in and around the studied school area is poor. The result indicates that the concentration of Particulate Matter PM_{10} and $PM_{2.5}$ is higher than NAAQ India standard and WHO guideline the average concentration of $PM_{2.5}$inside classroom for $School_1$ was 87.4µg/m^3 and for $School_2$ it was 97.75 µg/m3, which is almost 3 to 4 times higher than WHO guideline. While the concentration of PM_{10} was found to be exceptionally high not only in the classrooms, but also in the playground and near the school gate.

The mode of commute of students was private vehicle (50.13%) and school bus (35.98%). The concentration of PM10 and PM2.5 near school gates was observed significantly high (995.52 µg/m3 and 171µg/m3) in the morning time because the private and school vehicles reach at the same time to drop the students. The emissions from the vehicles that drops the students could be the reason for the high levels of PM, since diesel vehicle exhaust is known source of PM emissions. The stop and go and the congestion that is caused due to the high number of vehicles leads to idling which leads to higher concentration in the ambient air. Similarly, from 11 to 11:30 am the concentration was very high inside the classroom because that was break time and movement of student was high, but contribution to such a high extent seems almost impossible. While in the afternoon it was recorded high from1: 30 to 2 pm when there was high movement of vehicles and students outside the school gate.

It was also observed that other air pollutant elements such as TVOC, NO2, SO2 and CO are within NAAQ India standard, but it does not mean that the environment is good. The presences of air pollutants mean there is higher chances of health effects on children. There are enough evidences which establish that children are more susceptible to air pollution over a long period of time or by a large amount of air pollutants over a short amount of time. This might be the reason why about 50% students in Delhi were found suffering from cough, sneezing, phlegm, allergy and itching of the eyes.

Based upon the result, around 56.57% students had normal FVC % of predicted value, 58.30% had normal FEV_1% of predicted value and 95.19% had normal FEV_1/FVC % of predicted value. If we compare the result between these two schools, we can conclude that students of $School_1$ seem to have suffered more than $School_2$.While 32.66% of student had mild and 11.64% had moderate FVC% of predicted values. Same as 30.41% of student had mild, 10.04% had moderate and 1.21% had severe FEV_1 % of predicted values.

The results showed that there is still good no. of students who are suffering and urgent steps need to be taken. Exposure to tobacco smoke at home due to cigarette smoking increases the possibility of lung function deficits in children. It was also found that around 49.87% of households reported burning mosquito repellent coils and about 40.47% of households were found to burn incense, which might be a cause for respiratory illness and problem in the lungs.

9.1 Summary for Kanpur

In Kanpur, It was observed that levels of gaseous pollutants CO, NO_2 measured inside the classroom are well below the NAAQ standards of India. Levels inside classroom and in playground for NO2 and SO2 are within permissible limits. Levels of particles, $PM_{2.5}$, and PM_{10} inside the classroom were in the range of $>10^6$ particles/m^3 of air, which is rather high and compares well with particle number concentrations reported for emissions from automobile exhaust. Although no standards are available, it seems that the recorded levels would not be in the acceptable range. Variation of PM with respect to time has a decreasing trend, which indicates the outdoor pollutant's intervention in the early school hours.

The health issues like phlegm, Sneezing or a runny or blocked nose and cough with cold are high in students. Nearly 80% of the respondents of the survey reported with these health issues. Almost one third of respondents did not report any major air polluting activity being practised at home although 11% of respondents reported mold/mildew in rainy season only, and 3% reported mold/mildew on most days of the year. These observations show the likelihood of presence of health risk inside the schools or houses.

9.3 Comparison of results from Delhi and Kanpur

Questionnaire survey provides important information related to lifestyle and health of children in the schools which are part of this study. The impact of availability and affordability of basic necessities is evident. For instance, percentage of families using electricity for cooking purposes is twice as large in Delhi (~20%) than in Kanpur (~10%) which faces acute electricity shortage in Kanpur.

One third of respondents in Kanpur state no use of air polluting processes, mentioned in the questionnaire, at student homes. Actions indoors that lead to greater pollution, mainly incense burning and use of mosquito coils, occur much more in Delhi but air clarifying techniques are also practised in mush larger percentage of homes in Delhi. On the whole, it appears that condition of indoor air in student households in Kanpur is better than in Delhi. Based on data compiled for child health records, it seems that children in Kanpur face lesser health issues, and at much lower frequency, than children in Delhi. It is heartening to note that almost one third of the responses received in Kanpur reported no health problems in the last 12 months. ***The link between indoor air quality at homes and lesser reported occurrence of health problems such as asthma, bronchitis in students from Kanpur as compared to Delhi needs further examination.***

Air quality both inside the classrooms and outdoors in school premises in Delhi is of concern. The levels of PM2.5 and PM10 are much higher than permissible levels. Similarly, for Kanpur, the particle count is quite large. In terms of gaseous pollutants, levels inside classroom and in playground for NO2 and SO2 are within permissible limits. The levels in both schools in Kanpur are more than 3 orders of magnitude lower than in Delhi.The fact that levels in School 4, which is located closer to traffic intersections than School 3, are almost half, strongly suggests re-examination of location priorities of schools.

Conclusion

This preliminary study provides an overview of the health impacts faced by children due to presence of pollutants in ambient air quality which is greatly influenced by human activity. The findings and methodology of this study can be employed to further study air pollution in school and its health effects on children. This can go a long way to develop concrete plans aimed to reduce air pollution levels. Government of India is taking initiative to further develop policy and enact laws keep citizens informed and to curb pollution. Recent launch of Air Quality Index (AQI) is a positive step to keep people informed and make them aware of the problem. The next step for the government is to initiate sustainable measures that encourages mass involvement and helps to slow down the level of air pollution.

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Annexes

Annex 1: Photographs

Equipments used in air quality monitoring

During air quality monitoring nearby school gate

Level of crowdness after school

Source of air pollution; Generator nearby school

Government air quality index nearby school

Students in playground during AQ monitoring

Annex 2: National Ambient Air Quality Standard (NAAQ), CPCB

NATIONAL AMBIENT AIR QUALITY STANDARDS
CENTRAL POLLUTION CONTROL BOARD
NOTIFICATION
New Delhi, the 18th November, 2009

No. B-29016/20/90/PCI-L—In exercise of the powers conferred by Sub-section (2) (h) of section 16 of the Air (Prevention and Control of Pollution) Act, 1981 (Act No.14 of 1981), and in supersession of the Notification No(s). S.O. 384(E), dated 11th April, 1994 and S.O. 935(E), dated 14th October, 1998, the Central Pollution Control Board hereby notify the National Ambient Air Quality Standards with immediate effect, namely:-

NATIONAL AMBIENT AIR QUALITY STANDARDS

S. No.	Pollutant	Time Weighted Average	Concentration in Ambient Air		
			Industrial, Residential, Rural and Other Area	Ecologically Sensitive Area (notified by Central Government)	Methods of Measurement
(1)	(2)	(3)	(4)	(5)	(6)
1	Sulphur Dioxide (SO_2), µg/m^3	Annual* 24 hours**	50 80	20 80	- Improved West and Gaeke -Ultraviolet fluorescence
2	Nitrogen Dioxide (NO_2), µg/m^3	Annual* 24 hours**	40 80	30 80	- Modified Jacob & Hochheiser (Na-Arsenite) - Chemiluminescence
3	Particulate Matter (size less than 10µm) or PM_{10} µg/m^3	Annual* 24 hours**	60 100	60 100	- Gravimetric - TOEM - Beta attenuation
4	Particulate Matter (size less than 2.5µm) or $PM_{2.5}$ µg/m^3	Annual* 24 hours**	40 60	40 60	- Gravimetric - TOEM - Beta attenuation
5	Ozone (O_3) µg/m^3	8 hours** 1 hour**	100 180	100 180	- UV photometric - Chemilminescence - Chemical Method
6	Lead (Pb) µg/m^3	Annual* 24 hours**	0.50 1.0	0.50 1.0	- AAS /ICP method after sampling on EPM 2000 or equivalent filter paper - ED-XRF using Teflon filter
7	Carbon Monoxide (CO) mg/m^3	8 hours** 1 hour**	02 04	02 04	- Non Dispersive Infra Red (NDIR) spectroscopy
8	Ammonia (NH_3) µg/m^3	Annual* 24 hours**	100 400	100 400	-Chemiluminescence -Indophenol blue method

Annex 3: Sample questionnaire and logbook

QUESTIONNAIRE

Air Pollution Exposure and Health Survey

Name of School : ______________________________

Grade: ______________ Age: ______________ Gender: ______________

Height: ______________ (m) Weight: ______________ (kg)

Address: ______________________________

How long have you been living at your current address? ______________

Main streets passed by when you go to school : ______________

____

If you go to school by school bus, please fill in its route/line no.: ______________

<u>**Part I (To be answered by students)**</u>

Section A – Indoor Environment

Please tick the appropriate box.
You may select more than one answer.

Which of the following pets have you kept inside your home *during the last 12 months*?
□Dog □Cat □Bird □Other furry pets □Others:______________ □ None

Does any family member smoke inside your home *in the last 12 months*?
□ Yes □ No

If yes, how many cigarettes in total are smoked per day in your home?
□ Less than 10 cigarettes □ 10 -20 cigarettes □ More than 20 cigarettes

Which fuel has been used at your home for cooking *during the last 12 months*?
□ Electricity □ Gas □ Coal or Wood □ Others:_____________

Have there been the following indoor conditions *in the last 12 months*?
□Incense burning□ Indoor plants □Mosquito repellent burning □ Air purifier
□ Odoriferous chemical vapor □ Dehumidifier □ No

Does your apartment have moulds / mildew on the walls or ceiling *during the last 12 months*?
□ In the rainy season only□ When continuously raining □On most days of the year
□ When humidity level is high □No

Section B – Child Health Record

1. Has a doctor ***ever*** said that you have asthma? □Yes □ No
   If yes, How old were you ? _________ years old
2. Did you suffer from the following illnesses *in the last 12 months*?

   □Sinusitis□Allergic rhinitis□Bronchitis□Pneumonia

   □Eczema□Food allergy□None of these illnesses
3. Did you have the following symptoms *in the last 12 months*?
   (Tick box if the answer is 'Yes'. Leave blank if the answer is 'No')

   i. □Cough with colds□Cough apart from colds□ Night cough

   □Cough on most days (4 or more days in a week) for as much as 3 months in a year
   For how many years has this happened? __________ years

ii. □ Phlegm with colds □ Phlegm apart from colds

□Phlegm on most days (4 or more days in a week) for as much as 3 months in a year
For how many years has this happened? _________ years

iii. □ Sneezing or a runny or blocked nose with colds

□ Sneezing or a runny or blocked nose apart from colds

□ Sneezing or a runny or blocked nose on most days (4 or more days in a week) for as much as 3 months in a year, For how many years has this happened? _________ years

iv. □ Itching of the eyes

□ Itching of the eyes (4 or more days in a week) for as much as 3 months in a year
For how many years has this happened? _________ years

4. Did you ever have wheezing (whistling sound in the chest while breathing) *in the last 12 months*? If yes, i) How many attacks of wheezing did you have *in the last 12 months*? _______

ii) *In the last 12 months*, how often, on average, is your sleep been disturbed due to wheezing? □ Never woken with wheezing □ Less than one night per week

□ One or more nights per week

iii) *In the last 12 months*, has wheezing ever been severe enough to limit your child's speech to only one or two words at a time between breaths? □

5. Did you ever have wheezing(whistling sound in the chest while breathing)? □

If yes, did you have 2 or more episodes? □

i) How old were you when you had this attack? ____ years old

ii) Do you need medicine / treatment when you had an attack? □

iii) Is your breathing completely normal between the attacks? □

iv) Do you get an attack after playing hard or exercise? □

6. If you have none of these symptoms, please tick this box: □

Part II LOGBOOK (For a regular week, 5 days)

(To be filled in by child)

Date : 13- 10- 2010 (Example)

What is your trip purpose? ___________School Trip_____________________

What is your starting point and destination? Starting point: ___Home___ Destination:____School_______

Time	Walking	Waiting along roadside	On School Bus	On Private Car	On Bus	On Public Light Bus	On Tram/ Railway	On Motor Cycle	Others: _______
06:50 – 07:00	✓								
07:00 – 07:23							✓		
07:23 - 07:26		✓							
07:26 - 07:35						✓			
07:35 - 07:48	✓								
___:___ - ___:___									

Date : 13- 10- 2010 (Example)

What is your trip purpose? ____________Extra-curricular Activity Trip_____________

What is your starting point and destination? Starting point: ___School___ Destination: Activity Centre

Time	Walking	Waiting along roadside	On School Bus	On Private Car	On Bus	On Public Light Bus	On Tram/ Railway	On Motor Cycle	Others: ______
15:45 – 16:00	✓								
16:00 – 16:09		✓							
16:09 - 16:20					✓				
16:20 - 16:30	✓								
___:___ - ___:___									
___:___ - ___:___									
___:___ - ___:___									