PUNE STUDIES ON AIR POLLUTION AND HEALTH

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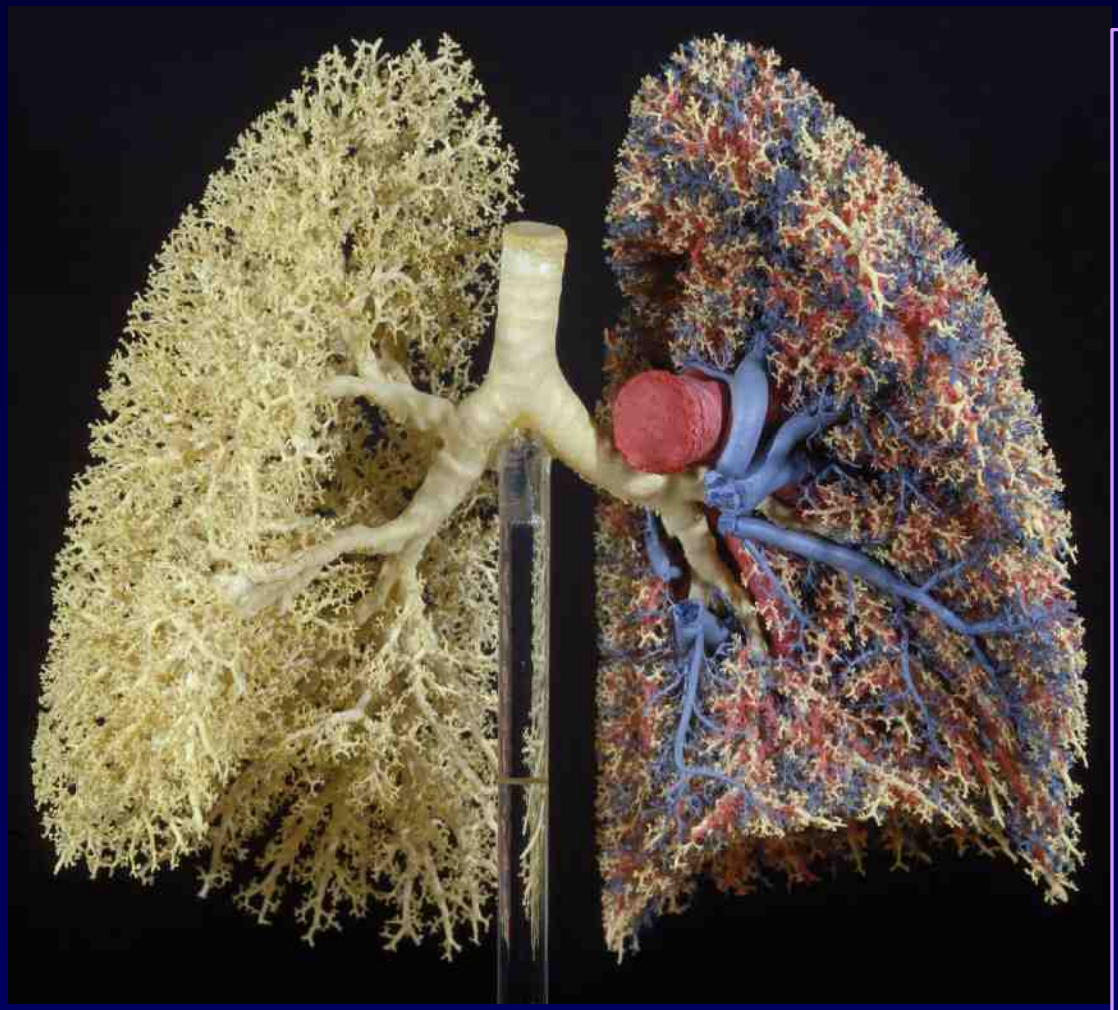
AIR POLLUTION AND THE LUNG



10,000 lts of air pass in and out of the lungs every 24 hours.

1000000000000 particles enter into lungs daily

150 m^2 - Surface area exposed to the external environment

10,000 lts of blood pass through the lungs every 24 hours.

Relative emissions from petrol cars and diesel cars

RUDOLF DIESEL

(1858-1913)

Pollutant	Petrol	Diesel
Carbon dioxide	++++	+
Carbon monoxide	+++	++
Benzene	+++	++
Nitrogen oxides	+	++
Hydrocarbons	++	+++
Aldehydes	++	+++
Sulphur dioxide	+	++++
PAHs	+	++++
Particulate matter*	+	++++

* **Diesel engines generate up to 1400 times more particles than petrol engines**

EXPOSURE OF HEALTHY HUMAN SUBJECTS TO DIESEL EXHAUST FOR 1 HOUR

Cellular and molecular changes in the lung tissue

	Air	Diesel
T lymphocytes		
Epithelium	3.8	23.5
Sub-mucosa	5.9	24.5
Neutrophils		
Epithelium	0.83	3.69
Sub-mucosa	21.8	59.9

1 hour exposure to diesel exhaust caused a significant cellular inflammatory response in the airways

Salvi S et al, Am J Resp CCM 1999; 159: 702-709

- Who are the people that are exposed to high levels of air pollution on a daily basis?
- What is the health impact of exposure to air pollution?

PUNE TRAFFIC POLICEMEN STUDY

323 traffic policemen; 122 non-traffic policemen

Respiratory questionnaire

Lung Function tests

Lung Oxidative stress

DIFFERENCES IN LUNG FUNCTIONS BETWEEN TRAFFIC AND NON-TRAFFIC POLICEMEN

	Traffic P	Non-traffic P
FEV1	3.19	2.94
FVC	3.69	3.36
PEFR	7.63	7.22

Traffic policemen show better lung function than non-traffic policemen

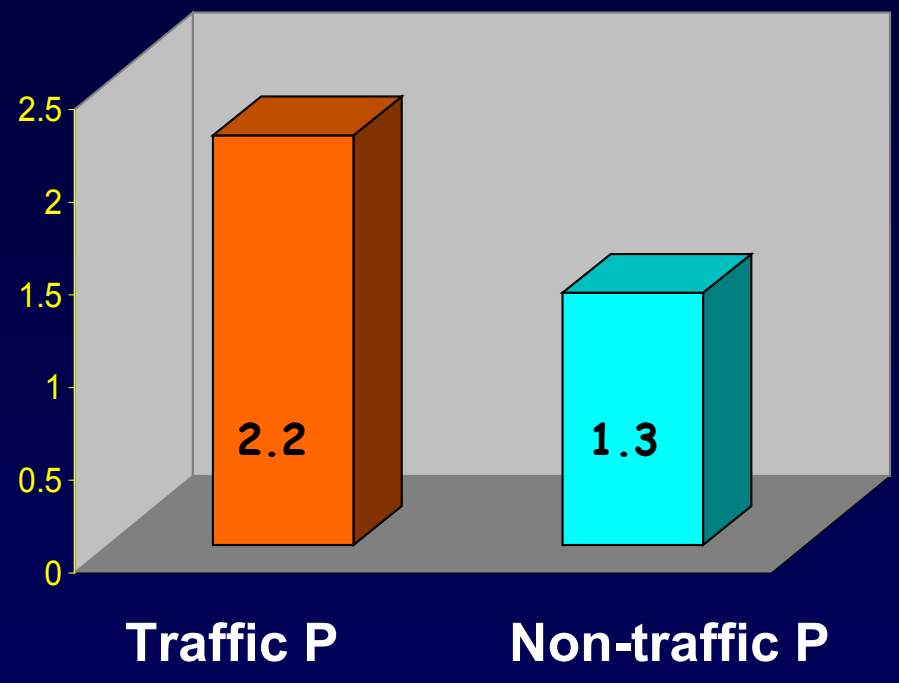
MEASURING OXIDATIVE STRESS IN THE LUNGS

Our lungs produce CO in response to oxidative stress, which is largely mediated by air pollutants and inflammation in the lungs.

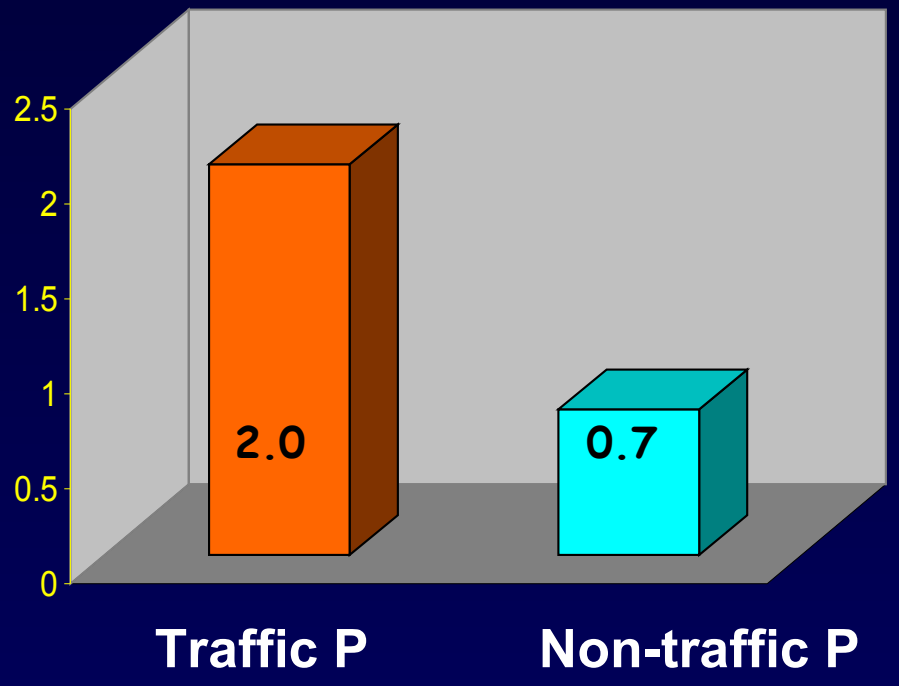
This can be measured in the exhaled breath

Breath exhaled CO is a useful non-invasive marker of oxidative stress in the lungs

Exhaled breath carbon monoxide levels (in ppm)



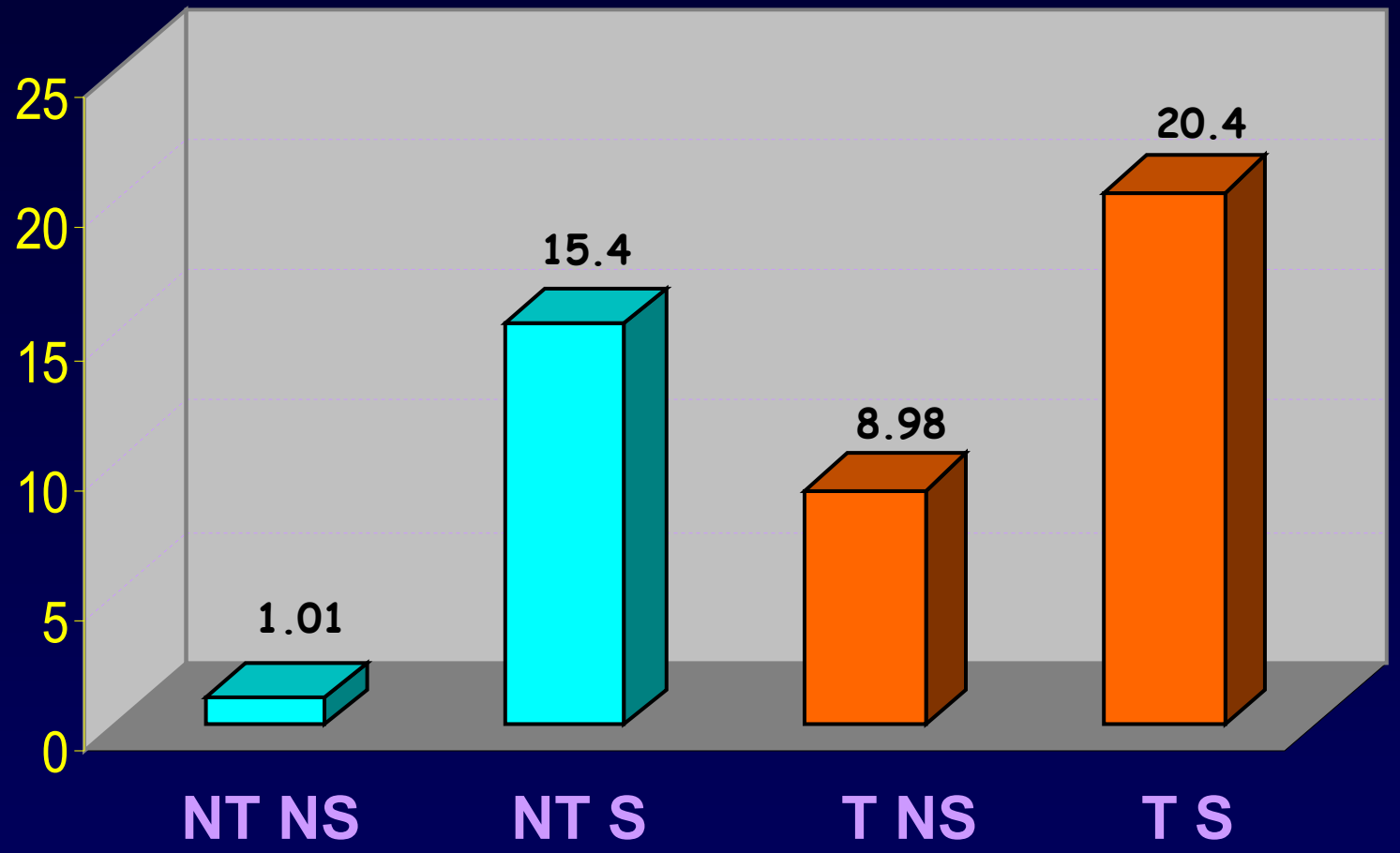
Smokers + Non-smokers



Non-smokers

(Chest Research Foundation, 2005)

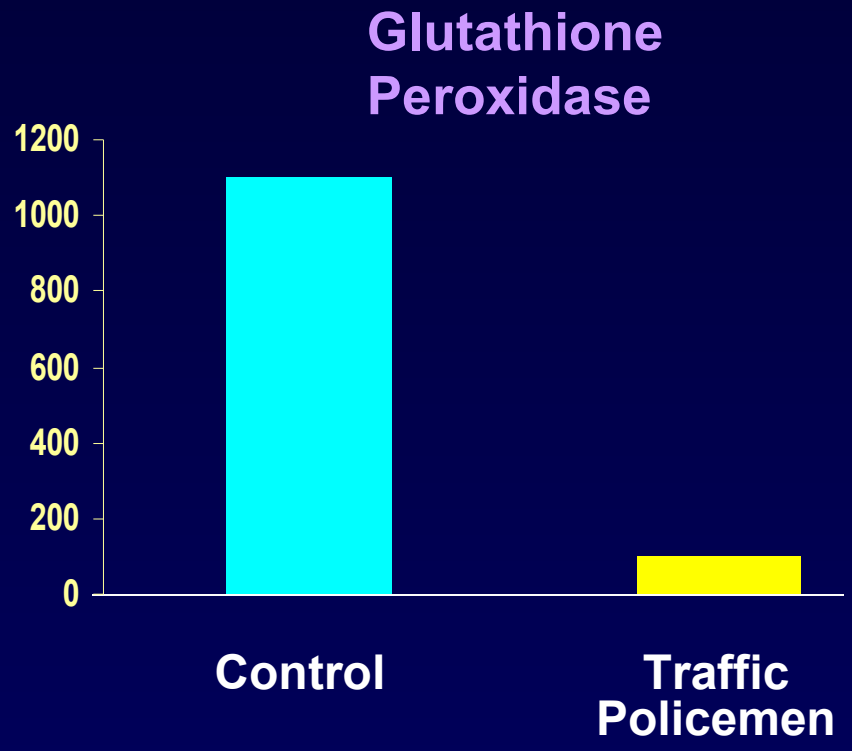
Incidence of exhaled CO > 6ppm (%)

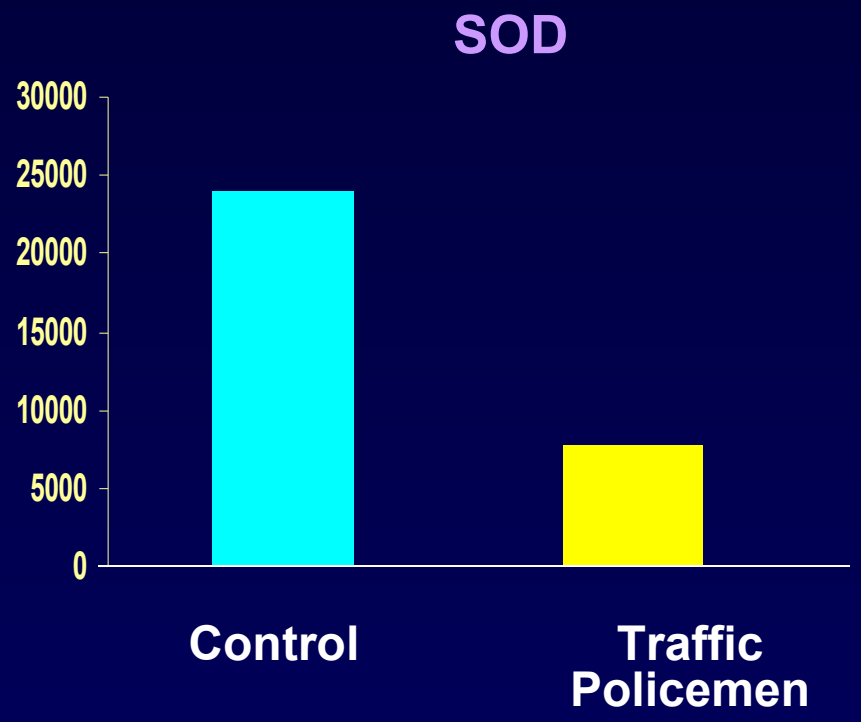


(NT – Non Traffic; T – Traffic; S – Smoker; NS – Non-smoker)

(Chest Research Foundation, 2005)

Evidence of oxidative stress in peripheral blood of traffic policemen from Hyderabad city, India

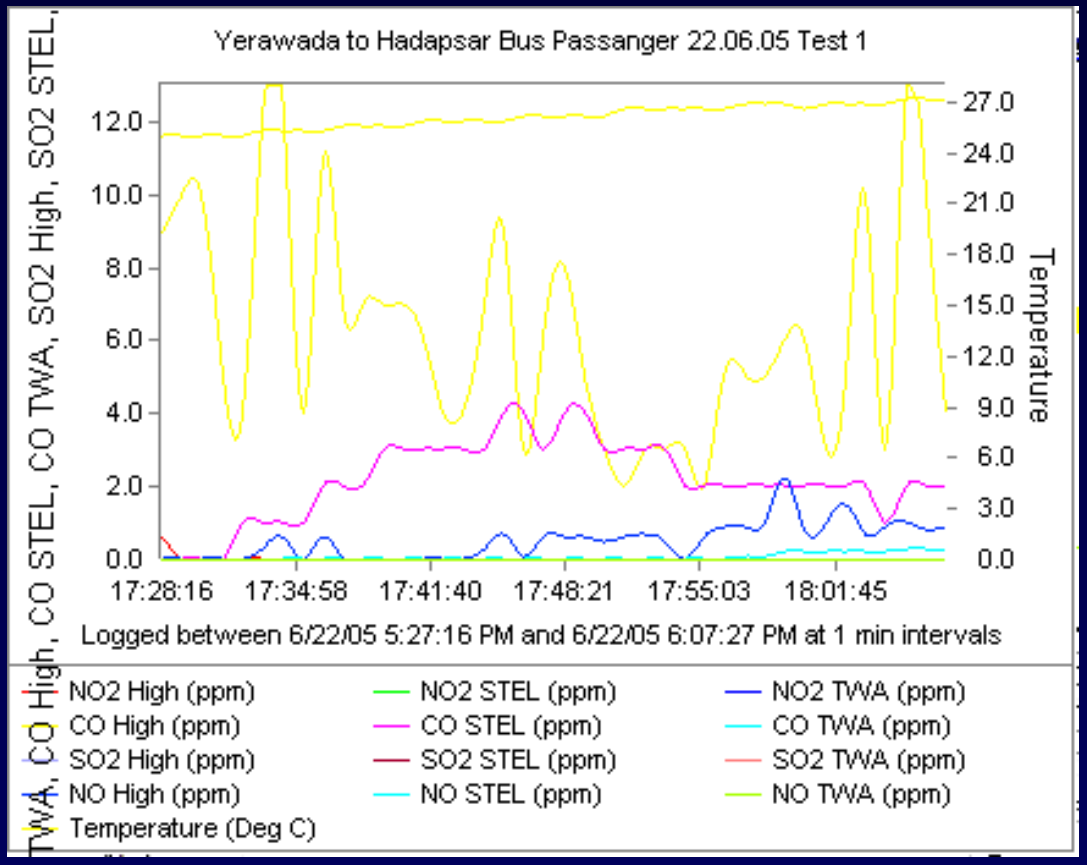




(Suresh Y et al, Environmental Pollution 2000; 109: 321-325)

Bus journey from Yerawada to Hadapsar

(Gaseous pollutants encountered on the way)



(Chest Research Foundation, 2005)

AIMS OF THE STUDY

- To measure and compare the levels of exhaled carbon monoxide in bus drivers and university staff members.
- To measure the levels of exhaled CO during the beginning, middle and end of their duties
- Is there an association between exhaled CO levels and respiratory symptoms?

STUDY POPULATION

- **PMT drivers:** (n = 256)
  - Permission from the Municipal Commissioner
  - Bus drivers from 9 busy bus stations from Pune city were approached.
  - Consent was obtained
  - Administered a questionnaire (demography, work details, smoking status and respiratory health assessment)
  - Exhaled breath CO levels measured.

- **Control group:** (n = 150)
  - Pune University Staff Members
  - Same approach as above

3 exhaled CO readings

First reading taken prior to the beginning of the shift

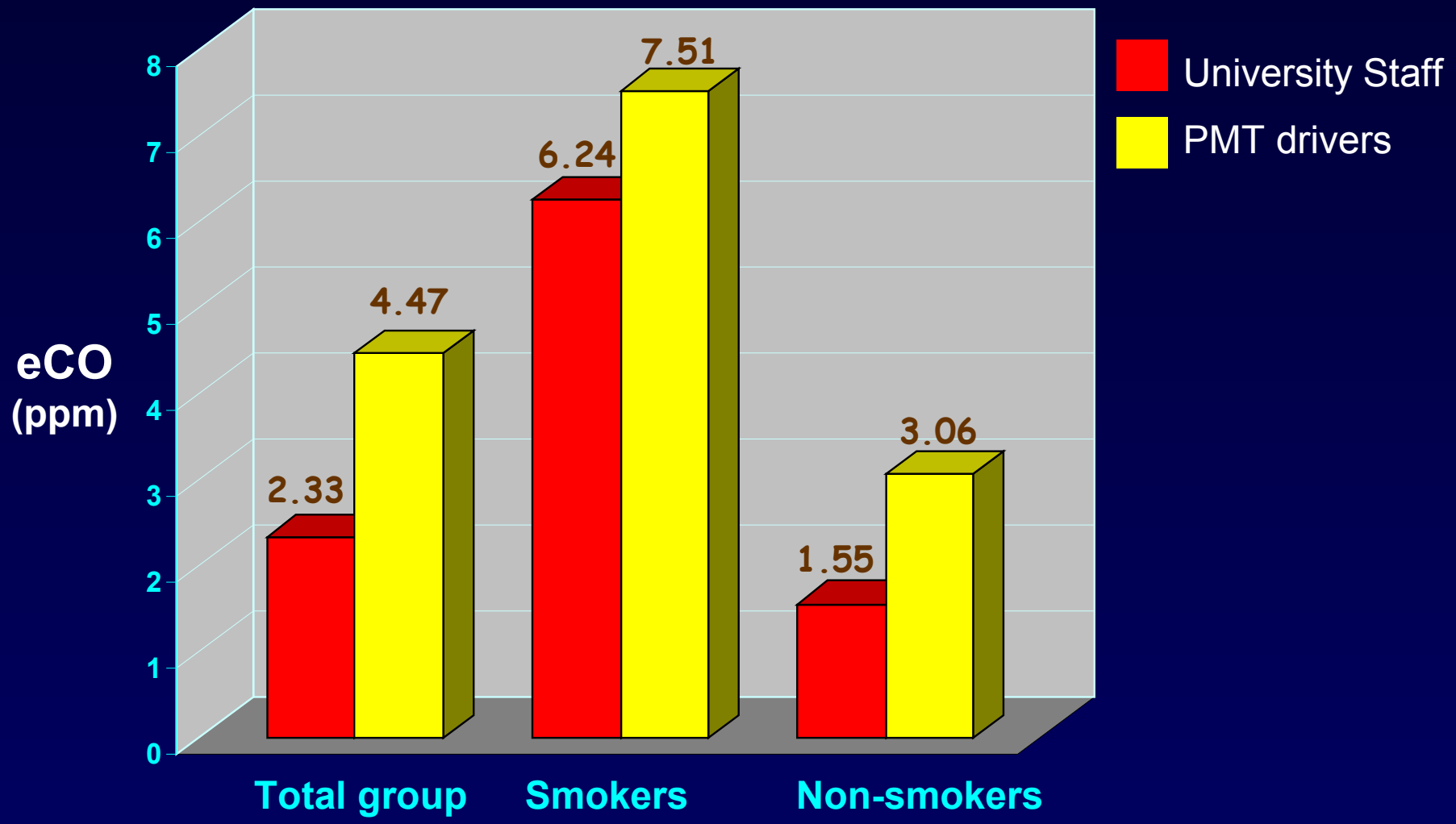
Second reading after approximately 4 hours

Third reading at the completion of the shift

Bus drivers from both morning and evening shifts were recruited into the study

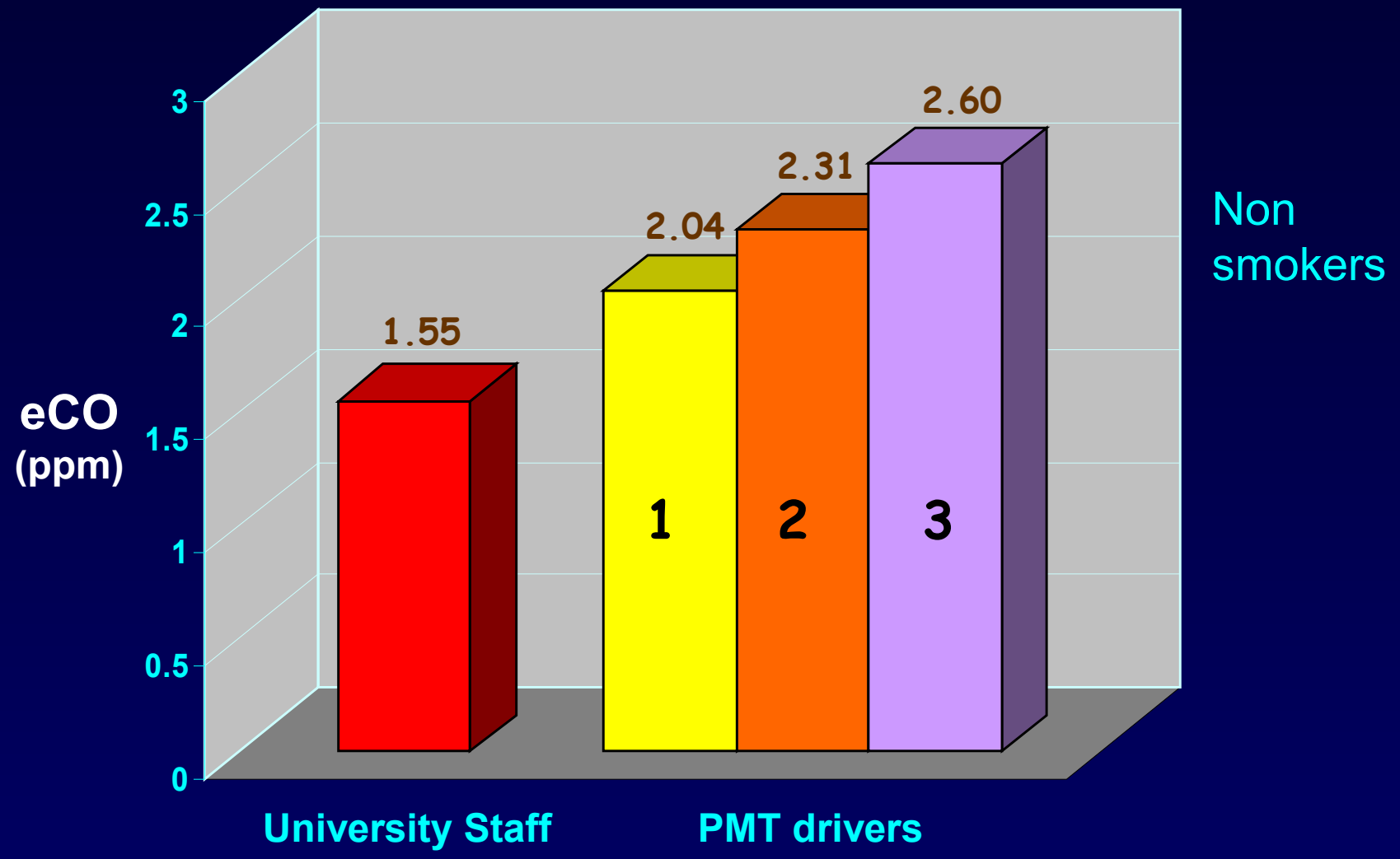
Exhaled CO levels of University staff members were measured only once

RESULTS



(Chest Research Foundation, 2005)

RESULTS



(Chest Research Foundation, 2005)

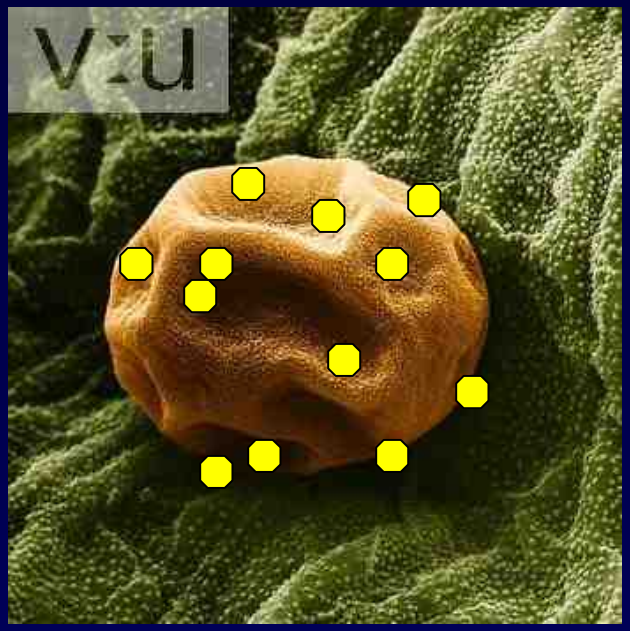
RESPIRATORY SYMPTOMS IN BUS DRIVERS AND UNIVERSITY STAFF MEMBERS

Symptom	University Staff (%)	PMT drivers (%)	Odds ratio (CI)
Blocked / Runny nose	7.33	28.13	**4.95** (2.5-9.7)
Chest tightness	5.33	12.11	**2.45** (1.1-5.5)
Wheeze	6.67	14.84	**2.44** (1.2-5.0)
Cough	10.67	13.67	**1.33** (0.7-2.5)

(Chest Research Foundation, 2005)

INTERACTIONS OF DIESEL EXHAUST PARTICLES WITH ALLERGENS

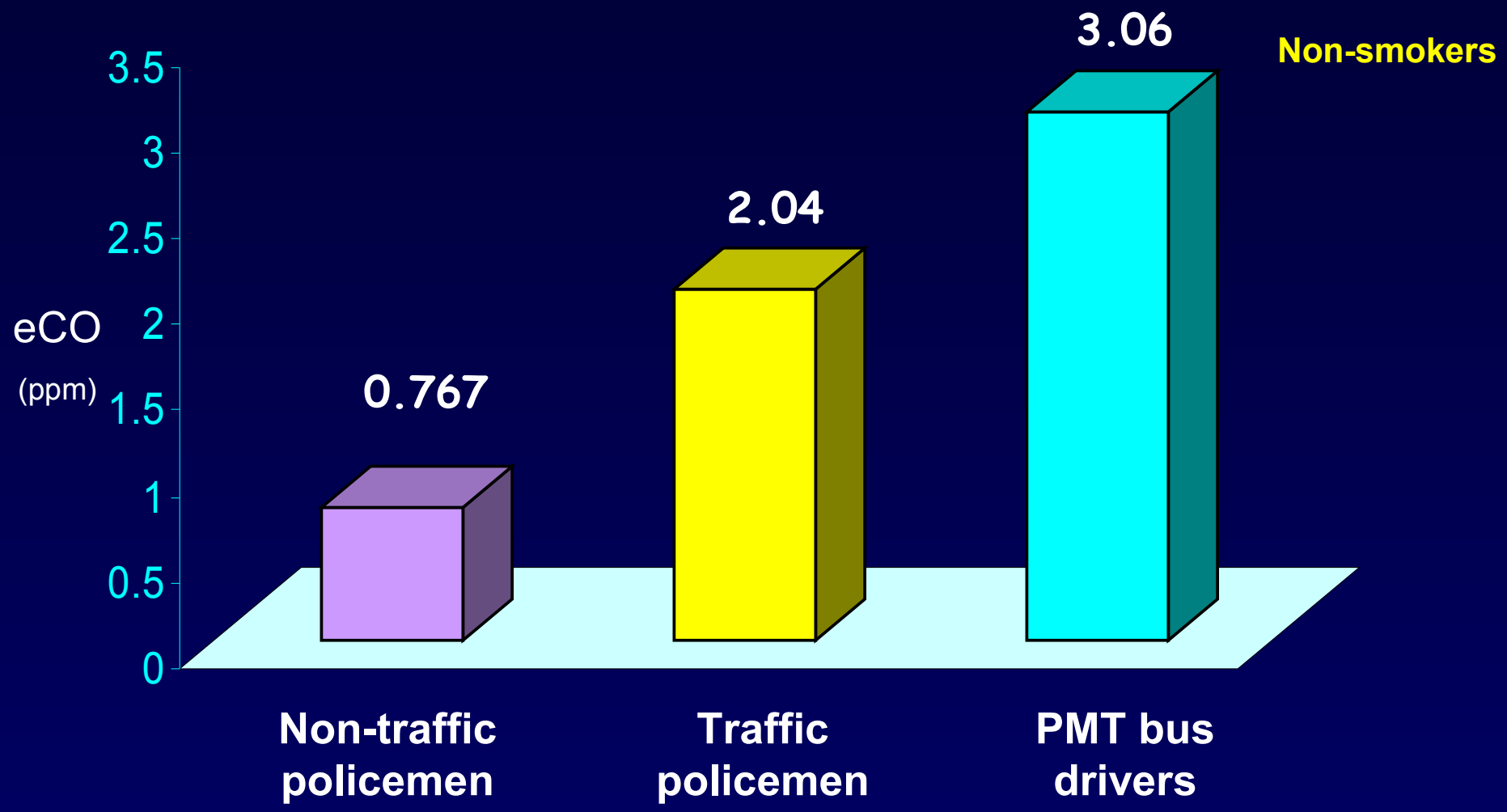
↑↑ IgE



↑↑↑↑ IgE

(50-fold increase)

Exhaled CO as a marker of oxidative stress in traffic policemen and PMT bus drivers



(Chest Research Foundation, Pune 2004-2005)

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Air pollution harming PMT drivers more than traffic cops

Chest foundation, UoP study points to similar fate for those who spend more time on city roads

RITUPARNA BHUYAN
DECEMBER 9

YOU'VE heard of air pollution's constant victim: the traffic policeman who is always in the line of fire. Now, spare a thought for the bus driver — the one who works for the Pune Municipal Transport. For, he is worse off — with an extremely high rate of oxidative stress that makes his lungs vulnerable to all kinds of ailments.

Worried? Better be. For, the study conducted by the Pune-based Chest Research Foundation (CRF) and Department of Environmental Sciences, University of Pune (UoP), also points to another bitter truth: a similar fate may be in store for people who are constantly on the move on Pune roads.

Just like PMT drivers, auto drivers, hawkers and people who need to spend long hours travelling on city roads are also exposed to polluted air. And they, too, have a high oxidative stress because of constant exposure to air pollution.

The study, conducted by Priyaranjani Dass from Fiji pursuing an MSc in environmental sciences, involved measuring the percentage of exhaled Carbon Monoxide (CO), which is a byproduct of respiration, in 256 PMT drivers. People with higher oxidative stress came up with higher percentage of (CO) in exhaled breath. The results were then compared with those from residents of the UoP campus, where the level of air pollution is comparatively less.

NUMBERS

- 256 PMT drivers, samples taken thrice daily: once before joining duty, once in the middle of work and once when they were about to leave for home
- 150 in University of Pune

HOW

Exhaled Carbon Monoxide Breath Analyser was used along with questionnaires

FINDINGS

Exhaled CO levels in PMT drivers increased as the day progressed, their Co levels were alarmingly high when compared to those residing in UoP campus

The findings were alarming. The average CO content in the exhaled breath of PMT drivers was 4.47 parts per million (ppm) while in UoP residents, it was 1.55 ppm. "We had conducted a similar study on the city's traffic police two years ago. Condition of PMT drivers is worse than them," says Dr Sundeep Salvi, director of CRF, who was also part of the study team. "This is because, the drivers are on the road while traffic cops are on the side of the road."

The study also exposed that PMT drivers had a higher risk of developing respiratory symptoms than those in normal circumstances, ie, a whopping 495 per cent chance of a blocked nose, 245 per cent chance of chest tightness, 244 per cent chance of wheezing and 133 per cent chance of coughing as compared to people living under normal conditions. "These symptoms cannot be taken lightly as they might be indicators of other respiratory diseases," adds Salvi.

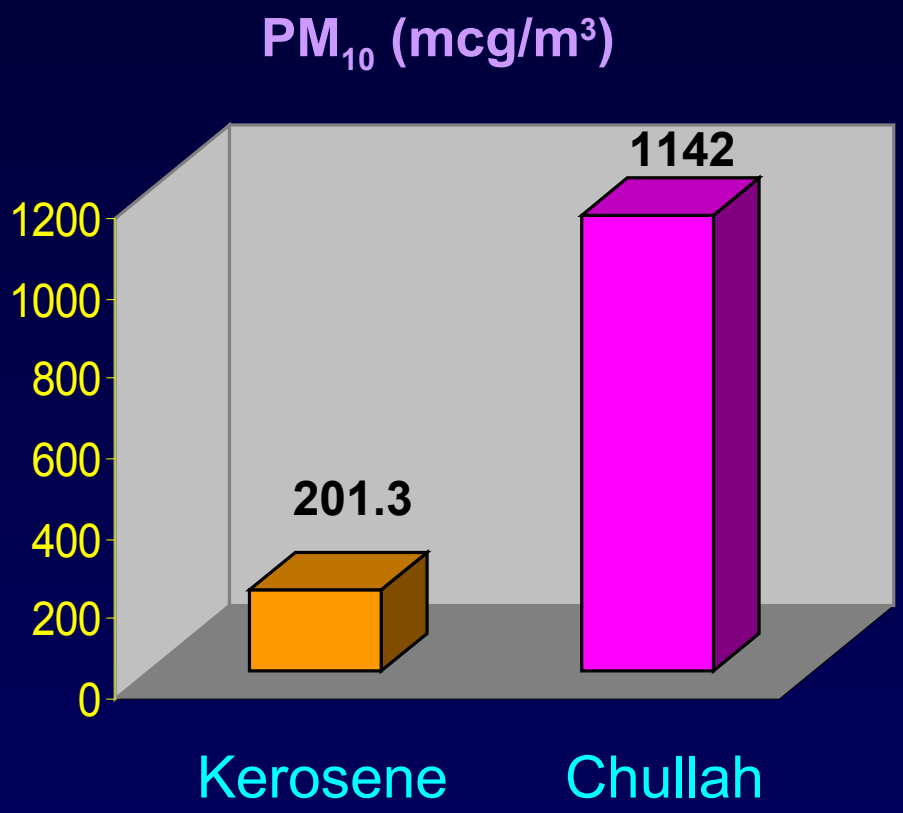
Another cause of concern, according to Salvi, is the possible relation between heart diseases and exposure to polluted air. "A study that was published in the New England Journal of Medicine in 2004 says persons with heart diseases exposed to air pollution have as much risk of heart attack as persons with high cholesterol.

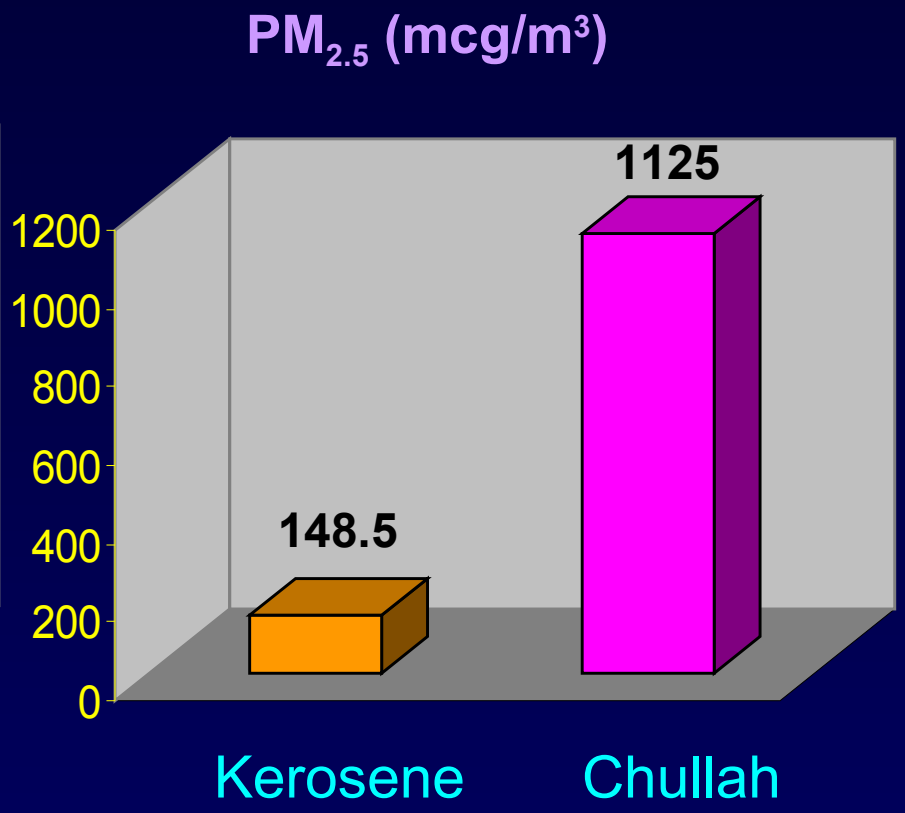
Are their remedies? "Eating a lot of fresh fruits and green vegetables because they have high levels of anti oxidants which reduce oxidative stress. Asthmatics having green vegetables and fresh fruits report lesser breathing problems when exposed to polluted air and thus PMT drivers may also benefit from it."

Do not forget

Indoor air pollution

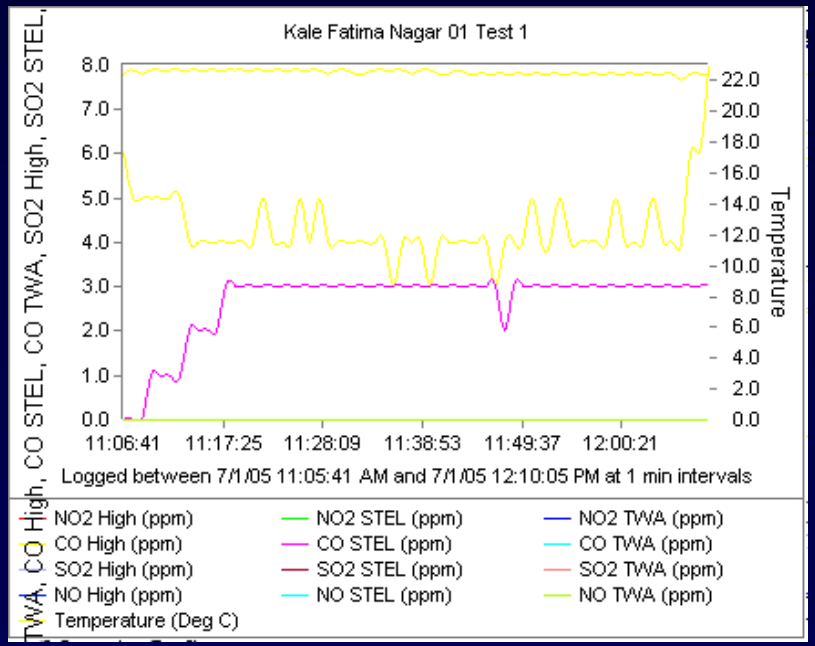
INDOOR LEVELS OF PARTICULATE MATTER



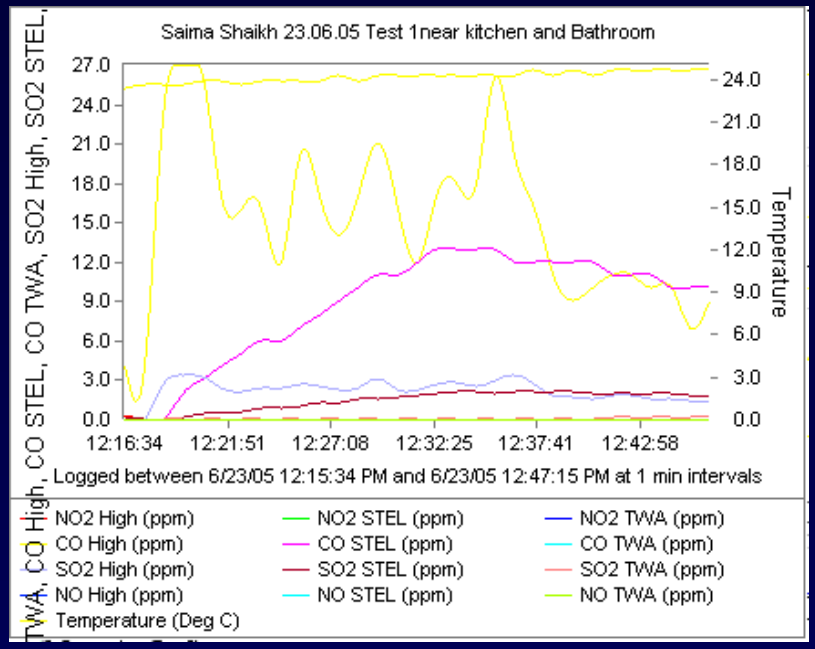


(Chest Research Foundation, 2005)

COOKING FUEL AS A MAJOR CONTRIBUTOR TO INDOOR AIR POLLUTION



LPG



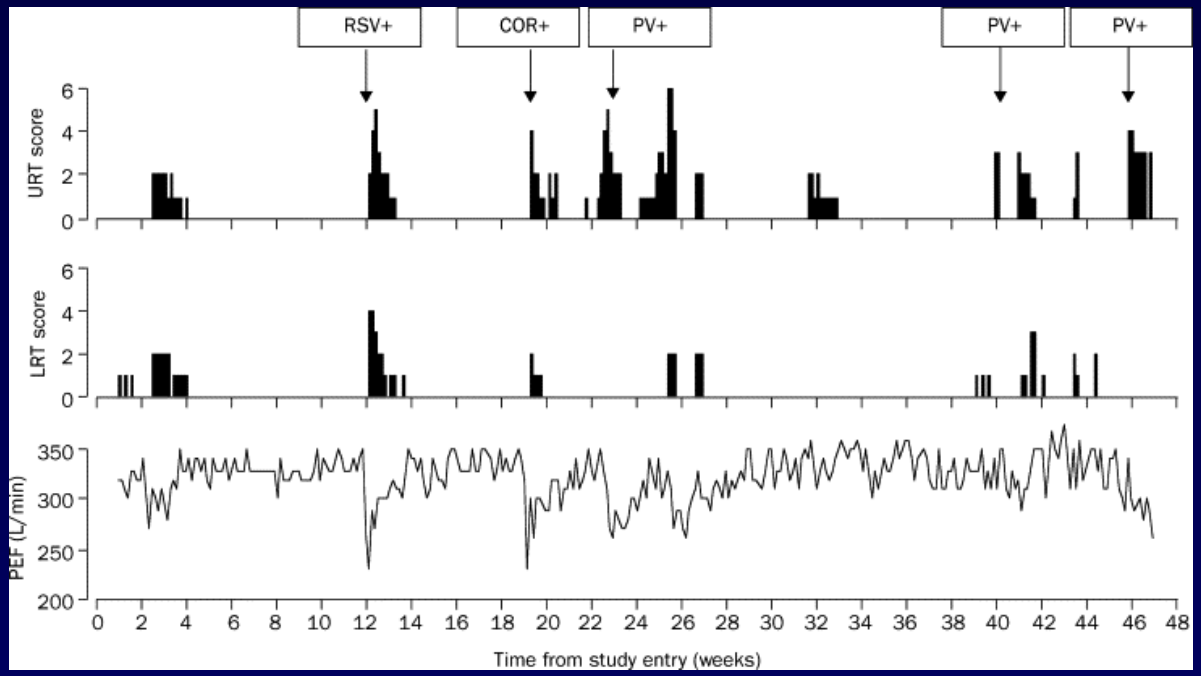
KEROSENE

(Chest Research Foundation, 2005)

INCREASED INCIDENCE OF VIRAL INFECTIONS

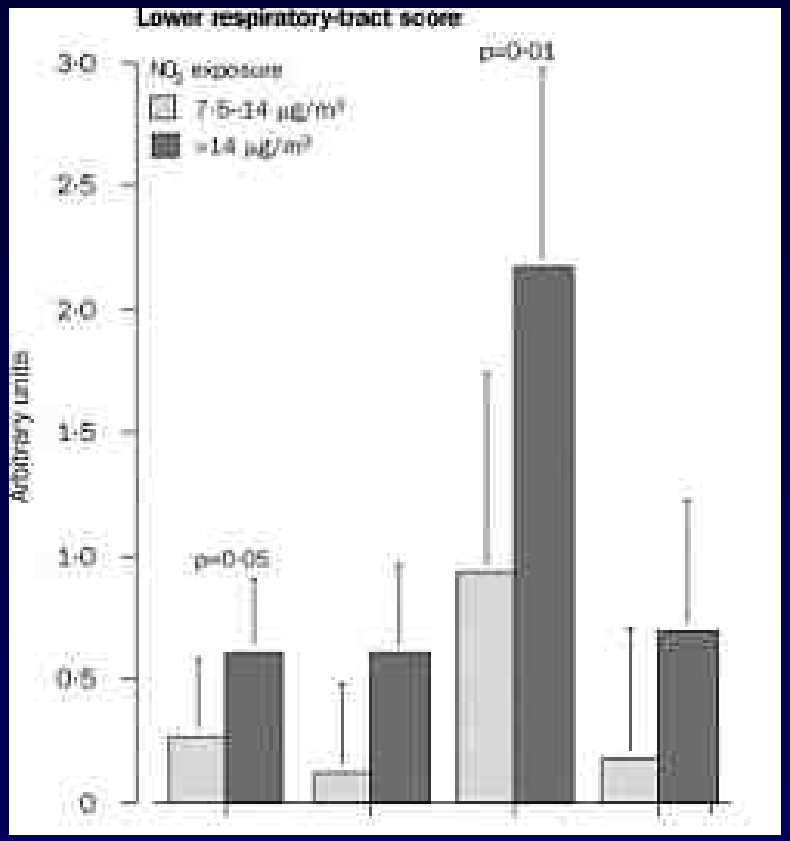
70-80% of URTI and LRTI in children are due to viral infections.

Does air pollution make this worse?



114 asthmatic children aged between 8-11 years

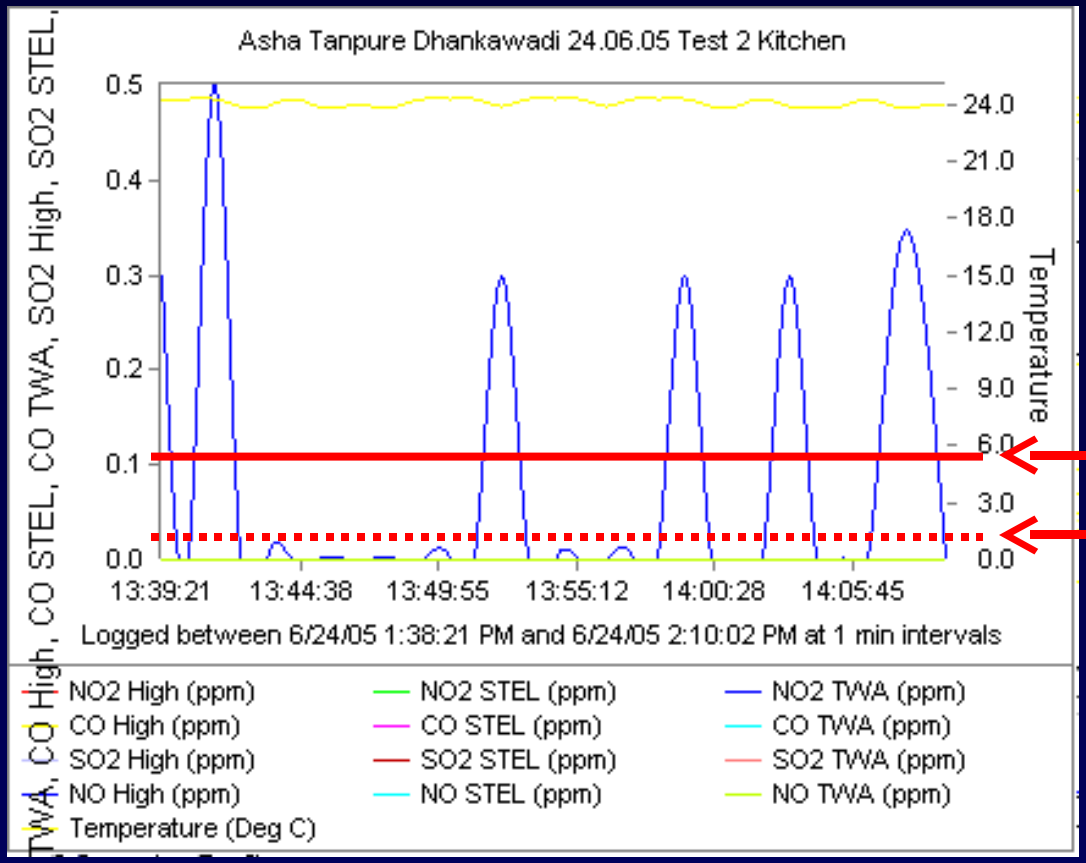
Personal monitoring of NO2 for 13 months



High personal NO2 exposure in the week before an upper respiratory infection was associated with increased severity of LRT symptoms and greater reduction in peak expiratory flow for all virus types together

(Chauhan et al, Lancet 2003; 361: 1939-1944)

NO2 levels measured in an indian home situated next to a busy road



WHO safety limits

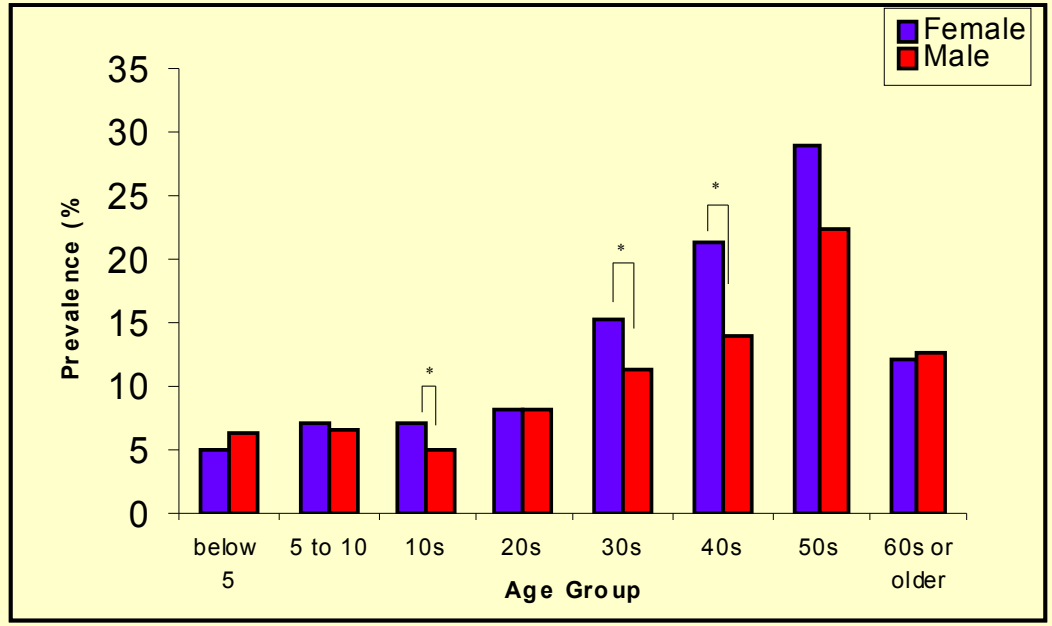
Levels of NO2 recorded by Chauhan et al in British homes

(Chest Research Foundation, 2005)

STUDY OF RESPIRATORY HEALTH STATUS IN 12,043 URBAN SLUM DWELLERS OF PUNE CITY

Study conducted with the help of local health workers (Anganwadi workers)

Asthma prevalence



Prevalence of COPD – 6.5%

Cough – 28.39; Chest tightness – 8.3%; Wheeze – 4.74

(Chest Research Foundation, 2005)

INTERESTING OBSERVATIONS

- 52% of COPD were non-smokers, suggesting that air pollution is likely a major cause of COPD in this population
- Respiratory symptoms dependent on kitchen

  - Those who had a separate kitchen had lower respiratory symptoms

MOSQUITO COIL

Mosquito Coil

0.3 – 0.4% Pyrethrin (insecticide)

99.6% - Binders, Fillers

Burning one mosquito coil releases the same amount of $PM_{2.5}$ mass as that of burning **75-137** cigarettes.

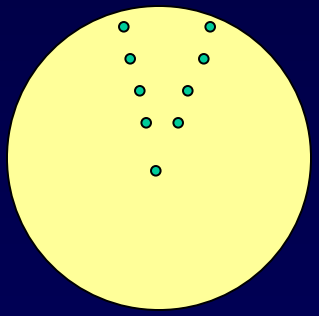
The emission of formaldehyde can be as high as that released from burning **51** cigarettes

(Liu W et al, Environ Health Perspect 2003; 111: 1454-1460)

AEROALLERGEN SAMPLING FROM HOMES

ANDERSONS AIR SAMPLER

Run for 30 mins



FUNGAL COLONIES GROWN ON SABOURAUD'S AGAR MEDIUM ISOLATED FROM HOMES

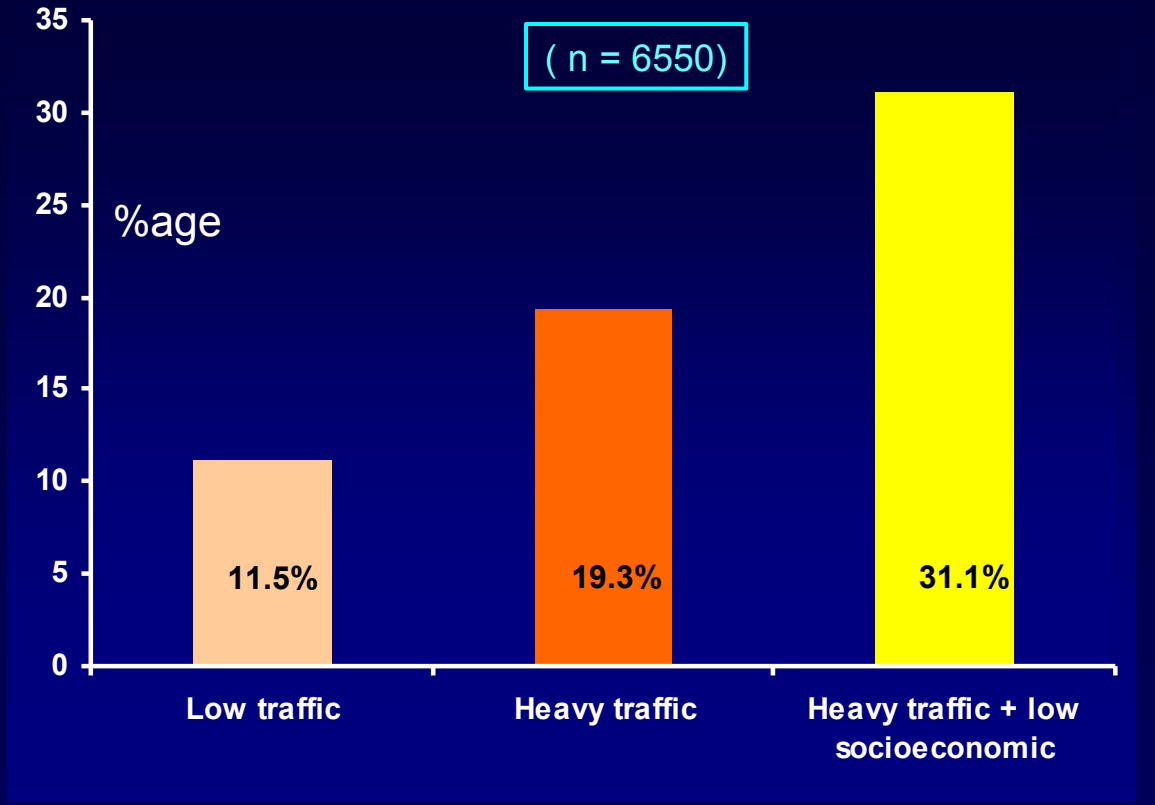
(Air samples collected from Andersons Air Sampler)

(Chest Research Foundation, 2005)

- Who are the people that are exposed to high levels of air pollution on a daily basis?
- What is the health impact of exposure to air pollution?

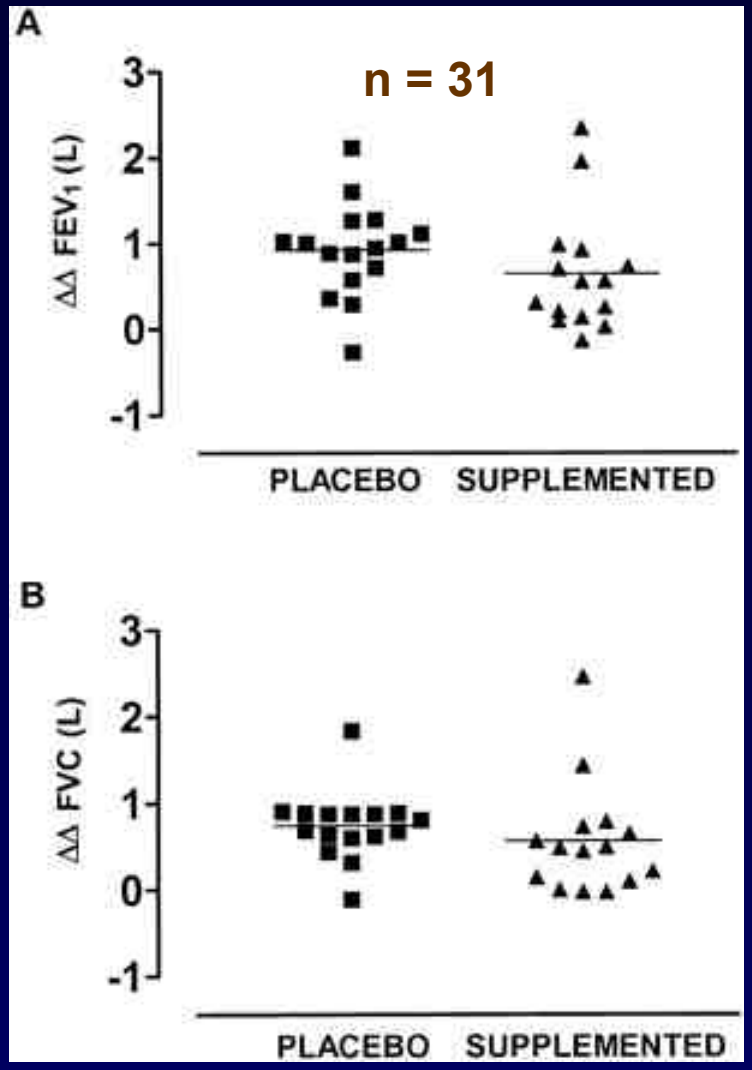
THANK YOU

Prevalence of asthma in school children in Bangalore - India: Variation with traffic density around school



(Paramesh H. Indian J Paed 2002; 69(4): 309-312)

Antioxidant supplementation reduces the decline in lung function following exposure to ozone



FEV1 following ozone exposure

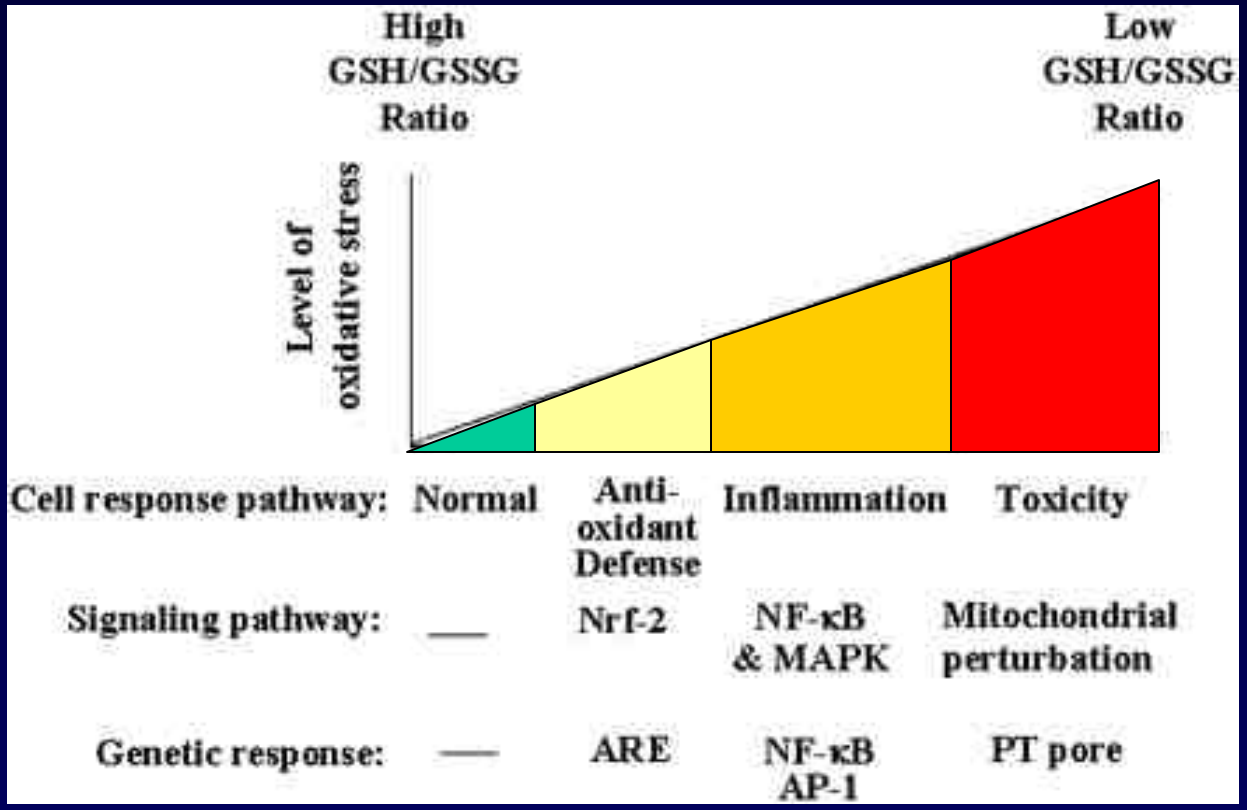
Placebo: 980 mL drop

Supplements: 680 mL drop

Vit C: 250mg + Vit E: 50 IU + 12 oz Veg cocktail daily x 2 weeks

(Samet J et al, AJRCCM 2001: 164: 819-825)

Hierarchical oxidative stress response in response to redox cycling DEP components



- Macrophage cell lines
- Proteomics

(Xiao GG et al, J Biol Chem 2003; 278: 50781-50790)

CHILDREN UNIQUELY VULNERABLE TO THE EFFECTS OF AIR POLLUTION

- Lungs are growing
  No. of alveoli –
  - At birth – 24 million
  - 4 years – 257 million
  - Adults – 600 million
- Lung growth is guided by a complex and precisely timed sequence of chemical messages

WHAT CAN BE DONE?

WHAT NEEDS TO BE DONE?

- Awareness
- Prevention

Relative emissions from petrol cars and diesel cars

Pollutant	Petrol	Diesel
Carbon dioxide	++++	+
Carbon monoxide	+++	++
Benzene	+++	++
Nitrogen oxides	+	++
Hydrocarbons	++	+++
Aldehydes	++	+++
Sulphur dioxide	+	++++
PAHs	+	++++
Particulate matter*	+	++++

- Diesel engines generate up to 1400 times more particles than petrol engines
- 1000000000000 particles enter into the lungs every day

ANTIOXIDANT PROPERTIES OF THE EPITHELIAL LINNG FLUID