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Comparison of respiratory symptoms and pulmonary function test in individuals residing in urban and hilly areas of Karnataka

Deepu Changappa Cheriamane [1]
Aravindh Ram V R [2]
Deepak U G [3]

1. Associate Professor, Dept of Respiratory Medicine, Sridevi Institute of Medical Sciences, Tumakuru
2. Assistant Professor, Kodagu Institute of medical science Kodagu- 571201
3. Assistant Professor, Department of Respiratory medicine, Kodagu Institute of medical science Kodagu- 571201
Corresponding author: Dr Deepak U G
Department of Respiratory medicine, Kodagu Institute of medical science, Kodagu- 571201

Abstract
Background- Air pollution is a major cause of premature death and disease, and is the largest environmental health threat globally The fast urbanization and economic expansion are principally driven by the tremendous use of fossil fuels, bringing about a dramatic increase in emissions of both ambient air pollutants and greenhouse gases.
Methods- Study Comprises of total 100 subjects of both sex in the age group of 18 to 25 years The subjects were divided into two groups. People residing in Madikeri since birth were selected for hilly area group and people living in major city like Bengaluru were selected for urban area group. Pulmonary function test with all essential parameters were assessed. Forced Vital Capacity, Forced Expiratory Volume in one second, and Peak Expiratory Flow Rate were recorded using hand held computerized spirometer
Results- The Mean S.D values of weight and Body Mass Index (BMI)(18-24kg/m2) were significantly low in urban area people compared to hilly area people within the normal limit. The Mean and Standard Deviation (S.D) of pulse rate (60-100beats/min) and respiratory rate(12-18cycles/min) was significantly more in urban area people compared to hilly area people and was observed within the normal limit. The Mean and S.D of FVC, FEV1, PEFR and FEF25-75 was significantly low in urban area people compared to hilly area people.
Conclusion: In our study FVC, FEV1, PEFR, FEF25-75 were comparatively more in people living in hilly areas than those people living in urban areas. Lung functions of hilly areas people are comparatively better to those of urban areas. The Presence of more number of trees and plants play a major role in purifying the air, decreased number of industries and factories, less usage of automobiles are responsible for better quality of air in hilly areas.

Keywords: *COPD, FVC, FEV1, PEFR, PM, WHO, SO2, O3, NO2.*

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I. Introduction:

Air pollution is a major cause of premature death and disease, and is the largest environmental health threat globally.[1–5] INDIA, being second largest developing country, is experiencing rapid economic development and urbanization from few decades. The fast urbanization and economic expansion are principally driven by the tremendous use of fossil fuels, bringing about a dramatic increase in emissions of both ambient air pollutants and greenhouse gases.

Air pollution risks are typically quantified for ambient particulate matter pollution, household air pollution, and, to a smaller extent, tropospheric ozone. The main sources of ambient particulate matter pollution in India are residential and commercial biomass burning, windblown mineral dust, coal burning for energy generation, industrial emissions, agricultural stubble burning, waste burning, construction activities, brick kilns, transport vehicles, and diesel generators, and tobacco smoking have made the air quality even worse [6–13]

Evidence of the adverse effects of air pollution on health has been growing in India.21 Studies from India have shown that short-term and long-term exposure are associated with disease burden and mortality.[14-17]

The levels of particulate matter (PM), SO2, O3, and NO2 are reported to be higher than those of the national standard and criterion concentration of WHO in many cities. These particles and toxic compounds of high concentration can dramatically impair pulmonary function of human being, consequently resulting in pathological conditions like bronchial asthma, bronchitis, allergic rhinitis, exacerbations of COPD, bronchiolitis, occupational disorders and various other respiratory disorders. [18] Diseases attributable to air pollution adversely affect economic growth through reduced productivity and decreased labor supply, and via health-care expenditures and lost welfare.[19, 20]

Pollution haze is an atmospheric phenomenon where dust, smoke and other dry PM composed of various components obscure the clarity of the sky. The coefficient of haze (COH) is used to measure the visibility interference in the atmosphere.

Pollutional haze is quite different from fog or mist. Fog is an aerosol system and more than 90% of its component is water, which causes visibility less than one kilometer. Therefore the occurrence of fog mainly affects traffic condition but has no much harmful effect on health when air is not polluted.

However, when air is polluted with dry particles like PM2.5 and PM10 and gases like ozone, nitric oxide, nitrogen dioxide and sulfur dioxide, pollutional haze may occur if the relative humidity is less than 80%. Because nitrogen dioxide and sulfur dioxide may react with tiny water drops in the air and form nitric acid and sulfuric acid respectively, in most cases the pollutional haze is of yellow or orange gray color since the particles of nitric acid and sulfuric acid primarily scatter visible light with relative long wavelength. So, pollutional haze particles are comprised of a complex range of chemically and physically diverse substances that exist in the atmosphere as discrete, suspended liquid or solid particles.

The basic components of pollutional haze are gases (e.g., ozone, sulfur dioxide, nitric oxide, nitrogen dioxide, carbon monoxide, carbon dioxide), volatile organic compounds (e.g., Benzene), and PM (e.g., metals, nitrates, sulfates, organic carbon, microbial components, pollen) [20,21] These haze particulates are characterized by various physical and chemical properties due to their sources, size ranges, formation mechanisms, and chemical composition. The effects of the pollutional haze particle on health mainly depend on its size and chemical composition.

Table 1: Air quality standards of various countries worldwide (WHO 2005)

Pollutant	Time	WHO	European Union	United States	California	Japan	Brazil	Mexico	South Africa	India (i1/ i2/i3)[d]	China (I/II/ III)[d]
Sulphur dioxide (µg/m³)	1 year			78			80	78	50	15/60/80	20/60/100
	24 h	20	125	366	105[c]	105	365	341	125	30/80/120	50/150/250
	1 h		350		655	262					150/500/700
	10 min	500							500		
Nitrogen dioxide (µg/m³)	1 year	40	40	100			100		94	15/60/80	40/40/80
	24 h					113			188	30/80/120	80/80/120
	1 h	200	200		470[c]		320	395	376		120/120/240
PM_{10} (µg/m³)	1 year	20	40	50	20		50	50	60	50/60/120	40/100/150
	24 h	50[a]	50[b]	150	50	100	150	120	180		50/150/250
$PM_{2.5}$ (µg/m³)	1 year	10		15	12			15			
	24 h	25[a]		65	65			65			
Ozone (µg/m³)	8 h	100	120	157	137			157[c]			
	1 h				180[c]	118[c]	160	216	235		120/160/200
Carbon monoxide (µg/m³)	1 h	30	-	40	23	11	40	-	30	4	10
	8 h	10	10	10	10	23	10	11	10	2	-

[a]: Not to exceed more than 3 days per year; [b]: Not to exceed more than 35 days per year ; [c]: Photochemical oxidants;
[d]: i_1: Sensitive population; i_2: Residential population; i_3: Industrial population.
Class I: tourist, historical, and conservation areas; Class II: residential urban and rural areas; Class III: industrial and heavy traffic areas

Our capital Delhi in recent studies have showed a significant increased prevalence of restrictive (22.5% vs. 11.4% in control), obstructive (10.7% vs. 6.6%) as well as combined (both obstructive and restrictive) type of lung functions deficits (7.1% vs. 2.0%). Metaplasia and dysplasia of airway epithelial cells were more frequent in Delhi, Besides these, non-respiratory effects were also seen to be more in Delhi than in rural controls. The prevalence of hypertension was 36% in Delhi against 9.5% in the controls, which was found to be positively correlated with respirable suspended particulate matter (PM_{10}) level in ambient air. Delhi had significantly higher levels of chronic headache, eye irritation and skin irritation.[22]

Our intention is to provide general information of what the pollutional haze in urban areas and its impact on people living in urban area, In this study we are comparing respiratory symptoms and pulmonary

function test of people living in hilly (Kodagu) and urban areas (Bengaluru) to assess the impact of pollution on people living in varied environment

Bengaluru being one of the major city of India with a population of more than 1.5 crore with the current vehicle population in state stands at 85 lakhs(as on May 2020) with an increase of vehicles is by a mind-boggling 6,099% in 40 years [23] and the emission of Particulate matter and smoke from factories in and around Bengaluru will lead to air pollution with an air quality index of around 150 to 200 which is unhealthy for all group of people will certainly have its effect on respiratory health and pulmonary status of its residents.

Kodagu being a hill station with a population of around 3 lakh with an air quality index of around 40-60 [24] which is a permissible level according to international norms. This difference in air quality index will have its effect on its people.

Moreover, most of data on effect of air pollution on respiratory health were obtained from western population and very few of Indian studies tried to see the effect of pollution on respiratory health and studies have done in urban areas. In the light of these finding the present study was conducted to assess the outcome of effect of air pollution on respiratory function of the people living in hilly and urban areas.

II. Aims And Objectives:

The aim of this project was to compare the respiratory symptoms and pulmonary function test in individuals residing in hilly and urban areas of Karnataka.

The objectives are:

1. Comparison of respiratory Symptoms of people residing in urban areas from those residing in hilly areas.
2. Comparison of pulmonary function test people residing in urban areas from those residing in hilly areas.

III. Materials And Methods:

Type of the study: This is a cross sectional comparative study.

Study population: Comprises of total 100 subjects of both sex in the age group of 18 to 25 years .The subjects were divided into two groups. People residing in Madikeri since birth were selected for hilly area group and people living in major city like Bengaluru were selected for urban area group.

Study period: 4 months

Sample Size: Around 50 subjects were selected from both groups, hence total of 100 subjects participated in the study.

Study Site : The study was conducted in department of physiology in Kodagu Institute Of Medical Sciences, Madikeri, Kodagu District.

Ethical clearance:

Ethical clearance was obtained from the Kodagu institute of medical sciences Ethical Committee for Human Research to conduct the study.

Inclusion criteria:

• Age group 18-25 years.
• 50 subjects residing in Madikeri since birth were selected for hilly area group
• 50 subjects living in Bengaluru since birth were selected for urban area group.

Exclusion criteria:

- Subjects with age group <18 and >25 years.
- Subjects with history of congenital respiratory diseases, cardiac illness, gastrointestinal diseases and neurological disorders.
- Subjects suffering from diseases like HIV, Tuberculosis or any other infectious disease.
- Subjects with history of smoking.
- Subject who denied consent.

Study design:

- For all the subjects a detailed history followed by clinical examination was carried. Each subject taking part in the study was explained about the purpose of the study and procedure to be adopted in the study.
- Subjects were made comfortable and asked to take rest for 10 minutes.
- Each person fulfilled questionnaires regarding their basic information and questions related to their present respiratory symptoms as well as their past respiratory health, life style h/o exposure to parental or friends smoking, h/o about exposure to traffic, industry, and factory near to their place.
- All the data were collected at a fixed time of the day between 6am to 8am to minimize any diurnal variation.

- Data on physical characteristics such as age, height, weight and Body Mass Index were obtained.
- Vital parameters such as Heart rate (HR), Respiratory Rate (RR). Pulmonary function with all essential parameters were assessed
- BMI was calculated as weight (in kilograms) divided by height (in meters) with the subjects wearing light indoor cloths and without shoes.
- Heart Rate (beats/min) was measured with the help of ECG in lead 2 in supine position after rest for 5 minutes .Three readings were taken at an interval of 15 minutes each and average of the three values calculated.
- Respiratory rate (cycles / min) was taken clinically by inspection. Subjects were asked to lie in supine position on examination table in well ventilated and well lighted examination room. Respiratory rate is counted by observing the moment of the chest with respiration. Three readings were taken at an interval of 15 minutes each and average of the three values calculated.
- Forced Vital Capacity (FVC), Forced Expiratory Volume in one second (FEV1), and Peak Expiratory Flow Rate (PEFR) were recorded using hand held computerized spirometer (Spiro Tech P310_S1_A Clarity Medical Pvt. Ltd.) .
- All subjects were made acquainted with spirometer before actual recording. Readings was recorded in sitting position. They were asked to practice the procedure.
- After sufficient exposure to practice the subjects were asked to begin relaxed tidal breathing through the mouth piece fixed over the transducer and then to take a deep breath in and to blow out as hard and fast as possible and continue blowing until no more air can be exhaled, then to take another deep breadth back in, mouth piece still in mouth until lungs are full.
- It was ensured that a tight seal was maintained between lips and mouth piece of spirometer. Nose clip was applied to close the nostrils. Three readings were taken and best of the three attempts were selected.

Statistical Analysis:

Descriptive statistics such as mean, SD and percentage was used to present the data. Comparison of respiratory parameters and pulmonary function parameters between urban and hilly area was performed by unpaired t-test for normally distributed data and Mann-Whitney U test for non-normally distribution. A p-value less than 0.05 were considered as significant.

IV. Obervations And Results:

The present study included 100 subjects (50 residing in hilly areas and 50 residing in urban areas) in the age group of 18-25 years. The subjects were given Study Pro forma and their anthropometric parameters, vital parameters and respiratory parameters were recorded and analyzed.

The history of any respiratory symptoms like cough, expectoration, chest pain, Breathlessness, allergic rhinitis and asthma were asked for the both the groups. Only few of the subjects had past history of allergic rhinitis and did not have any other symptoms.

The age and anthropometric parameters of subjects are depicted in table 1 as mean ± standard deviation (SD).

Table 1: Comparison of age and physical parameters among the individuals residing in urban and hilly areas

Parameters	Height(in m)	Weight(in Kg)	BMI(kg/m2)
Urban people (Mean ± S.D)	1.65 ± 0.09	59.3 ± 8.7	21.6 ± 2.2
Hilly people (Mean ± S.D)	1.63 ± 0.1	64.0 ± 7.6	24.2 ± 1.9
Mean difference	0.025	4.77	2.53
95% CI of Mean	-0.04-0.06	1.5-8.0	1.7-3.3
t-value / u-value	1.28	2.91	6.11
p-value	0.2	0.005	<0.0001
Remarks	Not significant	Significant	Significant

The Mean S.D values of height did show any significant difference between two groups.
The Mean S.D values of weight and Body Mass Index (BMI)(18-24kg/m2) were significantly low in urban area people compared to hilly area people within the normal limit..

Table 2: Comparison of pulse rate and respiratory rate in people residing in urban and hilly areas

Parameters	Pulse rate (beats/min)	Respiratory rate (cycles/min)
Urban people (Mean ± S.D)	77.5 ± 4.0	14.2 ± 1.8
Hilly people (Mean ± S.D)	75.3 ± 3.0	13.4 ± 1.4
Mean difference	2.16	0.84
95% CI of Mean	0.7-3.6	0.19- 1.48
t-value/ u-value	3.01	934.5*
p-value	0.003	0.02
Remarks	Significant	Significant

*Mann-Whitney Test was applied

The Mean and Standard Deviation (S.D) of pulse rate (60-100beats/min) and respiratory rate (12-18cycles/min) was significantly more in urban area people compared to hilly area people and was observed within the normal limit.

Table 3: Comparison of Respiratory Parameters of people residing in urban and hilly areas

Parameters	FVC	FEV1	PEFR	FEF25-75	FEV1/FVC
Urban people (Mean ± S.D)	2.04 0.7	1.97 0.6	2.99 1.3	2.7 1.2	96.4 5.9
Hilly people (Mean ± S.D)	3.1 0.6	2.99 0.6	7.86 2.0	5.06 1.5	95.9 6.1
Mean Difference	1.07	1.02	4.87	2.33	0.49
95% CI of Mean	0.8 1.3	0.7-1.3	4.2-5.5	1.8-2.9	-1.9-2.9
t-value/ u-value	8.4	8.2	14.2	8.51	1101.5*
p-value	<0.0001	<0.0001	<0.0001	<0.0001	0.3
Remarks	Significant	Significant	Significant	Significant	Not Significant

*Mann-Whitney Test was applied

The Mean and S.D of FVC, FEV1, PEFR and FEF25-75 was significantly low in urban area people compared to hilly area people.

The Mean and S.D of FEV1/FVC has no significant value on both urban area and hilly area individuals.

V. Discussion:

- Incidence of respiratory diseases is on rise due to increased pollution especially in urban areas. Increasing factories, industries and automobiles releases hazardous chemicals to environment and can cause adverse effects on human health. Air pollutant, the invisible killer contains nitrogen oxides, ozone (O3) and exceptionally small particulate matter (PM). Of the modern-day air pollutants, PM has been held responsible for the majority of health effects. Air pollution has negative impacts on respiratory and cardiovascular health following both short-term and chronic exposures. Incidence of respiratory diseases like bronchial asthma, bronchitis, allergic rhinitis, chronic obstructive pulmonary diseases(COPD) etc. which are characterized by main respiratory symptoms like cough with or without expectoration, shortness of breath, wheezing, chest pain etc.[18]
- In multi centric study conducted by Indian council of medical research (ICMR) ,it was found that about 5% men and 3.2 % of women in India suffering with chronic respiratory diseases and total number of patients of COPD increased from 6.45 million in 1971 to 14.84 million in 2011.Lung volume and capacities convey the condition of functional status of respiratory system in physiological as well as pathological situation.[26]
- The aim of this research work was to compare respiratory symptoms and pulmonary function rest in individual residing in hilly and urban areas. The study was conducted on 100 subjects of age 18-25 years. Study group consisted of 50 people from urban (25 male and 25 female) and 50 people from hilly areas (25 male and 25 female). The subjects with history of congenital respiratory, cardiac and gastrointestinal diseases, HIV, Tuberculosis and any other infectious diseases are excluded.
- The Data on physical characteristics such as Age, Height, Weight and Body Mass Index were collected. Parameters such Pulse rate(PR), Respiratory Rate(RR) , Forced vital capacity(FVC), Forced expiratory volume in one second(FEV1), Peak expiratory flow rate(PEFR), Forced expiratory flow at 25-75 percent of the lung volume (FEF25-75), were assessed among both the groups.
- The history of any respiratory symptoms like cough, expectoration, chest pain , Breathlessness, allergic rhinitis and asthma were asked for the both the groups. Only few of the subjects had past history of allergic rhinitis and did not have any other symptoms.
- Body Mass Index of urban people were significantly low when compared to hilly area people and was within the normal limit.
- The vital parameters like Pulse Rate and Respiratory Rate were significantly more in urban people when compared to hilly area people and was within the normal limit.
- By observing the Mean and S.D of FEV, FEF 25-75, FEV1, PEFR of urban areas was comparatively less to those of hilly areas and FEV1/FVC did not show any significant change.

- Our study show that even in individual who apparently enjoying their good health with no respiratory symptoms, there are measurable decrement in functions of respiratory system specially the expiratory flow.
- The lungs play an important role in filtration. Nasal turbulence mechanism remove particles > 6 μm in diameter enter the lungs through the nose. 1 and 5 μms settle in the smaller bronchioles. Terminal bronchiolar disease is common in coal miner because of settled dust particles. Particles with 1-5 μm are cleared by mucociliary clearance system of tracheo-bronchial tree by Ciliary escalator action. Particles smaller than 1 μm in diameter remain suspended in the alveolar air and expelled by expiration. Particles < 0.5 μm ingested (phagocytosis) by pulmonary alveolar macrophages. The particles of cigarette smoke are about 0.3 μm are precipitated in the respiratory passageways and alveoli (22).
- Nasal turbulence mechanism (nasal passage) is so effective that almost no particles > 6 μm in diameter enter the lungs through the nose. Of the remaining particles, many that is between 1 and 5 μms settle in the smaller bronchioles as a result of gravitational precipitation.[27] Air pollution induces oxidative stress of respiratory air ways and causing inflammation and obstruction of respiratory system. Sharp mineral crystals puncture the lysosomal membrane of the alveolar macrophages resulting in release of intracellular lysosomal enzymes and death of cell. Chemotactic factor released by dying macrophages cause fibroblast migration and collagen synthesis that lead to pulmonary fibrosis, disease associated with reduce lung compliance and impaired gas exchange(1 This suggests that people who are more exposed to air polluted areas have a high risk of obstructive and restrictive lung diseases.
- A tertiary care center for Kodagu district. Madikeri is a hilly area, present in Western Ghats with altitude around 1500 meters from sea level. Because of its rich biodiversity and forest areas, pollution observed is very low. Because of this reason people residing in hilly areas are less prone to get any respiratory diseases. The people living in hilly area have good spirometry values compared to urban because they are less exposed to toxic air pollutants which cause harm to respiratory system.
- Piotr Dabroweeki et al did study on spirometry and respiratory health. They took total of 1187 persons from 26 different location including rural areas and smaller and larger cities. In the total group 23 cases of bronchial obstruction were diagnosed. 134 persons with obstruction were tested for first time and were unaware of their disease. Lowest value of FEV1 and FEV1/FVC were observed in small and larger cities. Spirometry values were decreased in inhabitants living less than 50 meters from roads compare to inhabitants living more than 50 meters from roads[25]. The result of our study are consistent with Piotr Dabroweeki et al study which indicates that decrease in spirometry results are at high risk to get respiratory diseases without known respiratory symptoms due to exposure for air pollution.
- Pruthi et al. studied influence of aging on lung function test. It included 5 age group from 25 to 75 years of age. They studied lung function test namely FVC, FEV1,FEF 25-75, FEV1/FVC, PEFR and MVV. They conducted that the lung functions significantly decline with age. They explained that the changes are due to decreased in elastic recoil, stiffening of chest wall, decrease in alveolar surface area which results in diffusing capacity.[28]The result of our study are consistent with Pruthi et al. study that is the reason that age 18 -25 years individual showed less variations to spirometry and respiratory symptoms due to their high efficient immune system and well developed structures assisting respiration.
- Boskabady M H et al. pulmonary function test and respiratory system among smokers in the city of Mashhad (north east of Iron). The total number of subjects were 13289 aged 10 and above and were from 21 cities of Mashhad which had moderate industry and road traffic .34% subjects with smoking had tightness of chest and 17% had cough symptoms. All the respiratory symptoms were higher in study group compare to control group. LUNG function tests namely FVC, FEV1, FEV1/FVC,PEFR AND MEF were normal in study group but lower than that of nonsmokers .they concluded medium and large airways are more affected by smoking.[29] In our study the subjects from urban area are more exposed to cigarette smoke due to modern lifestyle.
- M Rosenlund et al. Traffic –related air pollution in relation to respiratory symptoms , allergic sensitization and lung function in children .they studied PFT of 1359 children aged 9 to 14 yrs. after confirming the history of respiratory symptoms by parental questionnaires . their results showed strong association between exposure to NO2 and lung functions especially expiratory flows like FVC, FEV1, FEV1/FVC,PEFR. All lung functions were decreased. They concluded air pollution induce oxidative stress in the respiratory tract resulting in airway inflammation[30]. In our study subjects did not complain of any significant respiratory symptoms because the age group 18-25 years had well developed immune system and respiratory system to combat the effect caused by air pollutants when compared to children of age group 9-14years.

VI. Conclusion:

The following conclusion were obtained during our comparative study

1) Air pollution can be defined as the presence of toxic chemicals, minute particulate matter, dust particles and pollutants which reduces the air quality and cause harm to living beings which eventually reduces the normal functioning of respiratory system.
2) In our study FVC, FEV1, PEFR, FEF25-75 were comparatively more in people living in hilly areas than those people living in urban areas. Lung functions of hilly areas people are comparatively better to those of urban areas.
3) The Presence of more number of trees and plants play a major role in purifying the air, decreased number of industries and factories, less usage of automobiles are responsible for better quality of air in hilly areas. This in turn helps in retaining normal functions of respiratory system.

VII. Summary:

- Air pollution is now fully acknowledged to be a significant public health problem, responsible for growing range of health effects that are well documented from the results of an extensive research work conducted in many regions of the world. Whilst there is no doubt that rapid urbanization as decreased air quality due to increasing pollutants in an around the surroundings. Industries, automobiles, and combustion of bio mass have become major source of air pollutant emissions, with substantial, spatial and temporal variation.
- The present study was done to compare respiratory symptoms and pulmonary function test in people of hilly and urban areas and to about damage occurred to respiratory system due to pollution.
- The study was conducted on 100subjects of age group 18-25 years. The group consists of 50 subjects from urban (25 male and 25 female) and 50 subjects from hilly (25 male and 25 female) who stayed in their respective areas since birth.
- The subjects who had history was of congenital respiratory diseases, cardiac illness, gastrointestinal diseases, neurological disorders, HIV, Tuberculosis, any other infectious diseases were excluded. Even the subjects who had history of smoking and the on who denied consent were not included for the study.
- Questionnaire were given regarding respiratory symptoms. The history of any respiratory symptoms like cough, expectoration, chest pain, Breathlessness, allergic rhinitis and asthma were asked for the both the groups. Only few of the subjects had past history of allergic rhinitis and did not have any other symptoms.
- Basic parameters like Height, Weight and Body Mass Index (BMI), were obtained. Vital parameters like Pulse Rate (PR), Respiratory Rate (RR) was collected. Respiratory parameters like Forced Expiratory Volume in One Second (FEV1), Forced Vital Capacity(FVC), Peak Expiratory Flow Rate (PEFR), Forced Expiratory Flow During 25 -75 % Of Expiration (FEF 25-75) were assessed among the groups.
- An Independent unpaired t-test for normally distributed data and Mann Whitney U test for non-normally distributed data was applied for both hilly and urban area groups. A p value less than 0.05 were considered as significant.
- The result showed that - The pulse rate and respiratory rate was comparatively more but within the normal range in urban area people than hilly area people.
- Forced Expiratory Volume in One Second (FEV1), Forced Vital Capacity (FVC), Peak Expiratory Flow Rate (PEFR), Forced Expiratory Flow During 25 -75 % Of Expiration (FEF 25-75) was significantly better in hilly area people than the urban area people.
- Both the gender was equally affected to air pollution which led to decrease lung functions in them who were living in urban areas.
- In our study we did not get significant history of any known respiratory symptoms in both the groups but their pulmonary function test showed significant decrease in lung functions in urban people when compared to hilly area people.
- This suggests that the presence of numerous amount of trees and plants have contributed a lot for the quality of air in hilly areas. The number of factories and industries is very less in hilly areas when compared to urban areas which rarely contribute pollutants to air in hilly areas. The automobiles are very less in hilly areas so that the toxic chemicals released from fossil fuels do not add up to decrease the air quality in hilly areas.
- Due to all these reasons we can conclude that deforestation, industrialization and urbanization in urban areas have serious impact on respiratory system functions of human being who are more prone to develop respiratory diseases like asthma, bronchitis, allergic rhinitis and so on.
- Thus its better to plant more trees, avoid industrialization and reduce the usage of automobiles for the betterment of lung function and increase the life span. Since our study mainly showed that even when respiratory symptoms were not shown lung functions was significantly decreased in urban people compared

to hilly people. This suggest a routine pulmonary function test to be conducted in order to assess the respiratory functions so that we can prevent from respiratory diseases in future.

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