Original Article

Association of Indoor Air Pollution with Allergic Respiratory Diseases in Paediatric Population Residing in National Capital Region

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Abstract

Background. World Health Organization (WHO) has observed that around seven million people died every year globally due to indoor air pollution. The purpose of this study is to evaluate the effect of indoor air pollution on respiratory health [bronchial asthma (BA) and/or allergic rhinitis (AR)] in a paediatric population in the National Capital Region (NCR) of Delhi, India.

Methods. A cross-sectional study to assess the factors responsible for respiratory diseases (BA and/or AR) in homes in rural areas of National Capital Region (NCR), India was done. Sixty-one households where at least one child who had symptoms of BA/AR (case households; Group A) and another 61 households with children without any symptom of BA/AR (Group B) were selected for the study. A standard questionnaire was used to collect the information about the health status of children and pollution levels in these homes.

Results. A total of 95 (43.8%) children in Group A households were found to have history of allergic respiratory diseases (n=43–BA, n=19–AR) while 33 children had both BA and AR. There was a statistically significant difference in the 24-hour particulate matter concentration (24-hour) $PM_{2.5}$ (P=0.01) and 6-hour concentration of PM_{10} (P=0.02) in Group A households as compared to Group B households. The 6-hour concentration of $PM_{2.5}$ and PM1 and 12-hour concentration of volatile organic compounds (VOCs) was found to be higher in households of Group A. Group A households also had a higher number of smokers and usage of kerosene oil for lighting of lamps.

Conclusions. Tobacco smoking, use of kerosene oil for lighting and combustion of solid fuel for cooking results in an increased level of particulate matter and VOCs in indoor air and are the major contributing factors for respiratory illness in the paediatric population. **[Indian J Chest Dis Allied Sci 2019;61:181-197]**

Key words: Allergic respiratory diseases, Indoor air pollution, Tobacco smoking.

Introduction

Air pollution is one of the major contributing factors for airway diseases. World Health Organization (WHO) reports showed that around 7 million people died every year globally due to indoor air pollution. Regionally, low- and middle-income countries had a high air pollution-related morbidity burden as per report of the WHO South-East Asia, and Western Pacific regions (2012).[1] Around 300 crore people are still using solid fuels in open fires and leaky stoves (*i.e.*, wood, crop waste, charcoal, coal and dung) for cooking and warming their homes, which produce high levels of household air pollution, including a range of health-damaging pollutants, like small soot particles that penetrate deep into the lungs. In poorly-ventilated homes, indoor smoke may contain 100 times higher than acceptable levels of fine particles. Women and young children who spent most of their time near the domestic hearth are the most affected. More than 50% of premature deaths due to pneumonia among children lesser than five years of age are caused by the particulate matter (*soot*) inhaled from household air. It is estimated that 3.8 million premature deaths occur annually from non-communicable diseases, including stroke, ischaemic heart disease, chronic obstructive pulmonary disease and lung cancer, possibly due to exposure to the polluted air inside the homes.[1]

A study from Sri Lanka[2] showed that cooks and children suffer more with respiratory health symptoms compared to households having a chimney due to lower particulate matter (PM) concentrations that may reduce respiratory health conditions. Variables, such as type of cooking stove, chimney, location of the cooking area are strong indicators for respiratory health outcomes, rather than variables associated with household characteristics and prolonged exposures associated with cooking.[2,3]

Exposure to environmental tobacco smoke (ETS) increases the risk of having carotid atherosclerotic plaque[4] respiratory tract infections, otitis media, asthma, and sudden infant death syndrome.[5] Smoking in homes needs to be discouraged to protect children from the adverse health effects of ETS exposure.[6,7] Emergency department

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visits and hospitalisations in patients with asthma increases with an increase in certain air pollutants, such as ozone (O_3), PM_{10}, $PM_{2.5}$, sulphur dioxide (SO2), and nitrogen dioxide (NO_2).[8-11] A multicenter study on sensitisation in patients with rhinitis and/or asthma in China[12] showed that the rate of sensitisation to *Periplaneta americana and Blattella germanica* was 26.3% and 19.4%, respectively.

A decrease in indoor $PM_{2.5}$ levels by using air purifiers with high-efficiency particulate air (HEPA) filters can improve nasal symptoms in children with allergic rhinitis.[13] Some studies reported a positive association between the increased concentrations of indoor air pollutants and increased prevalence of asthma, rhinitis and upper respiratory tract infection in children.[14-17]

Children exposed to higher air pollution levels are more vulnerable with increase in the severity of the disease.[18,19] Earlier studies observed that exposure to fine particulate matter (less than 2.5μm in diameter) in children are associated with decrements in lung functions in atopic boys[20], rise in paediatric emergency department visits for asthma[21], and the higher risk of hospitalisation.[22] The concentration of nitrogen dioxide (NO_2), $PM_{2.5}$, or more recently VOCs in indoor air was found to be associated with asthma and other related respiratory diseases.[23]

The present study was undertaken to assess the impact of household air pollution on respiratory health in the paediatric population having bronchial asthma (BA) and/or allergic rhinitis (AR). There is a paucity of studies from North India to correlate the indoor air pollutants (PM_{10}, $PM_{2.5}$, PM_1 and VOCs) with allergic respiratory diseases (ARDs) (bronchial asthma [BA] and/or allergic rhinitis [AR]) in children, especially in rural areas of National Capital Region (NCR).

Material and Methods

This study was conducted in 122 households with 420 children (age range 4-17 years) at Village Khanpurjupti, Loni, Ghaziabad, a rural area of Delhi-NCR, India from May 2011 to August 2015. Farming and cattle herding are the main occupations of the people of this village. The study was approved by the Institutional Ethics Review Committee and Institutional Human Ethics Committee of our Institute.

The households were divided into two groups, *viz*, Group A consists of 61 households where at least one child had symptoms of BA and/or AR were selected as case household and Group B with 61 households where no child had any symptom of BA or AR (Group B) as controls.

Prevalence of respiratory symptoms, such as cough, phlegm, sputum, wheezing and shortness of breath in the children for the last 12 months and life-time prevalence of respiratory illnesses, such as asthma, allergic rhinitis, pneumonia, and bronchitis, as diagnosed by their doctors were collected through a questionnaire by the members of our research team (*see* Annexure). The questionnaire has already been validated for Indian conditions.[24]

Detailed history including socio-economic status, indoor environmental determinants (*e.g.*, use of biomass fuels for cooking, heating, and lighting purpose, place, and type of the kitchen and history of pets), type of house (*pucca*/*kaccha*), ventilation, type of roof, use of liquefied petroleum gas, family history of respiratory illnesses and smoking history of adults and their occupation was recorded.

24-hour Measurement of $PM_{2.5}$. Fine particulate matters less than 2.5μm ($PM_{2.5}$) were measured in every household with a small portable data logging device (Modified Commercial Smoke Detector; University of California-Berkeley Particle and Temperature Sensor [UCB-PATS] equipped with a photoelectric detector) which measured and logged $PM_{2.5}$ concentration for each minute of the sampling period. The UCB-PATS were placed on the wall of the kitchen above 100cm from the combustion zone (stove or open fire) and 125cm away from the combustion zone (this height relates to the approximate edge of the active cooking area). The $PM_{2.5}$ was measured as an average daily exposure expressed as photomass in mg/m^3. The chamber of the photoelectric detector was cleaned with isopropyl alcohol after every five uses.

6-hour Measurement of PM_{10}, $PM_{2.5}$ and PM_1. Continuous measurement of dust particles (PM_{10}, [coarse], $PM_{2.5}$ [fine], and PM_1 [ultrafine] in $\mu g/m^3$) was done using the GRIMM Portable Laser Aerosol spectrometer and dust monitor (model 1.107/ 1.109, GRIMM Aerosol Technik GmbH & Co., KG, Germany), simultaneously. The PM masses are gathered in a size ranged from 0.25μm to 32μm in >30 size classes and displayed as PM values using PTFE-filter paper of the size 47mm. The sampling period of this monitor measured and logged the respirable suspended particulate matter (RSPM) concentration for every 10 minutes. The instrument was kept for six hours (record at least one cooking time reading) in these households.

Monitoring of volatile organic compounds (VOCs). Levels in parts per million (ppm) were monitored for 12 hours at a 10-minute interval using a portable VOC monitor with PID (Photoionization detection) (Phocheck Tiger, version 1.0.0.58, Ion Science Ltd, Cambridge Shire, UK). The detector is equipped with 10.6-eV ultra-voilet (UV) lamp. Isobutylene was used to calibrate PID as it is relatively moderate among the VOCs generally observed in the general environment. Furthermore, at the low concentration used for the calibration, it is easy to handle as it is non-toxic and non-flammable.[25] The recorded values were isobutylene equivalent concentration in parts per million (ppm).

Statistical Analysis

Data were analysed using Statistical Package for the Social Sciences (SPSS) (version 22.0) software. Independent t-test was used to compare means of both the groups. A two-tailed p-value of <0.05 was considered statistically significant at 95% confidential interval.

Results

A total of 420 children (age range 4-17 years) were enrolled from 122 households in both the groups; Group A had 217 children (121 males and 96 females) and Group B had 203 children (122 males and 91 females). The mean age of the children was 9.5 years (Group A) and 9.0 years (Group B), respectively.

The prevalence of allergic respiratory diseases (ARDs) was significantly higher in households with the poor socio-economic status (Group A [54.1%] *versus* Group B [36.1%]; P=0.046) in the present study (Table 1).

Table 1. Demographic Profile of Households

Parameters	Number of Households (n=122)		
	Group A (n=61) No. (%)	Group B (n=61) No. (%)	P-value
Socio-economic status			
Lower	33 (54.1)	22 (36.1)	0.046
Middle	23 (37.7)	34 (55.7)	0.046
Higher	5 (8.2)	5 (8.19)	1.0
Smoking households	42 (68.9)	35 (57.4)	0.19
Smokers in households	65 (59.6)	44 (40.4)	0.004
Outside smoker's visits			
Daily	11(18.3)	7 (11.5)	0.31
Few times a week	8 (13.1)	5 (8.2)	0.38
Smoking in front of children	29 (56.9)	22 (43.1)	0.16
Occupancy			
≤3	49 (80.3)	45 (73.8)	0.06
>3	12 (19.7)	16 (26.2)	0.06
Ventilation in room			
Good	39 (63.9)	50 (82.0)	0.025
Not good	22 (36.1)	11(18.0)	0.025
Type of kitchen			
Parts of main house	2 (3.3)	2 (3.3)	1
Separate	38 (62.3)	47 (77.1)	0.07
Verandah	21 (34.4)	12 (19.7)	0.068
Fuel used in households			
Bio-mass fuel (BMF)	45 (73.8)	45 (73.8)	1.0
Liquefied petroleum gas (LPG)	10 (16.4)	11 (18.1)	1.0
Both (LPG+BMF)	06 (9.8)	05 (8.2)	0.75
Kerosene oil in lamps	23 (37.7)	9 (14.8)	0.004
Mean time spent by female child in kitchen (per day)	0.24hr	0.15hr	1.0

P-value <0.05 at 95% confidential interval is considered to be significant

Smoking was more prevalent in households of Group A compared to Group B (68.9% *versus* 57.4%; P=0.19), that was not statistically significant. The number of smokers were significantly higher in Group A than Group B households (59.6% *versus* 40.4%; P=0.004). Though in Group A adults smoked more in the presence of children as compared to Group B, the difference was not statistically significant (P=0.169). Daily and a few times a week visits of outside smokers in households of Group A was more compared to Group B (18.3% *vers*us 11.5%; P=0.31 and 8.19% *versus* 13.1%; P=0.38, respectively) but statistically insignificant (Table 1).

Over-crowding was another contributing factor for the respiratory diseases in children in the present study. Respiratory diseases were more common in the children of families where more than three persons lived in one room [19.7% (Group A) *versus* 8.2% (Group B); P=0.068] (Table 1). Ventilation in the room was observed by using two parameters (Good and Not good) as per our questionnaire (*see* Annexure). 'Good' condition of ventilation was found to be significantly higher in Group B households as compared to Group A (82% *versu*s 63.9%; P=0.025 but 'Not good' condition of ventilation was observed significantly higher in households of Group A in comparison of Group B (36.1% *versus* 18%; P=0.025) (Table 1).

The use of kerosene oil for lighting lamp in the households of Group A was found to be significantly higher as compared to Group B households (37.7% *versus* 14.8%; P=0.004). No significant difference was observed in liquefied petroleum gas (LPG) usage (for cooking) in both the groups. Biomass fuel (wood, coal, and cow dung cakes) was used almost similar in both the households.

In the present study, the prevalence of ARDs was higher in children of Group A households where cooking was done in the *verandah*, compared to Group B where cooking was done in a separate room (34.4% *versus* 19.7%; P=0.068). Mean time spent by female children in the kitchen was more in Group A as compared to Group B (0.24-hours versus 0. 15-hours; P=1.0) (Table 1).

Allergic respiratory diseases. Out of a total of 217 children of Group A, 95 (43.8%) children had a history of ARDs (43, 19.8% with BA; 19, 8.8% with AR; whereas 33, 15.2% had both BA and AR (Table 2).

Table 2. Respiratory allergic diseases (bronchial asthma, allergic rhinitis and asthma with allergic rhinitis) based on questionaire (*see* Annexure)

Allergic Diseases	Number of Households	
	Group A (n=217) No. (%)	Group B (n=203) No. (%)
	>1 year respiratory history	>1 year respiratory history
Asthma +ve	43 (19.8) [M-28; F-15]	0
Allergic rhinitis +ve	19 (8.8) [M-9; F-10]	0
Asthma with allergic rhinitis +ve	33 (15.2) [M-16; F-17]	0
Total	**95 (43.8) [M-53, F-42]**	**0**

Definition of abbreviations: M=Males; F=Females; P-value <0.05 at 95% confidential interval is considered to be significant

24-hour $PM_{2.5}$ concentration. This was measured in all 122 households. The average minimum and maximum concentration of $PM_{2.5}$ in Group B households were observed to be 1.8mg/m^3 and 15.7mg/m^3, respectively; whereas these were 6.3mg/m^3 and 27.1mg/m^3, respectively among the households in Group A. The mean $PM_{2.5}$ values in the households (Group A) with children having respiratory diseases were found to be significantly higher than Group B (10.3mg/m^3 *versus* 4.2mg/m^3; P=0.01) (Figure 1).

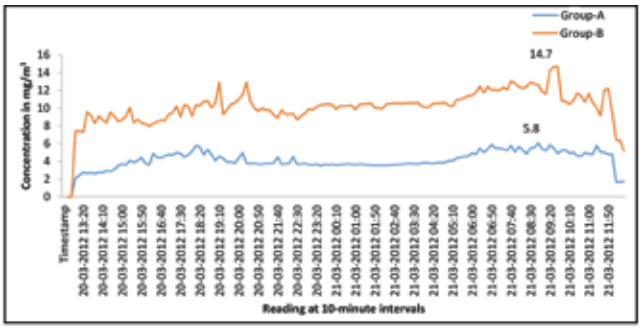

Figure 1. Comparison of mean concentration of 24-hour $PM_{2.5}$ at 10-minute interval showing maximum peak (at the cooking time) of $PM_{2.5}$ in both the groups.

6-hour PM_{10}, $PM_{2.5}$, and PM_1 concentration. A higher difference was observed in the concentration of particulate matters during cooking hours between group A and B households. The values for PM_{10} were significantly high in group A households as compared to group B (351.3µg/m^3 *versus* 261.3µg/m^3; P=0.02). However, values for $PM_{2.5}$ (154.1µg/m^3 *versus* 123.2 µg/m^3; P=0.12) and PM_1 (120.5µg/m^3 *versus* 97.1µg/m^3; P=0.19) were also found to be high in Group A, but statistically insignificant.

12-hour VOCs concentration. The average concentration levels of VOCs were higher in Group A compared to Group B households, but was not statistically significant (2.42ppm *versus* 1.1ppm; P=0.09) (Figure 2).

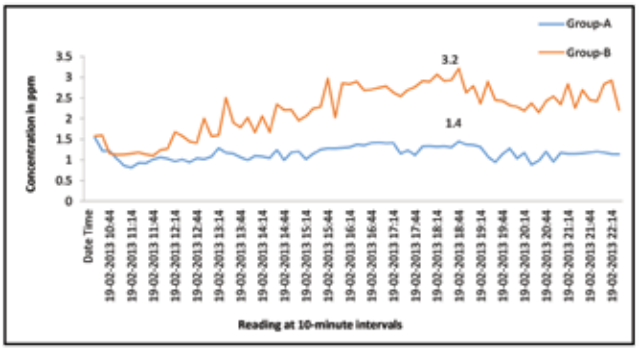

Figure 2. Comparison of mean concentration of 12-hour VOCs at 10-minute interval showing a maximum peak (at the cooking time) in both the groups.

Correlation of indoor air pollutants with allergic respiratory diseases. ARDs found to be increased significantly with the level of VOCs in Group A (P=0.025) as compared to Group B households. ARDs were also increased with the increasing level of 24-hour $PM_{2.5}$ (P=0.326), 6-hour PM_{10} (P=0.300), 6-hour $PM_{2.5}$ (P=0.810) and 6-hour PM_1 (P=0.627); but was not statistically significant.

Discussion

Exposure of children to indoor air pollution is a common factor for ARDs. The results of the present study showed that there is a significant and consistent association between the indoor air pollution and the respiratory diseases among the children who lived in rural areas of NCR.

In the present study, we observed that due to high exposure to the kerosene oil fumes; children in rural areas of NCR developed various respiratory symptoms, such as breathlessness (55.7%), fever (47.1%), and cough (31.4%), as lighting was basically done by the burning of kerosene oil. In an earlier study, kerosene oil has been significantly observed to cause higher respiratory symptoms in children with a mortality rate of 4.3%.[26] A combination of various gases and particulate matter is released during combustion that pollutes the indoor air of the homes. These mixtures of gases and particles are responsible for weak host defenses against respiratory infections that lead to an increased predisposition to respiratory infections.[27]

Over-crowding was also an important factor to develop respiratory diseases in children besides other factors, *i.e.* age, gender, parent's education, history of child's allergies (food, drugs, or pollen), history of eczema, parental asthma, parental chronic obstructive pulmonary disease (COPD) and age of the household.[28]

A relationship between passive smoking and the occurrence of respiratory symptoms among children has been reported by some workers.[29-36] The results of our study highlight that ETS increases the risk of respiratory diseases in children which depends on the presence of smoking in a household, number of smokers in a household, duration of smoking in the presence of children and daily outside smoker's visit to the household. Children exposed to ETS presents with chronic coughing with sputum. Another study reported a decrease in these symptoms in households having good indoor air ventilation.[37] Everyday exposure to indoor air pollution was associated with a higher risk of childhood asthma. Specific effects could occur in rural environments where ventilation in the households is poor as compared to urban areas.[38] A study showed that asthma was more frequent and often uncontrolled in children from families with low socio-economic status.[39] We also observed in the present study that children who belong to low-income families suffered more with respiratory diseases compared to families with middle- and higher-income groups.

Conclusions

In the present study, we observed that the raised levels of PM_{10}, $PM_{2.5}$, PM_1, VOCs, passive smoking, poor ventilation in the room and low socio-economic status causes allergic respiratory diseases among children of rural households. Observations of the present study highlights that by reducing the level of particulate matters (PM_{10}, $PM_{2.5}$, and PM_1), volatile organic compounds and burning of kerosene oil in the indoor air of the households in rural as well as the urban area of National Capital Region may improve clinical outcomes of respiratory diseases among the children. It is very vital to create awareness about the harmful effects of indoor air pollution by educating the citizens (children as well as adults) by involving schools, colleges, workplaces and public areas with the help of government departments and non-governmental organisations.

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Annexure

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Questionnaire

Indoor Air Pollution and Asthma Exacerbation in Children: A Population Based Study

Principal Investigator – Dr. Raj Kumar

House No: ----------

Chief of Family: ---------- **Patient Code: ----------**

Baseline Interview

Serial No:	Date & Time of Enrollment:
Informant with Relation:	Interviewer:
Address & Telephone No:	

SECTION I

Section I of this questionnaire deals with General Information about the child

01. Name of the Child : Last Name ---------- First Name ----------
02. Father's Name : Last Name ---------- First Name ----------
03. Mother's Name: Last Name ---------- First Name ----------
04. Age: ----------
05. Sex: [Male–(M)/Female–(F)] ----------
06. Number of Brothers & Sisters: ---------- & ----------
07. Date of Birth: ----------
08. Birth Order: ----------
09. Education: Illiterate (1)/Primary (1 to 5) (2)/ Middle (6 to 8) (3)/
    Higher (9 to 12) (4)/More than 12 (5) ----------
10. Religion: Hindu (1)/Muslim (2)/Christian (3)/Sikh (4)/Others (O) ----------
11. Occupation: Shop (1)/Office (2)/Farming (3)/Non Polluted Factory (4)/
    Polluted Factory (5)/Labor (6)/Student (7)/Others (O) ----------
12. Food Habit: Vegetarian (1)/Non vegetarian (2) ----------
13. Years of Breast Feeding: ----------
14. Name of School: ----------
    Class & Section ---------- Distance of School from your Home (in Km) ----------
15. How goes to School: Bus (1)/Train (2)/Car (3)/Three Wheeler (4)/Motercycle (5)/
    Scooter (6)/Bicycle (7)/On foot (8) ----------
16. Smoking Status: Never Smoked (1)/Ex-smoker (2)/Current Smoker (3) ----------
    (a) Type of Smoking: Cigarette (1)/Bidi (2)/Cigar (3)/Hukka (4)/Others (O) ----------
    (b) Age of Start Smoking: ---------(c) Duration:---------(d) Quantity per day: ----------
17. Smokeless Tobacco:
    (a) Type: Khaini (1)/Gutka(2)/Pan(3)/Pan Masala (4)/Others (O) ----------
    (b) Quantity per day ---------- (c) Duration of use ----------

SECTION II

Section II of this questionnaire concerns with the Family and Household of Child

19. Type of Family: Nuclear (1)/Joint (2) /Extended (3)/ Others (O) ----------
20. Total Number of Family Members (including child): ----------
21. Number of Adults in the Family: Male: --------- Female: ----------
22. Number of Children in the Family: Male: --------- Female ----------
23. Family Monthly Income: <1000(1)/1000-3000(2)/3000-5000(3)/5000-10000(4)/>10000(5) ----------
24. Socio-economic Condition: Lower (1)/Middle (2)/Upper (3) ----------
25. Details of Family Member(s): ----------

Relation with Child	**Age (in years)**	**Occupation:** ***Shop/Office/Polluted Factory/ Non Polluted Factory/ Labour/ Farming/ Unemployed/ Others***	**Education:** ***Illiterate/Primary/ Middle/Higher/ Graduate/More than Graduate***	**Suffering from Any Disease**
Father				
Mother				
Grand Father				
Grand Mother				
Uncle 1				
Aunty 1				
Uncle 2				
Aunty 2				

26. Smoking Habits of Family Members:
If any of the family members are smoker/ex-smokers then give the details:

Smokers in Family	**Type of Smoking**	**Age at Start**	**Duration**	**If Left, How Many Years**	**Number Per Day**		**Packs/ Year**
					Total	**In home**	

A. How many family members smokes at house: ----------
B. Place in home where people smoke? ----------
C. Are people smoke in front of children? Yes/No ----------

27. Do you Think Smoking Affects your Child's Health? Yes/No ----------
28. What is the Frequency of Visiting the Outside Smokers at your Home?
Daily (1)/Few times a week (2)/Few times a month (3)/Occasionally, rarely (4) ----------
If Yes, how many outside smokers visits and smoke at your home? ----------

SECTION III

Section III deals with Indoor Structure of Home

29. For how long you are staying in this home? ----------
30. Distance from the main road (in Meters): ----------
31. House characteristics: Own (1)/Rented (2)/Others (O) ----------
32. General construction of house:
    Clay (1)/Constructed home (by cement & bricks) (2)/*Juggi – Jhopdi* (3)/ ----------
    Others (O) If 'O' then (specify) ----------
33. Total area of home (in yards): ----------
34. Number of rooms including the drawing room? ----------
35. Occupancy per room: ----------
36. Floor of residency: Ground (G)/Ist floor (I)/IInd floor (II)/IIIrd floor (III)/Others (O) ----------
37. Sanitary condition: Good/OK/Not good ----------
38. Ventilation: Good/OK/Not good ----------
39. Toilet: Yes/No ----------
40. Animals and Pets: Yes/No ----------
41. Equipments used in the home:
    a. Air-conditioner ---------- b Electric fan ----------
    c. Heater during the winter ---------- d. Candles when no electricity ----------
    e. Exhaust fan ---------- f. Lamp (Kerosene oil) ----------
    g. Refrigerator ---------- h. Engine Chara Machine ----------
    i. Generator ---------- j. Others (specify) ----------
42. Kitchen type: Part of main house (1)/Separate room (2)/Verandah (3)/Open area (4) ----------
    (a) Type of roof of kitchen:
    Mud or cow-dung (1)/Ferro- cement (2)/Iron sheets (3)/Thatch (4)/Others (O) ----------
    (b) Permanent ventilation in roof:
    None (1)/Small (less than 3 inches in diameter) (2)/
    Large (more than 3 inches in diameter) (3)/Others (O) (describe) ----------
    (c) Kitchen with exhaust: Yes/No ----------
    (d) Fuel for cooking used:
    LPG (1)/Coal (2)/Wood (3)/Kerosene (4)/Cow-dung cakes (5)/ Electric (6)/
    Agriculture crop waste (7)/Others (O) ----------
    (e) On an average how many hours a day you use above fuel for cooking (hr/day): ----------
    LPG (hr/day) ----------
    Coal/Wood/Cow-dung cakes/Agriculture crop waste (hr/day) ----------
    (f) If child is female, then how much time she spends in kitchen? ----------
43. How many hours the child spends in his house per day: ----------
44. Sewage disposal: Public sewer (1)/Septic tank (2)/Leach field (3)/Dug well (4)/Others (O): ----------
45. Any outdoor pollution sources nearby the locality:
    Specify: ----------
46. What is the general perception about air quality in your locality?:
    Good (1)/Fair (2)/Bad (3) ----------
47. Source of drinking water:
    Public tap (1)/Tube-well (2)/Ground water (3)/Others (O) ----------
48. How many public parks are there in your locality?: ----------

SECTION IV

This section deals with the General Awareness

GENERAL AWARENESS: Indoor Air Pollution

49. Do you know about indoor air pollution Yes/No ----------
50. Have you any idea about the sources of indoor air pollutants? Yes/No ----------
    If Yes, please specify: ----------
51. Do you think your home has polluted indoor air? Yes/No ----------
52. Do you think indoor air pollution effects on your child? Yes/No ----------
53. Are you aware that indoor air pollution causes illness? Yes/No ----------
54. If Yes, please describe the diseases:

GENERAL AWARENESS: Outdoor Air Pollution

55. Do you know about outdoor air pollution Yes/No ----------
56. Have you got any idea about the sources of outdoor air pollutants? Yes/No ----------
    If Yes, please specify: ----------
57. Do you think your area has polluted outdoor air? Yes/No ----------
58. Are you aware that outdoor air pollution causes illness? Yes/No ----------
59. If Yes, please describe the diseases:

SECTION V

This section deals with the Major Chronic Chest Symptoms

HEALTH HISTORY OF CHILD

A. COUGH

01. Does the child frequently get a cough? (Exclude clearing of throat) YES/NO
02. Does the child usually coughs when get up in the morning? YES/NO
03. Does the child woken up with an attack of coughing at night? YES/NO
04. In the past 12 months, have the child had a dry cough at night, apart from a cough associated with a cold or chest infection? YES/NO
05. In which season the child get cough more often: Winter (1)/Summer (2)/Rains (3)/Same in all seasons (4)/ Change of season (5) --------

B. PHLEGM

06. Does the child frequently bring up phlegm or sputum from chest? YES/NO
07. Does the child usually bring up phlegm or sputum in the morning? YES/NO
    a. Colour of Phlegm ---------- b. Quantity of Phlegm (Tea spoon/day) ----------

C. SHORTNESS OF BREATH

08. Does the child ever suffered repeatedly in the past with shortness of breath? YES/NO
09. Does the child get short of breath on running or playing? YES/NO
10. Does the child get breathing problem with wheezing after catches a cold? YES/NO
11. In which season, the child gets short of breath more often: Winter (1)/Summer (2)/Rains (3)/Same in all seasons (4)/ Change of season (5) ----------

D. WHEEZING

12. Does the child ever get wheezing or whistling sound in breathing or chest in past? Yes/No
13. Did the child get wheezing or whistling sound in chest in the: Last week (1)/Last month (2)/Last 3 months (3)/Last 6 months (4)/Last 1 year (5) ----------
14. Does this wheezing or whistling sound occur:
    a. After a “cold"?
    b. After running or severe exercise?
    c. When the child is exposed to dust/smoke/strong fumes/smells?
    d. When the weather or season changes?
15. How many attacks of wheezing the child had in the past 12 months? None (1)/1 to 3 (2)/4 to 12 (3)/More than 12 (4) ----------
16. In the past 12 months, how often, on an average, has the child’s sleep been disturbed due to wheezing? Never woken with wheezing (1)/Less than one night per week (2)/One or more nights per week (3) ----------
17. In the past 12 months, has wheezing ever been severe enough to limit your speech to only one or two words at a time between breaths? YES/NO
18. In the past 12 months, has the child’s chest sounded wheezy during or after exercise? YES/NO
19. Has the child ever been diagnosed to have any of the following? Asthma (1)/Allergy (2)/Recurrent bronchitis (3)/Recurrent pneumonia (4) ----------
20. Any of family members of child suffering from asthma? YES/NO
    if Yes, relation with Child ----------
21. Cough, wheezing or shortness of breath aggravated by exercise or cold air? YES/NO

E. If Diagnosed Asthma- DRUGS & MORBIDITY

22. Does the child have been prescribed any drugs for asthma (Please mention)? YES/NO
    Name of drugs----------
23. How many months the child has used drugs for asthma in last 12 months? ----------
24. Had the child admitted in the hospital for asthma in the past? YES/NO
25. How many times the child has been admitted in the hospital for asthma in last 12 months? ----------
26. Had the child admitted in the Intensive Care Unit (ICU) for asthma in the past? YES/NO
27. How many times the child has been admitted in the ICU for asthma in last 12 months? ----------
28. Had the child admitted in the Emergency Department for asthma in the past? YES/NO
29. How many times the child has been admitted in the Emergency for asthma in last 12 months? ----------

F. RHINITIS

30. Does your child get common cold/sneezing/nasal blockage frequently? YES/NO
31. In which season, the child get common cold/sneezing/nasal blockage frequently:
    Winter (1)/Summer (2)/Rains (3)/Same in all seasons (4)/Change of seasons (5) ----------
32. In which of the past 12 months did this nose problem occur?
    January (1)/February (2)/March (3)/April (4)/May (5)/June (6)/July (7), August (8)/
    September (9)/October (10)/November (11)/December (12) ----------
33. Have your child ever had a problem with sneezing, or a runny, or blocked nose
    when the child DOES NOT have a cold or the flu? YES/NO
34. In the past 12 months, have your child had a problem with sneezing, or a runny, or
    blocked nose when the child DOES NOT have a cold or the flu? YES/NO
35. In the past 12 months, has this nose problem accompanied by itchy-watery eyes? YES/NO
36. In the past 12 months, how much did this nose problem interfere with your daily activities?
    Not at all (1)/A little (2)/A moderate amount (3)/A lot (4) ----------
37. Have you ever had hayfever? YES/NO
38. When your child are exposed to dusty areas, or pets like dog, cat or feathers or pillows or
    pollen or agriculture crop dust, etc., then common cold/sneezing/nasal blockage aggravated YES/NO
39. Any of the family members suffering from common cold/ sneezing/ nasal blockage? YES/NO
    if Yes, relation with child: ----------

G. UPPER RESPIRATORY TRACT INFECTION (URTI)

40. Does the child develop frequent throat congestion/ tonsil? YES/NO
41. In which season, the child get frequent throat congestion/ tonsil:
    Winter (1)/Summer (2)/Rains (3)/Same in all seasons (4)/Change of seasons (5) ----------

PAST MORBIDITY IF CHILD IS ASTHMATIC

Morbidity measure in the past 2 weeks

	Days														
• Maximum symptom days	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
• Days —wheeze	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
—chest tightness	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
—cough	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
• Days —child slowed	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
—stopped play	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
• Night's child awake due to asthma	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
• School Absentee	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

Morbidity measure in the past 3 months

• Hospitalizations due to asthma	15d	15d	15d	15d	15d	15d
• Unscheduled visits due to asthma	15d	15d	15d	15d	15d	15d
• Missed days of work for the caretaker	15d	15d	15d	15d	15d	15d

Use of the drugs in the past 3 months

• Bronchodilators	15d	15d	15d	15d	15d	15d
• Anti-inflammatory	15d	15d	15d	15d	15d	15d
• Oral steroids	15d	15d	15d	15d	15d	15d
• Nebulizer drugs	15d	15d	15d	15d	15d	15d

Money used for the treatment of asthma in 3 months----------

PHYSICAL EXAMINATION:

Pulse: ---------- BP: Systolic ---------- Diastolic ----------

Respiration rate: ---------- Weight (Kg): ----------

Height (cm): ---------- General built (frame): Small/Medium/Large ----------

Nutritional Status: Poor/Good/Obese …… BMI ----------

RESPIRATORY SYSTEM:

PULMONARY FUNCTION TEST:

Parameter	PREDICTED Before Bronchodilator			After Bronchodilator			% Change
	Predicted	Actual	%	Predicted	Actual	%	
FVC							
FEV_1							
FEV_1/ FVC %							
FEF 25%–75%							

PEAK FLOW METER READING:

Dr. Signature ---------- LT. Signature ----------

CONSENT FORM

CONSENT OF THE PARENTS/GURDIAN OF THE CHILDREN

I ---------- F/M of ----------aged----------living at ---------- hereby give my consent freely to participation of my child in the project titled "INDOOR AIR POLLUTION AND ASTHMA EXACERBATION IN CHILDRENS: A POPULATION BASED STUDY". It has been explained to me that all the information from the questionnaire and analysis of air sample of my home will be stored anonymously. I also give my consent for withdrawal of blood and urine for analysis, pulmonary function test, and PEFR study of my child.

Signature/Thumb impression of parents / Guardian of Child

अनुमति प्रपत्र

बच्चे के माता या पिता/अभिभावक की अनुमति

मैं---------- पिताजी/माताजी/अभिभावक ----------की/का उम्र---------- निवासी---------- "घरेलू वायु प्रदूषण एवं बच्चों में दमा वृद्धि: एक प्रदूषण के प्रभाव आधारित अध्ययन" में अपने बच्चे की हिस्सेदारी के लिये स्वतंत्र रूप से सादर अनुमति देता हूँ। मुझे स्पष्ट कर दिया गया है कि प्रश्न-प्रपत्र की सभी जानकारियाँ एवं मेरे घर के वायु के नमूने का विश्लेषण गुप्त रूप से संचित रहेगी। मैंने अपने बच्चे का विश्लेषण के लिये खून व मूत्र निकालने, फेफडो की क्रिया विधि परिक्षण तथा स्वास छोडने के अनुपात का अध्ययन करने की भी अनुमति दे दी है।

बच्चे के माता या पिता/अभिभावक के हस्ताक्षर/अंगूठे का निशान

SECTION VI

FOLLOW-UP OF THE STUDY

AT 3 MONTHS

Morbidity measure in the past 2 weeks

	Days														
• Maximum symptom days	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
• Days —wheeze	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
—chest tightness	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
—cough	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
• Days —child slowed	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
—stopped play	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
• Night's child awake due to asthma	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
• School Absentee	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

Morbidity measure in the past 3 months

• Hospitalizations due to asthma	15d	15d	15d	15d	15d	15d
• Unscheduled visits due to asthma	15d	15d	15d	15d	15d	15d
• Missed days of work for the caretaker	15d	15d	15d	15d	15d	15d

Use of the drugs in the past 3 months

• Bronchodilators	15d	15d	15d	15d	15d	15d
• Anti-inflammatory	15d	15d	15d	15d	15d	15d
• Oral steroids	15d	15d	15d	15d	15d	15d
• Nebulizer drugs	15d	15d	15d	15d	15d	15d

Money used for the treatment of asthma in 3 months----------

FOLLOW-UP OF THE STUDY

AT 6 MONTHS

Morbidity measure in the past 2 weeks

	Days														
• Maximum symptom days	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
• Days —wheeze	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
—chest tightness	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
—cough	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
• Days —child slowed	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
—stopped play	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
• Night's child awake due to asthma	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
• School Absentee	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

Morbidity measure in the past 3 months

• Hospitalizations due to asthma	15d	15d	15d	15d	15d	15d
• Unscheduled visits due to asthma	15d	15d	15d	15d	15d	15d
• Missed days of work for the caretaker	15d	15d	15d	15d	15d	15d

Use of the drugs in the past 3 months

• Bronchodilators	15d	15d	15d	15d	15d	15d
• Anti-inflammatory	15d	15d	15d	15d	15d	15d
• Oral steroids	15d	15d	15d	15d	15d	15d
• Nebulizer drugs	15d	15d	15d	15d	15d	15d

Money used for the treatment of asthma in 3 months----------

FOLLOW-UP OF THE STUDY

AT 9 MONTHS

Morbidity measure in the past 2 weeks

	Days														
• Maximum symptom days	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
• Days —wheeze	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
—chest tightness	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
—cough	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
• Days —child slowed	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
—stopped play	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
• Night's child awake due to asthma	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
• School Absentee	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

Morbidity measure in the past 3 months

• Hospitalizations due to asthma	15d	15d	15d	15d	15d	15d
• Unscheduled visits due to asthma	15d	15d	15d	15d	15d	15d
• Missed days of work for the caretaker	15d	15d	15d	15d	15d	15d

Use of the drugs in the past 3 months

• Bronchodilators	15d	15d	15d	15d	15d	15d
• Anti-inflammatory	15d	15d	15d	15d	15d	15d
• Oral steroids	15d	15d	15d	15d	15d	15d
• Nebulizer drugs	15d	15d	15d	15d	15d	15d

Money used for the treatment of asthma in 3 months----------

FOLLOW-UP OF THE STUDY

AT 12 MONTHS

Morbidity measure in the past 2 weeks

	Days														
• Maximum symptom days	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
• Days —wheeze	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
—chest tightness	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
—cough	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
• Days —child slowed	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
—stopped play	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
• Night's child awake due to asthma	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
• School Absentee	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

Morbidity measure in the past 3 months

• Hospitalizations due to asthma	15d	15d	15d	15d	15d	15d
• Unscheduled visits due to asthma	15d	15d	15d	15d	15d	15d
• Missed days of work for the caretaker	15d	15d	15d	15d	15d	15d

Use of the drugs in the past 3 months

• Bronchodilators	15d	15d	15d	15d	15d	15d
• Anti-inflammatory	15d	15d	15d	15d	15d	15d
• Oral steroids	15d	15d	15d	15d	15d	15d
• Nebulizer drugs	15d	15d	15d	15d	15d	15d

Money used for the treatment of asthma in 3 months----------