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Investigation on Substantial Health Effect of Fine-Particulate Air Pollution on Roadside Venders in India

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Abstract:
The present research on"Investigation on outdoor air pollution has substantial effect on health of road side venders in India"have been carried out at Lakdikapul station. The ambient air quality was measured in this traffic station and the monthly means were recorded. A 24 h cycle of hourly sampling was also carried out to assess the peak hour traffic concentrations of the ambient air quality parameters. The mean concentration of the TSPM recorded for the whole study period was 308.20 µg/m^3. the mean concentration of the RSPM recorded for the whole study period was 112.01 µg/m^3. The mean concentration of sulphur dioxide for the whole study period was 5.78 µg/m^3. The concentrations of the oxides of nitrogen for the whole study period ranged between 23.70 and 42.60 µg/m^3, with a monthly mean of 31.30 µg/m^3. The mean concentration of CO_2 for the whole study period was 3.10 mg/m^3. At Lakdikapul, out of the five roadside vendors, 3 subject vendors have showed a decrease in the Forced Expiratory Volume in first second. The FEV1 ranged from -50.00 to -840.00 ml among these vendors. Two of the subject vendors have shown an improved FEV1 which ranged from 0 to 290.00 ml. Reducing exposure, especially from traffic, is the most effective strategy to mitigate the effects of pollution. The Air Quality Health Index is a tool that can help patients gauge risk before engaging in outdoor activity.

Keywords*:* Air pollution,Forced Vital Capacity, Health hazards, Roadside vendors, Transport emissions.

1.0Introduction:
Air is the most important component of the environment. The quality of air that is inhaled is more important than the quality of water and food that is consumed, because, a person inhales about 16-20 kg of air per day. Any minute change in the composition of air is likely to bring about a change in the health of the individual. The human health effects of poor air quality are far reaching, but principally affect the body's respiratory system and the cardiovascular system. Individual reactions to air pollutants depend on the type of pollutant a person is exposed to, the degree of exposure, the individual's health status and genetics. People who exercise outdoors, for example, on hot, smoggy days increase their exposure to pollutants in the air. The health effects caused by air pollutants may range from subtle biochemical and physiological changes to difficulty breathing, wheezing, coughing and aggravation of existing respiratory and cardiac conditions. These effects can result in increased medication use, increased doctor or emergency room visits, more hospital admissions and even premature death.

The urban sprawl, drastic increase of vehicles, bad condition of roads, prolonged development activities in the cities, contribute to changes in the urban ambient air quality. There were several studies on the impacts of traffic on ambient air quality. Studies are also available on the long term and short term health effects of traffic pollution. The target groups for such studies were conveniently selected by individual investigators. Ambient air quality in industrial areas, residential areas, traffic zones, rural areas, etc were popular in various cities across the world. Often these studies end up meaningfully with an aspect of health over different target groups such as, traffic police, taxi drivers, school children, avenue gardeners, etc. The present study was conducted on the "impact of traffic pollution on the health of roadside vendors in Hyderabad city, Andhra Pradesh, India".

Many chemical substances may cause the formation of reactive oxygen. This oxidative metabolism is considered to be critical to the preservation of cardiovascular function. For example, oxygen free radicals oxidize low-density lipoproteins, and this reaction is thought to be involved in the formation of the atherosclerotic plaques. Oxidized low-density lipoproteins can injure blood vessel cells and increase adherence and the migration of inflammatory cells to the injured area. The production of oxygen free radicals in heart tissues have been associated with arrhythmias, and heart cell death.Urban air pollution is a major environmental problem in the developing countries. As a part of Global Environment Monitoring System (GEMS), the World Health Organization (WHO) and UNEP have created an air pollution monitoring network in which 50 cities from 35 developed and developing countries were covered (Mage et al, 1996). This network analyzed data from 24 mega cities of the world and concluded that ambient air pollution concentrations were at such levels where serious health effects were likely.

The United States Environment Protection Agency (USEPA, 2003) observed that the emissions of NO_x from new cars and light duty trucks were peaked in 1994 and they were on decline since then with the implementation of stringent standards. But the emissions from heavy duty gasoline vehicles, diesel trucks and non road vehicles were still increasing. There has been good number of studies on the impact of these air pollutants on the health of human beings. A study estimated hospital admissions for congestive heart failure, inability of the heart to pump out all the blood that return to it increased 8% for each 100 $\mu g/m^3$ increase in PM_{10} (Raloff, 1995). Evidence that tens of thousands of premature deaths were caused each year in the United States due to inhaled particulate matter lead the Environment Protection Agency (EPA) to re-evaluate its short term $PM_{2.5}$ air quality standard in 2006. The new 24 h standard reduction from 65 to 35 $\mu g/m^3$ was expected to result in an annual reduction of: 2,500 to 7,000 premature deaths with lung/heart diseases,2,600 cases of chronic bronchitis,7,300 cases of acute bronchitis,5,000 nonfatal heart attacks,1,630 hospital admissions for cardiovascular or respiratory symptoms,1,200 emergency room visits, 3,50,000 days when people miss work or school EPA estimated that the monetary value of these benefits as between $17 billion and 35 billion (USEPA, 2006).

In some cases exposure to a pollutant can be linked to cancer and other health problems. By way of epidemiological evidence, one pollutant that clearly and indisputably correlated with cancer and other disorders was benzene. This organic chemical is present in motor fuels and cigarette smoke; EPA classified benzene as a group 'A' known human carcinogen, linked to leukemia in persons encountering the chemical through occupational exposure. Chronic exposure to benzene can also lead to numerous blood disorders and damage the immune system.

In the light of the above the present work has been carried out with the following specific objectives:

1. To monitor the ambient air quality at Punjagutta traffic station, by measuring the concentrations of TSPM, RSPM, SO_2, NO_x and Carbon Monoxide.
2. To ascertain the quality of air in the study area basing on the results of the monitoring and also to compare with the NAAQ Standards.
3. To correlate the concentrations of the quality parameters with the volume of the traffic and peak hour traffic.
4. To study the impact of traffic pollution on the health of roadside vendors, through pulmonary function test and carboxyhaemoglobin tests.

2.0 Methodology:

2.1 Lakdikapul

Satellite image of Lakdikapul traffic station

Lakdikapul is a very important traffic station which has many junctions in the roads radiating from this station. The traffic volume is very high as this station is located near the Andhra Pradesh state secretariat, Andhra Pradesh state legislative assembly, Abids, etc. This station has radiating roads to Secunderabad via tank bund, Mehdipatnam, and Khairatabad (Plate III). This junction experiences severe traffic jams throughout the day. Another important factor contributing to heavy traffic in this station is the presence of Multi Modal Transport System (MMTS) railway station. Groups of people move in and out of this area to catch local trains. The two wheelers and three wheelers mobility is very high in this zone. The number of roadside vendors was very high distributed in all the junctions radiating from the Lakdikapul. Also the road side shops and hotels were more as all important state bodies are located here.

Table 1:Location of the traffic stations selected for the present study:

Name of the Traffic Station	Longitude	Latitude
Lakdikapul	170 26’ 12.86” N	780 26’ 38.05” E

2.2 Sampling of Suspended Particulate Matter (SPM)

The suspended particulate matter was collected in the Lakdikapulstation using APM 460 Respirable Dust Sampler (Envirotech Pvt. Ltd., New Delhi). Monthly samples were collected from May 2006 to May 2008 in this station. Both Total Suspended Particulate Matter (TSPM) and Respirable Suspended Particulate Matter (RSPM) were collected and the values were expressed as µg/m^3. The RSPM was collected using glass fibre filter paper (Whatman GF/A Glass Microfiber Filter, Made in England). The TSPM was collected using the plastic cones supplied along with the sampler by Envirotechpvt.ltd., New Delhi, India. The cones were labelled with the sampling station and date of sampling. The glass fibre filter paper which was pre-equilibrated for 24 h was taken after ensuring that there were no holes or other visible defects and placed on the mesh. The initial weight of the filter paper was recorded (W1) using an electronic balance (Dhona, 200 D). Final weight of the filter paper was also recorded (W2) after sampling. The initial weight of the cones used for collection of coarse particulates was recorded (C1) before inserting in the cyclone and final weight was recorded (C2) after the completion of the sampling.

Calculations

The concentrations of RSPM were calculated using the formula:

$$(RPM)\ \text{in}\ \mu g/m^3 = \frac{(W2 - W1)}{M.R \times T} \times 10^6$$

$$(TSPM)\ \text{in}\ \mu g/m^3 \frac{\{(C2-C1)+(W_2 - W_1)\}}{M.R \times T} \times 10^6$$

Where,

C1	:	Initial weight of the Cone (g)
C2	:	Final weight of the Cone (g)
W_1	:	Initial weight of the Filter Paper (g)
W_2:		Final weight of the Filter Paper (g)
M.R	:	Manometer Reading (lpm)
T	:	Total Sampling time (minutes)

2.3 Sampling and Analysis of Sulphur Dioxide

Thirty ml of 0.04 M Potassium Tetrachloromercurate (TCM) absorbing solution was taken in a midget impinger and arranged in the gaseous sampling kit attached to the Respirable Dust Sampler. The sampler was allowed to run for 8 hrs (the rotameter set for 0.2 litre / minute) and then the contents of the impinger were transferred to a clean sampling bottle and it is clearly labeled with the date and time of the sampling. The impinger was again filled with 30 ml of TCM solution to continue the sampling procedure. The collected samples were immediately transferred to the laboratory for further analysis.The contents of the sampling bottle were transferred to a 50 ml volumetric flask. A reagent blank was prepared by adding 25 ml of unexposed absorbing reagent in a 50 ml volumetric flask. To destroy the nitrates from oxides of nitrogen, 1 ml of 0.6% sulfuric acid was added and was allowed to react for 10 minutes. Two ml of 0.2% of formaldehyde and 5 ml Pararosaniline reagent were added. The contents were allowed to stabilize for 30 minutes then the absorbance was measured at a wavelength of 560 nm in a UV-Visible Spectrophotomer (ELICO Model No SL 177, Scanning SPEC). Aliquots of diluted Sodiumsulphite solution was added to 0,1,2,3,4 and 5 ml were taken into series of 25 ml volumetric flasks. The contents were made up to 25 ml in the volumetric flask using 0.04 M TCM solution. The absorbances were plotted against concentrations. Concentrations of the SO_2 in the unknowns were drawn from the graph.

Calculations:

$$SO_2 \text{ Concentration in } \mu g/m^3 = \frac{(A-A_0) \times (10^3) \times B \times V_s}{V_a \times V_t}$$

A	- Sample Absorbance
A_0	- Reagent Blank absorbance
10^3	- Conversion litres to cubic meters
B	- Calibration factor µg/absorbance
V_a	- Volume of air sampled in litres
V_s	- Final volume of sampling solution
V_t	- Aliquot taken for analysis

2.4 Sampling and Analysis of Oxides of Nitrogen

Thirty ml of Sodium hydroxide and sodium arsenite absorbing solution was taken in a midget impinger and arranged in the gaseous sampling kit attached to the Respirable Dust Sampler. After the sampling, the contents were taken to the laboratory in the amber colored bottle and subjected to further analysis. 1.5306 g of NaNO2 was dissolved in double distilled water and made up to 1l. 1 ml of this solution was equivalent to 1000 µg/ml of NO_2. 10 ml of this solution was diluted to 1 l. This contained 10 µg/ml of NO_2. Again 10 ml of this solution was diluted to 100 ml with absorbing solution; this contained 1 µg/ml of NO_2.25 ml of absorbing solution was taken in ten volumetric flasks and 0.5, 1, 3, 5, 7, 10, 15, 20, 25 ml of 1 µg/ml of NO_2 was placed in each of the flask and made up to 25 ml using absorbing solution. 1ml of H_2O_2, 10 ml of Sulfanilamide solution and 1 ml of NEDA were added to each flask, the contents were thoroughly mixed and left for 30 min for colour development. Then absorbance at 550 nm was measured using a UV-Visible spectrophotometer (Model ELICO Model No SL 177, Scanning Mini SPEC). The absorbance was plotted against concentration to prepare a calibration curve. The concentrations of the unknowns were drawn from this calibration curve.

Calculations:

$$NO_x \text{ Concentration } (\mu g/m^3) = \frac{\mu g/NO_2 \times V_s}{V_a \times 0.82 \times V_t} \times D$$

$\mu g/NO_2$	- NO_2 concentration in analyzed sample (Graph factor x (Samples absorbance – Blank absorbance))
V_a	- Volume of air sampled in m^3
0.82	- Sampling efficiency
D	- Dilution Factor (D=1 for no dilution; D=2 for 1:1 dilution)
V_s	- Final Volume of sampling solution
V_t	- Aliquot taken for analysis

2.5 Sampling of Carbon Monoxide (CO)

The concentrations of the Carbon Monoxide were recorded using an instrument (Make: Quest technologies) that directly gave the read out. The values were recorded exposing the instrument to the ambient condition for one minute. Series of values were recorded and the mean values were tabulated.The respective concentrations of the ambient air quality parameters were compared at this station with the National Ambient Air Quality (NAAQ) standards.

2.6 Sampling and Testing of Street Vendors

For the present study, the vendors were selected using judgment sampling and convenience sampling. The vendors were selected from each sampling station and were subjected to various tests. For all the tests, people who have been living in this area for a minimum of three years were selected. After preliminary interview the vendor was taken to Andhra Pradesh chest hospital, Hyderabad and tested for the parameters initially. The vendor was taken as the item in the sample only when they promised to attend to the tests for the second time. They were financially compensated for the loss of income on the days of tests. The following tests were performed to the vendors, to identify the impacts of traffic on the health.

a) Blood pressure test
b) Pulse oxymetry
c) Pulmonary function test
d) Carboxyhaemoglobin test.

All these tests were performed after recording the age, height (in cm) and weight (in kg) of the vendors. A brief description of each test is given.

a)Blood pressure test

The systole and diastole pressure was measured using a sphygmomanometer. This test was performed only to ascertain the initial health status of the vendors as a cross checks for the information provided by the sample vendor.

b)*Pulse oxymetry*

The pulse oxymetry was performed for all the vendors to record percent saturation of oxygen in the blood and the pulse rate. The vendors' finger was clipped connecting to the pulse oxymetry (BPL) apparatus. The instrument gave direct reading of percent saturation and the pulse rate of the vendor. The saturation percentage of the individual was compared to the standards available and accordingly the decrease of percent saturation was categorized as normal, mild, moderate and severe, in that order.

c)*Pulmonary Function Test*

PFT test is envisaged to detect whether the vendor has got any breathing problem. This test also helps to detect any obstruction in the trachea of the vendor. The PFT besides tracing out the obstructions, also measures the volume of air that could be held by the lung. The Pulmonary Function Test was performed to all the vendors. The Pulmonary Function was assessed through two components namely FEV1 and FVC. FEV1 was Forced Expiratory Volume in the first second. The total expiration was measured after a full breathe to record Forced Vital Capacity. The FEV1 and FVC were measured twice at an interval of 20 minutes. The first record of FEV1 and FVC were taken as the base volume and the second record generally was used to prescribe the drug dose basing on the difference. After six months all the vendors were tested for second time. The difference between the two base volumes was considered for the assessment of the impact. The difference between the first FEV1 and second FEV1 (after 6 months) was recorded in ml. The difference between first FVC and value after 6 months was also recorded in ml. The increase of value for FEV1 and FVC over the initial value (when the study was started) was taken as the improvement in the condition and a decrease over the first record was taken as the deterioration of the lung capacity which is referred in the study as 'Affected'.

d)*Carboxyhemoglobin test*

The amount of Carbon monoxide in the blood was recorded using a CO meter (Micro Medical CO meter, UK). The vendor was asked to inhale the air to full capacity and hold it for 15-20 seconds and then blow the air out through the mouth piece attached to the CO meter. The CO meter gave a direct read out in percentage COHb. The Carboxyhaemoglobin (COHb) test was repeated after six months for all the vendors. The difference between the two records was used to assess the impact. An increase in the value at the second instance was considered to designate the vendor as affected and a decrease for improvement in the condition.

3.0 Results and Discussion:

3.1 Ambient air quality in the Lakdikapul traffic station

The study included monitoring of TSPM, RSPM, SO_2, NO_x and CO at ameerpet station. The monthly means of the ambient air quality parameters are discussed for each station. Basing on the number of ambient air quality parameters exceeding the standards, the traffic stations were assigned a rank to denote the level of air pollution. The hourly means of 24 hours analysis was also made and the concentrations of ambient parameters during peak traffic hours was also determined. A brief description of various AAQ parameters at this traffic zone was furnished here under

3.2Total suspended particulate matter (TSPM)

The monthly means of total suspended particulate matter for the study period showed a wide range of concentrations. The minimum TSPM concentration was recorded in September 2006 (233.00 μg/m^3) and the maximum was recorded in November 2006 (382.00 μg/m^3), while the mean concentration of the TSPM recorded for the whole study period was 308.20 μg/m^3. There were supporting evidences by many authors for these sources (Roorda-Knape et al., 1998; Kumar et al., 2001; Saksena et al., 2003; Fenger, 2009;Charron and Harrison 2003) measured the particle size distribution in the range of 11 - 452 nm on the side of a busy Marylebone road in Central London and concluded that 11-30 nm size contained freshly nucleated particles formed as the exhaust gases diluted with ambient air. The pattern of seasonal distribution of TSPM was same for both years. The summer seasons exhibited moderate concentrations of TSPM and the rainy seasons showed the lowest concentrations, while the highest concentrations of the TSPM were shown during winter season (Table 2; Fig. 1).

3.3 Respirable suspended particulate matter (RSPM)

The monthly means of respirable suspended particulate matter for the study period showed a wide range of concentrations. The minimum concentration of RSPM was recorded in October 2006 (85.10 µg/m^3) and the maximum was recorded in November 2007 (146.50 µg/m^3), while the mean concentration of the RSPM recorded for the whole study period was 112.01 µg/m^3. (Leung and Lam 2001) examined the respirable suspended particulates at 72 locations in 6 urban districts of different land use types in Hong Kong and concluded that the problem of respirable suspended particulates in Hong Kong's roadside environment is quite seriousThe seasonal distribution of RSPM was same for both the years. The summer seasons showed moderate concentrations of RSPM and the rainy seasons showed the lowest concentrations, while the highest concentrations of the RSPM were observed during winter season(Table 2; Fig. 1).   .

3.4 Sulphur dioxide

The monthly means of sulphur dioxide for the study period showed a marginal range between 5.10 and 6.90 µg/m3. The mean concentration of sulphur dioxide for the whole study period was 5.78 µg/m3. The seasonal variations in the concentrations of sulphur dioxide were not considerable since there was only marginal difference between the lowest and highest concentrations during the study period. The sulphur dioxide coupled with particulate matter is known to increase the respiratory and cardio-pulmonary mortality (Neuberger and Moshammer, 2004). The concentrations of sulphur dioxide were considered as negligible as the recorded concentrations were less than 10% of the prescribed national standard(Table 2; Fig. 1).   .

3.5Oxides of nitrogen

The concentrations of the oxides of nitrogen for the whole study period ranged between 23.70 and 42.60 µg/m3, with a monthly mean of 31.30 µg/m3. The concentrations of oxides of nitrogen during summer were moderate. A study made in Hong Kong on the daily variations of NO_2 at 14 monitoring stations by (Lau et al., 2009) concluded that the air pollution behavior was in tune with the variations in the traffic volume and further the dispersion of these pollutants was hindered by the tall buildings and their high density. The rainy season exhibited low concentrations while higher concentrations were observed in winter season. However, the highest concentration recorded at Lakdikapul (42.60 µg/m3) was slightly higher than half of the specified national standard(Table 2; Fig. 1).

3.6 Carbon monoxide

The carbon monoxide concentrations at Lakdikapul ranged between 2.20 and 4.80 mg/m3. The mean concentration for the whole study period was 3.10 mg/m3. Though the difference between the lowest and highest records seem to be less, a difference of 2.60 mg/m3 was definitely a considerable difference if we take into account the permissible limit for carbon monoxide which stands at 2.00 mg/m3 for 8 h averaging time. Bremauntz and Ashmore (1995) conducted a study in Mexico city on in-vehicle carbon monoxide levels to identify the main factors affecting the variation in CO concentrations inside public and private transport vehicles during the winter of 1991. The seasonal march of the carbon monoxide was similar to that of any other parameter with trends following, moderate in summer, less in rainy and high in winter seasons (Table 2; Fig. 1).

Table 2: Monthly mean concentrations of Ambient air quality parameters at Lakdikapul traffic station during the study period

Month and Year	TSPM (µg/m^3)	RSPM (µg/m^3)	SO_2 (µg/m^3)	NO_x (µg/m^3)	CO (mg/m^3)
MAY, 2006	297.00	103.50	5.50	28.20	2.80
JUNE, 2006	295.00	102.40	5.60	27.40	2.90
JULY, 2006	262.00	89.60	5.10	24.80	2.30
AUG, 2006	275.00	87.40	5.20	26.30	2.40
SEP, 2006	233.00	88.70	5.10	24.80	2.70
OCT, 2006	249.00	85.10	5.30	25.40	2.20
NOV, 2006	382.00	135.70	6.60	41.20	3.60
DEC, 2006	373.00	140.20	6.80	42.30	3.70
JAN, 2007	359.00	134.20	6.70	39.70	3.80
FEB, 2007	364.00	131.50	6.10	38.40	4.40
MAR, 2007	292.00	121.40	5.60	29.30	2.80
APR, 2007	286.00	102.30	5.70	28.70	2.60
MAY, 2007	294.00	120.30	5.30	29.50	2.70
JUN, 2007	288.00	107.80	5.40	27.90	2.90
JUL, 2007	270.00	90.50	5.20	25.30	2.30
AUG, 2007	267.00	99.60	5.10	23.70	2.20
SEP, 2007	279.00	97.60	5.40	24.30	2.40
OCT, 2007	272.00	92.70	5.30	25.50	2.50
NOV, 2007	381.00	146.50	6.60	41.40	3.90
DEC, 2007	374.00	129.30	6.90	42.60	4.80
JAN, 2008	378.00	139.50	6.70	40.40	4.20
FEB, 2008	366.00	129.70	6.40	39.90	4.50
MAR, 2008	295.00	108.20	5.60	28.20	2.70
APR, 2008	286.00	109.60	5.60	29.70	2.90
MAY, 2008	288.00	106.90	5.80	27.50	3.20
Mean	**308.20**	**112.01**	**5.78**	**31.30**	**3.10**
NAAQ Standard	**200**	**100**	**80**	**80**	**2**

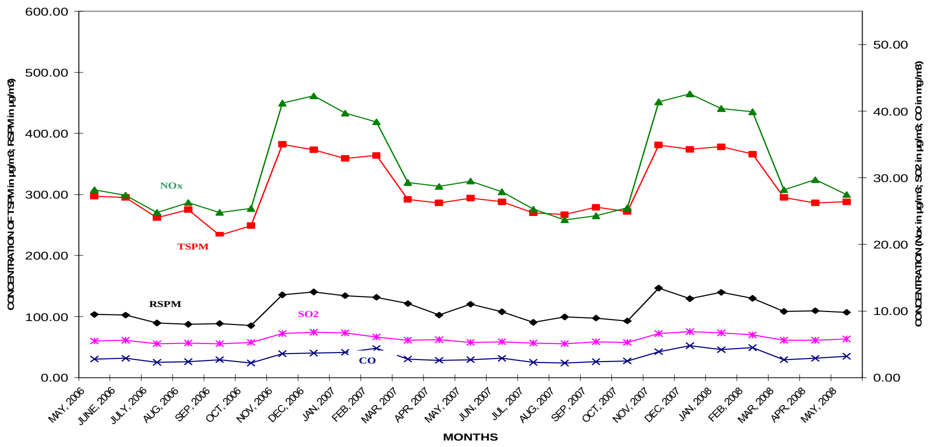

Fig. 1: Monthly mean concentrations of ambient air quality parameters at Lakdikapul during the study period

3.7 Hourly mean concentrations of ambient air quality at ameerpet station:

3.7.1 Air quality during peak traffic hours

This station selected was known for experiencing high traffic volume and density in Hyderabad city. Though the vehicular mobility is continuous for nearly 18 hours a day, there were certain hours of the day when the volume and density of the traffic was very high and hence is named as 'the Peak Traffic Hour' (PTH). Generally, two such PTHs existed in a day, once in the morning and other in the evening. However, the times of the peaks and duration of each the peak varied within a day as well as from station to station. The present observations revealed that there was a marked change in the concentrations of the respective parameters during PTH and non PTHs. The concentrations of the quality parameters in each station during PTHs and non PTHs is described here.

3.7.2 Total suspended particulate matter (TSPM)

The monthly means of total suspended particulate matter for the study period showed a wide range of concentrations. The minimum TSPM concentration was recorded in September 2006 (233.00 µg/m^3) and the maximum was recorded in November 2006 (382.00 µg/m^3), while the mean concentration of the TSPM recorded for the whole study period was 308.20 µg/m^3. The pattern of seasonal distribution of TSPM was same for both years. The summer seasons exhibited moderate concentrations of TSPM and the rainy seasons showed the lowest concentrations, while the highest concentrations of the TSPM were shown during winter season (Table 3; Fig. 2).

3.7.3Respirable suspended particulate matter (RSPM)

The monthly means of respirable suspended particulate matter for the study period showed a wide range of concentrations. The minimum concentration of RSPM was recorded in October 2006 (85.10 µg/m^3) and the maximum was recorded in November 2007 (146.50 µg/m^3), while the mean concentration of the RSPM recorded for the whole study period was 112.01 µg/m^3. The seasonal distribution of RSPM was same for both the years. The summer seasons showed moderate concentrations of RSPM and the rainy seasons showed the lowest concentrations, while the highest concentrations of the RSPM were observed during winter season(Table 3; Fig. 2).

3.7.4 Sulphur dioxide

The monthly means of sulphur dioxide for the study period showed a marginal range between 5.10 and 6.90 µg/m3. The mean concentration of sulphur dioxide for the whole study period was 5.78 µg/m3. The seasonal variations in the concentrations of sulphur dioxide were not considerable since there was only marginal difference between the lowest and highest concentrations during the study period. The concentrations of sulphur dioxide were considered as negligible as the recorded concentrations were less than 10% of the prescribed national standard(Table 3; Fig. 2).

3.7.5Oxides of nitrogen

The concentrations of the oxides of nitrogen for the whole study period ranged between 23.70 and 42.60 µg/m3, with a monthly mean of 31.30 µg/m3. The concentrations of oxides of nitrogen during summer were moderate. The rainy season exhibited low concentrations while higher concentrations were observed in winter season. However, the highest concentration recorded at Lakdikapul (42.60 µg/m3) was slightly higher than half of the specified national standard(Table 3; Fig. 2).

3.7.6Carbon monoxide

The carbon monoxide concentrations at Lakdikapul ranged between 2.20 and 4.80 mg/m3. The mean concentration for the whole study period was 3.10 mg/m3. Though the difference between the lowest and highest records seem to be less, a difference of 2.60 mg/m3 was definitely a considerable difference if we take into account the permissible limit for carbon monoxide which stands at 2.00 mg/m3 for 8 h averaging time. The seasonal march of the carbon monoxide was similar to that of any other parameter with trends following, moderate in summer, less in rainy and high in winter seasons (Table 3; Fig. 2).

3.8 Impacts of traffic pollution on the health of roadside vendors:

The impact of traffic pollution on the health of roadside vendors was studied in selected high traffic zone of Hyderabad city in Andhra Pradesh, India. After monitoring the ambient air quality which was primarily determined by the vehicular emissions and road conditions, the study was continued for their impacts on the health of roadside vendors. Hyderabad City is a fastest growing city in India, with the recent up gradation as "Greater Hyderabad", the urban sprawl was enthralled. As a result of increased job potential, immigrations have increased that reflected in increase of traffic volume, pollution loads and increased population density that bring about unwanted changes in the quality of human environment. Lakdikapul , a major traffic station experienced during the morning peak traffic, vehicle volume of 28,934 and 30,851 during morning and evening peaks. The plight of vehicles per hour was 7,233.5 vehicles in morning and 7,712.7 vehicles per hour in the evening. The vendors were tested twice in a span of six months. The difference between the initial test and final test values were used to record whether the person was affected and if affected the intensity of the impact by comparing with the available standard values.

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Table 3: Monthly mean concentrations of Ambient air quality parameters at Lakdikapul traffic station during the study period.

Month and Year	TSPM (µg/m^3)	RSPM (µg/m^3)	SO_2 (µg/m^3)	NO_x (µg/m^3)	CO (mg/m^3)
MAY, 2006	297.00	103.50	5.50	28.20	2.80
JUNE, 2006	295.00	102.40	5.60	27.40	2.90
JULY, 2006	262.00	89.60	5.10	24.80	2.30
AUG, 2006	275.00	87.40	5.20	26.30	2.40
SEP, 2006	233.00	88.70	5.10	24.80	2.70
OCT, 2006	249.00	85.10	5.30	25.40	2.20
NOV, 2006	382.00	135.70	6.60	41.20	3.60
DEC, 2006	373.00	140.20	6.80	42.30	3.70
JAN, 2007	359.00	134.20	6.70	39.70	3.80
FEB, 2007	364.00	131.50	6.10	38.40	4.40
MAR, 2007	292.00	121.40	5.60	29.30	2.80
APR, 2007	286.00	102.30	5.70	28.70	2.60
MAY, 2007	294.00	120.30	5.30	29.50	2.70
JUN, 2007	288.00	107.80	5.40	27.90	2.90
JUL, 2007	270.00	90.50	5.20	25.30	2.30
AUG, 2007	267.00	99.60	5.10	23.70	2.20
SEP, 2007	279.00	97.60	5.40	24.30	2.40
OCT, 2007	272.00	92.70	5.30	25.50	2.50
NOV, 2007	381.00	146.50	6.60	41.40	3.90
DEC, 2007	374.00	129.30	6.90	42.60	4.80
JAN, 2008	378.00	139.50	6.70	40.40	4.20
FEB, 2008	366.00	129.70	6.40	39.90	4.50
MAR, 2008	295.00	108.20	5.60	28.20	2.70
APR, 2008	286.00	109.60	5.60	29.70	2.90
MAY, 2008	288.00	106.90	5.80	27.50	3.20
Mean	**308.20**	**112.01**	**5.78**	**31.30**	**3.10**
NAAQ Standard	**200**	**100**	**80**	**80**	**2**

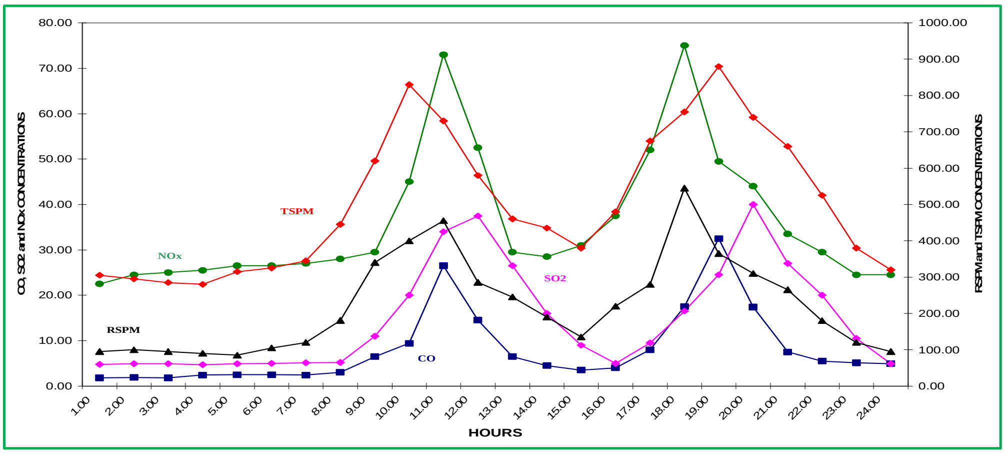

Fig. 2: Hourly parameters at the Lakdikapul traffic station during study period

3.9.0 Tests for health impacts:

3.9.1 Blood Pressure

The Blood pressure of the vendors was initially measured to cross check the information provided by the respondents. Only one out of five were found having high blood pressure. The remaining vendors had normal blood pressure. All these vendors were in the age group of 38-50 years. All these four people have fallen in the impacted category in the remaining tests on the health impacts. The vendors had normal blood pressure was shown in Table .4.

Table 4: Details of the blood pressure measurement in the beginning of the study for the subject vendors in the study area.

Station	Sample size	Normal B.P.	High B.P.
Lakdikapul	5	4(80%)	1 (20%)

Table 5: Measurement of the percentage oxygen saturation in blood among the subject vendors through pulse oxymetry in the beginning of the study.

Name of the Station	Normal	Mild of impact	Moderate of impact
Lakdikapul	1	3	1

3.9.2 Pulse oxymetry

The pulse oxymetry was used to measure percent oxygen saturation in the blood. Out of the total 52 vendors only 11 roadside vendors were normal, the remaining vendors have been affected at varied intensities. However, 40.4% of the vendors had the saturation level between 93-95% which was designated as 'mild impact'; another 38.5% were affected with moderate impact. In these cases the saturation level was between 87-92%. There was no case of 'severe impact'. On the whole, 79% of the roadside vendors were affected and only 21% were normal. This decreased saturation level of oxygen could be taken as a forecasting tool for the future ailments or disorders. Out of the thirteen vendors selected for the present study from Lakdikapul only 4 have above 95% oxygen saturation levels and declared as normal (Table 5). The saturation levels were less in others. In seven vendors the saturation level was 93-95% and hence they were declared as affected with 'mild impact' while in the remaining two, the saturation levels were still less, varied between 87 and 92% and were considered moderately affected. Nine out of thirteen vendors selected were affected. While in this station, 80% people were found affected.

3.9.3 Pulmonary function test (PFT)

Pulmonary Function Test is generally considered as the clinical support test of the general health of an individual. The 'Pulmonary Function' varies with not only the bacterial lung infections but also with non bacterial lung infections. Exposure to a deteriorated ambient air quality also lead to the non bacterial lung infections. The periodical testing of lung function helps in prediction of the respiratory allergies, aggravation of already existing respiratory ailments such as Asthma and Bronchitis and also the consistent decrease of lung function forecasts the Chronic Obstructive Pulmonary Disease (COPD). Hence, the pulmonary function test was considered in the present study as the primary indicator of the impact of traffic pollution on the health of roadside vendors. The Pulmonary function test reveal the air handling capacity of the lungs of an individual. This capacity was measured in two dimensions viz., FEV1 and FVC. The FEV1 was Forced Expiratory Volume in the first second of expiration which was expressed in ml. The FVC was Forced Vital Capacity measures the amount of air one can exhale with force after a full breath, the value of which was expressed in ml(Zahra Hojati 2013).FEV1 and FVC, both were measured to evaluate the pulmonary function of the roadside vendors in the beginning of the study as well as after six months. The change of value over the first record in the beginning of the study was noted to denote the impact as "improved" when the second record was higher than the first and the impact was considered as "affected", when the second record was lower than the first. After both the tests, the vendor was considered as "improved" when the second record was higher for both FEV1 and FVC. The vendor was considered as "affected" when the FEV1 and / or FVC have shown a decrease. These values were influenced by many factors such as volume of traffic, duration of exposure, age group, habits of the individual, etc.,A maximum of 4,060.00 ml of Forced Expiratory Volume in first second was recorded at Lakdikapul in the first test.

3.9.4 FEV1 and FVC of the subject samples in the study area

At Lakdikapul, out of the five roadside vendors, 3 subject vendors have showed a decrease in the Forced Expiratory Volume in first second. The FEV1 ranged from -50.00 to -840.00 ml among these vendors. Two of the subject vendors have shown an improved FEV1 which ranged from 0 to 290.00 ml. This group which showed improvement included the people shifted their residence to a non traffic zone, some were ex-smokers and never smokers. The improvement was attributed to shifting to a new place, a recovery from an ailment and the individual's resistance capacity in whom the effects of traffic pollution were not yet in vogue (Table 6). The decreased FEV1 indicated, the development of obstructions in the respiratory tract of the subject vendorssimilar results were observed in (Janssen, N.A.H et al., 2003). Among the vendors who showed the decrease one vendor has also showed very less FEV1 at the beginning of the study, which further decreased in the final FEV1, among the samples at Lakdikapul.Forced Vital Capacity which indicate the total air handling capacity of the lungs revealed a decrease in two subject vendors. The decrease ranged from -40.00 to -160.00 ml. The decrease in FVC is a sign of susceptibility for future infections. Three vendors showed an improvement in the FVC, and two subject vendors showed substantial improvement. Among the vendors, the vendor who showed maximum decrease in FVC has also showed very less vital capacity (Table 6) in the beginning of the study and at the end of the study, her vital capacity further decreased (A. Mani Prakashetal., 2013).

Table 6 : FEV1 and FVC values

Sl. No	Code of Sample Vendor	FEV1 Initial in ml	FEV1 Final in ml	FEV1 difference in ml	FVC initial in ml	FVC final in ml	FVC difference in ml
1	Lkd 1	3320.00	3270.00	-50.00	3680.00	3730.00	50.00
2	Lkd 2	1940.00	1100.00	-840.00	2120.00	1960.00	-160.00
3	Lkd 3	2460.00	2460.00	0.00	3130.00	3460.00	330.00
4	Lkd 4	2610.00	2900.00	290.00	2890.00	3270.00	380.00
5	Lkd 5	4060.00	3920.00	-140.00	4510.00	4470.00	-40.00

4.0 Conclusions:

1.The AQHI Air Quality Health Index in general encourages exercise in accordance with other public health guidelines except in situations of higher risk from air pollution, which occur infrequently. In those situations, people are advised to reduce strenuous outdoor activity, to move indoors, or to reschedule.

2.They are also advised to avoid cumulative exposures by not exercising near traffic and to be aware of the risks of exercising in excessive heat.

3.The AQHI is a public health and clinical tool that can easily be taught to vulnerable patients, such as patients with asthma, COPD Chronic obstructive pulmonary disease (COPD), and cardiovascular disease, by family physicians and other health professionals.

4.Family physicians can learn more about the health effects of air pollution and about the AQHI through accredited online courses and educational brochures.

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