

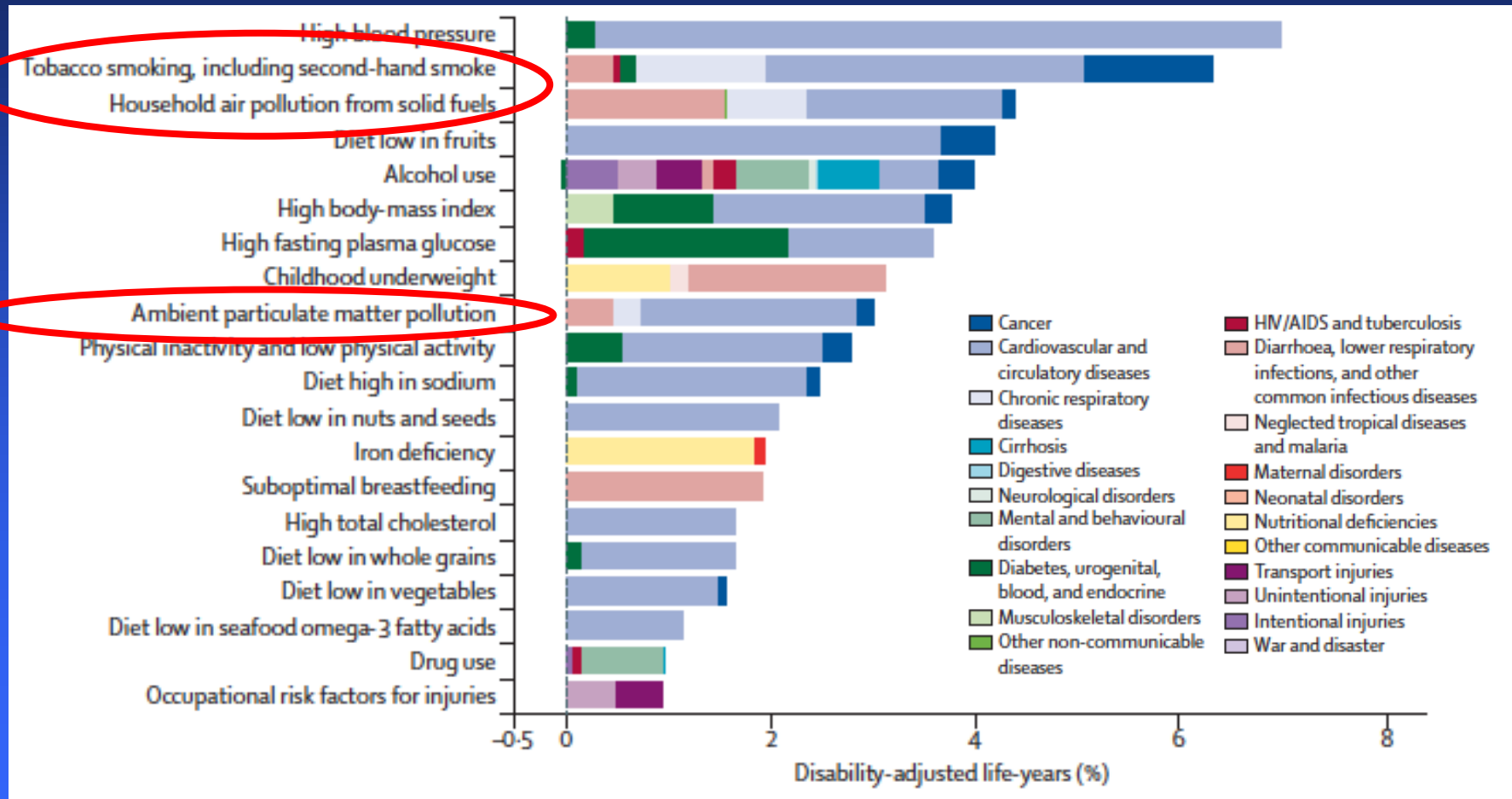


Cardiovascular Effects of Air Pollution

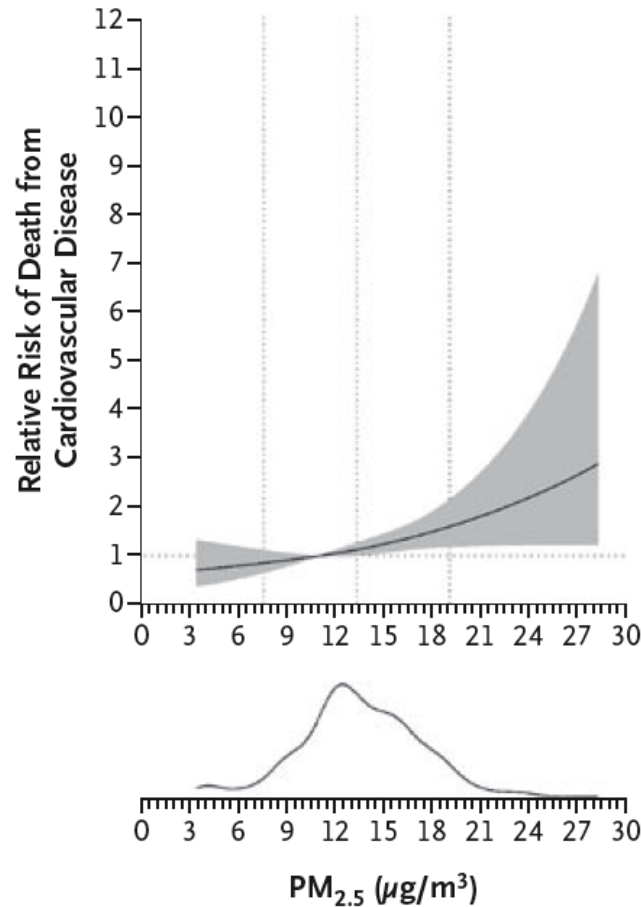
David Newby

BHF John Wheatley Chair of Cardiology

A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990–2010: a systematic analysis for the Global Burden of Disease Study 2010



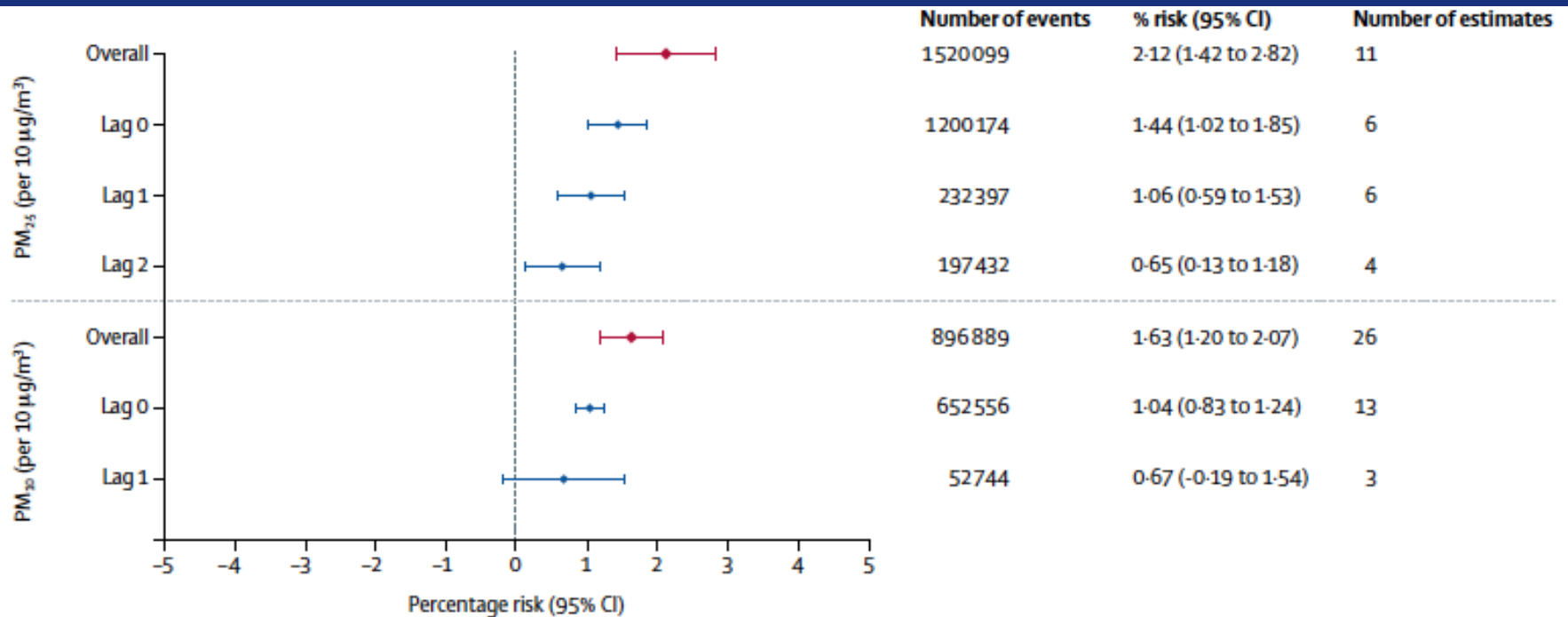
Air Pollution and Cardiovascular Disease



Miller et al. *N Engl J Med* 2007;356:447-458

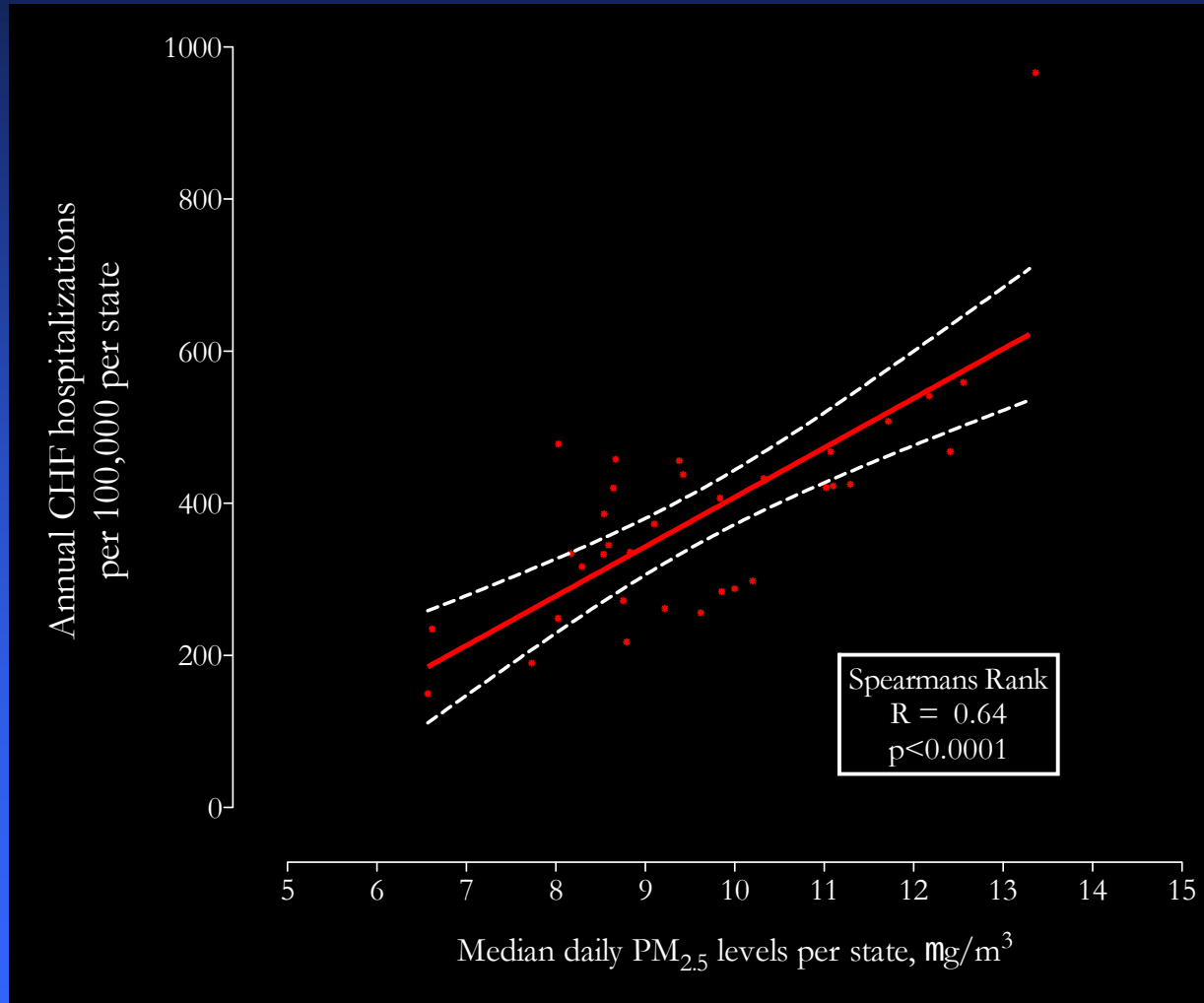
Global association of air pollution and heart failure: a systematic review and meta-analysis

Anoop SV Shah, Jeremy P Langrish, Harish Nair, David A McAllister, Amanda L Hunter, Ken Donaldson, David E Newby, Nicholas L Mills

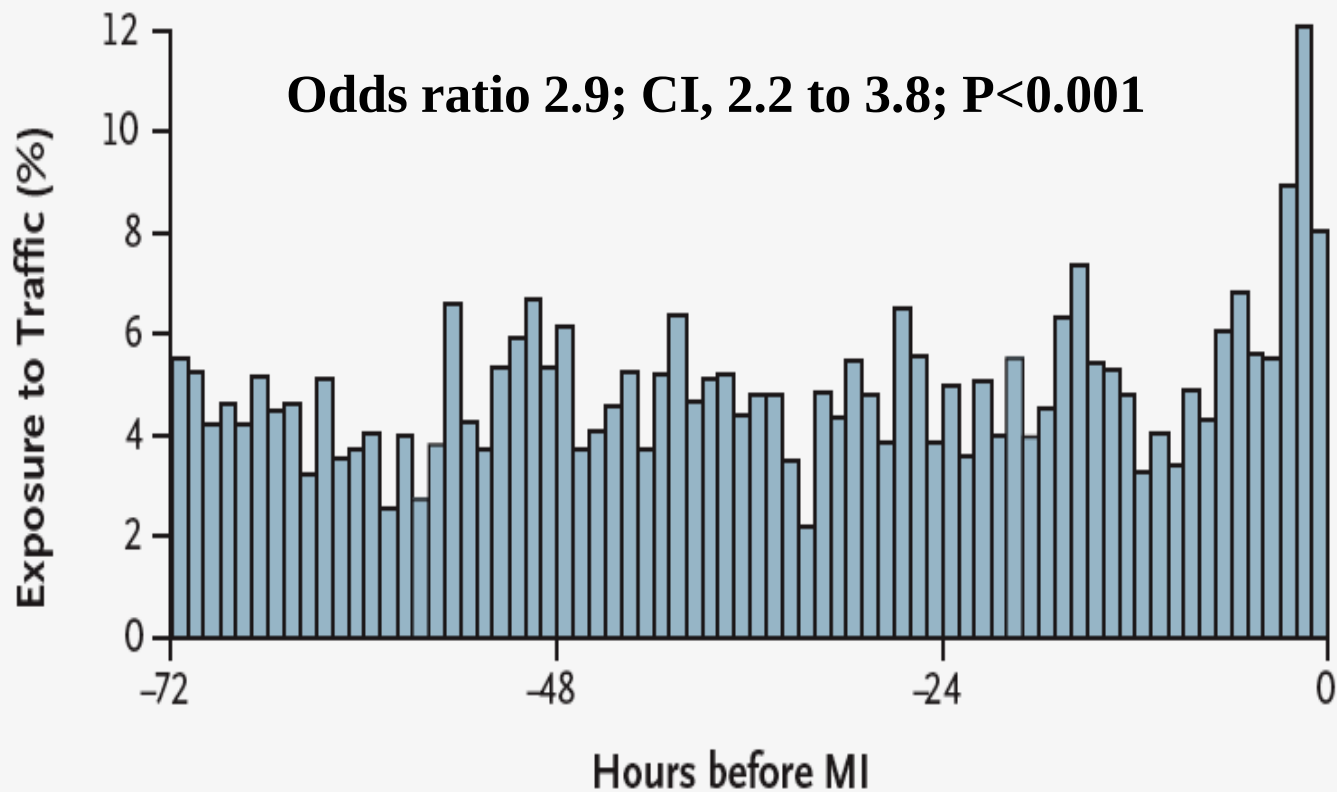


Global association of air pollution and heart failure: a systematic review and meta-analysis

Anoop SV Shah, Jeremy P Langrish, Harish Nair, David A McAllister, Amanda L Hunter, Ken Donaldson, David E Newby, Nicholas L Mills



EXPOSURE TO TRAFFIC AND ACUTE MYOCARDIAL INFARCTION

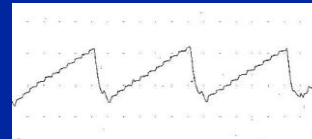




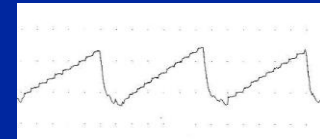
Diesel Exposure Chamber Umeå, Sweden



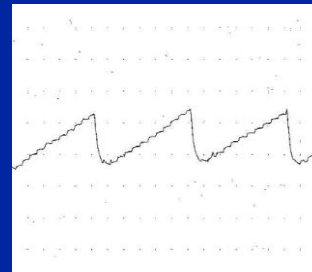
Forearm Venous Occlusion Plethysmography



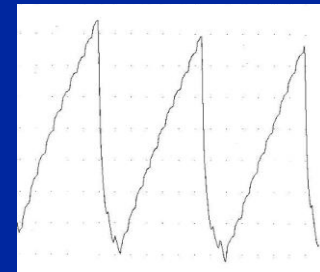
**Control Arm:
Baseline**



**Infused Arm:
Baseline**



**Control Arm:
Substance P**



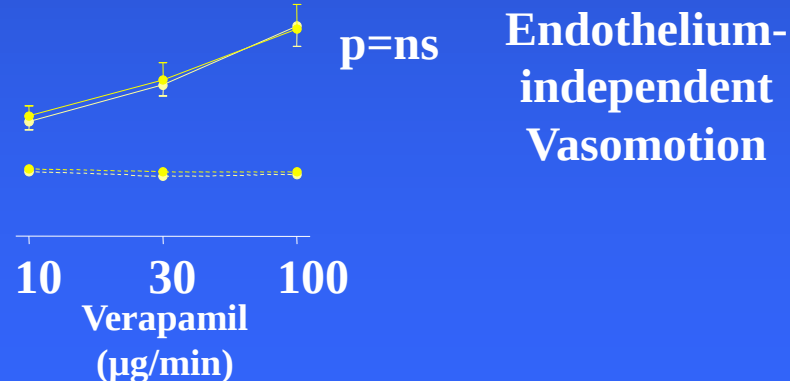
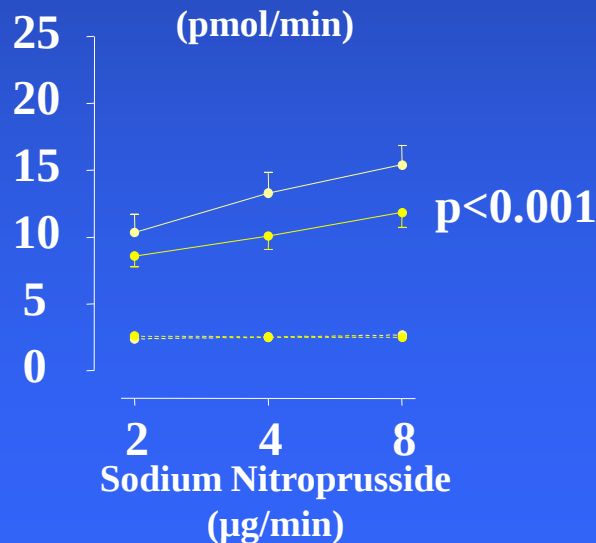
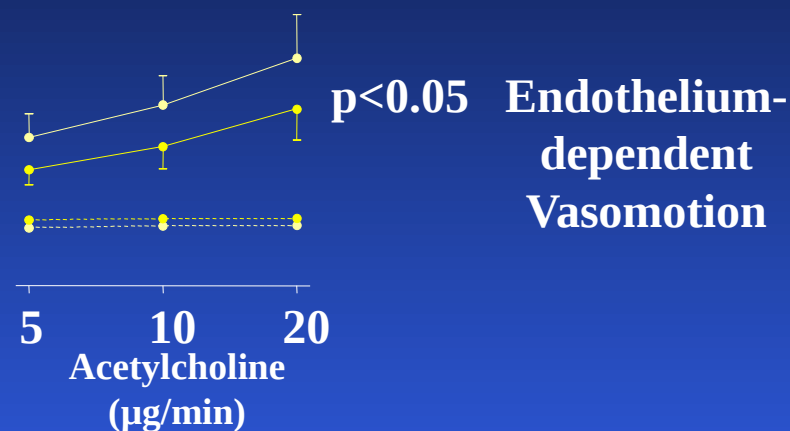
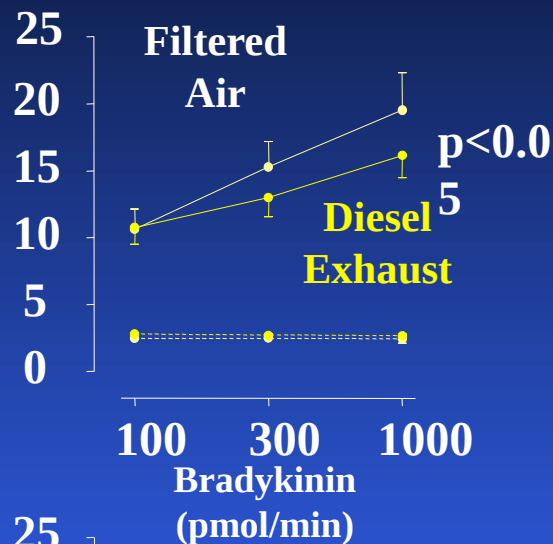
**Infused Arm:
Substance P**



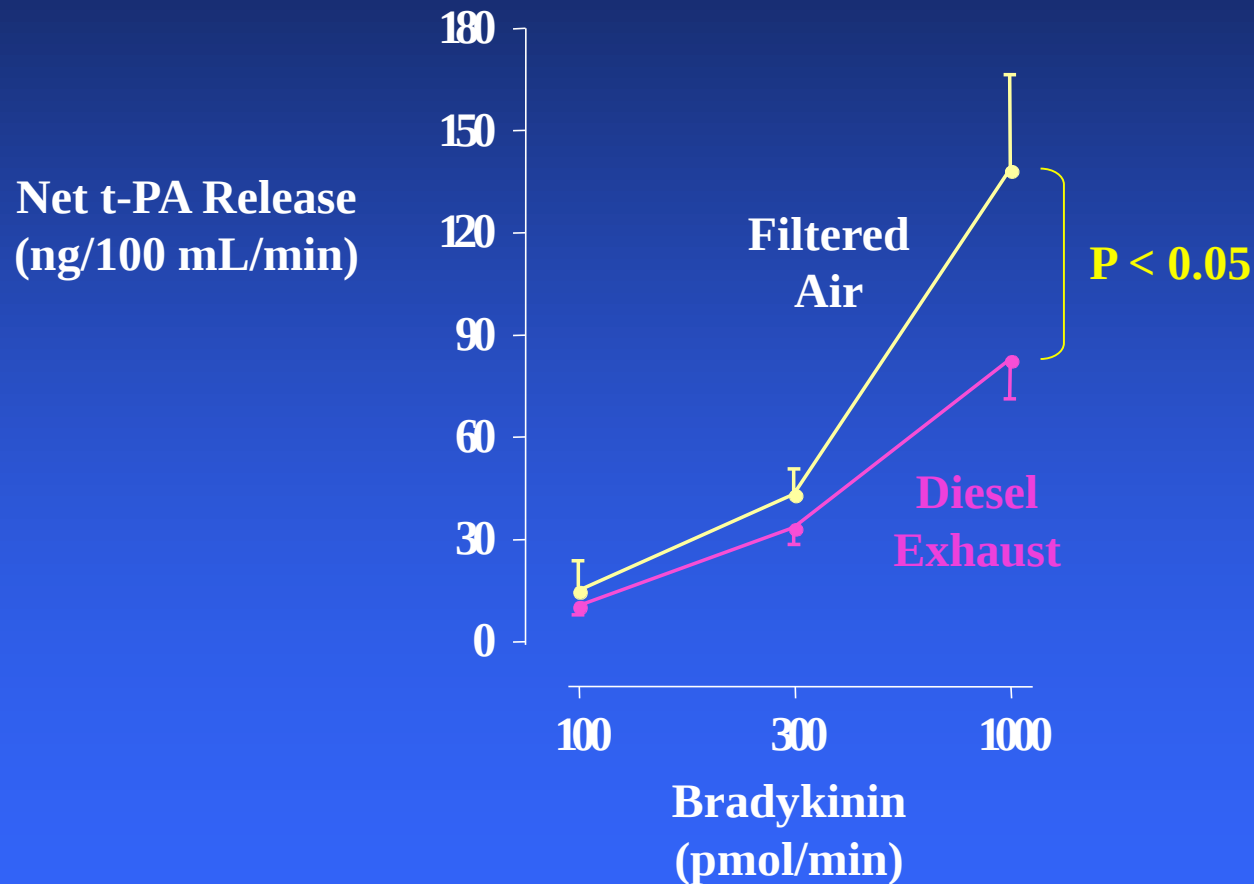
**Combined with
Bilateral Venous Sampling**

Vasomotor Effects of Diesel Exhaust Exposure

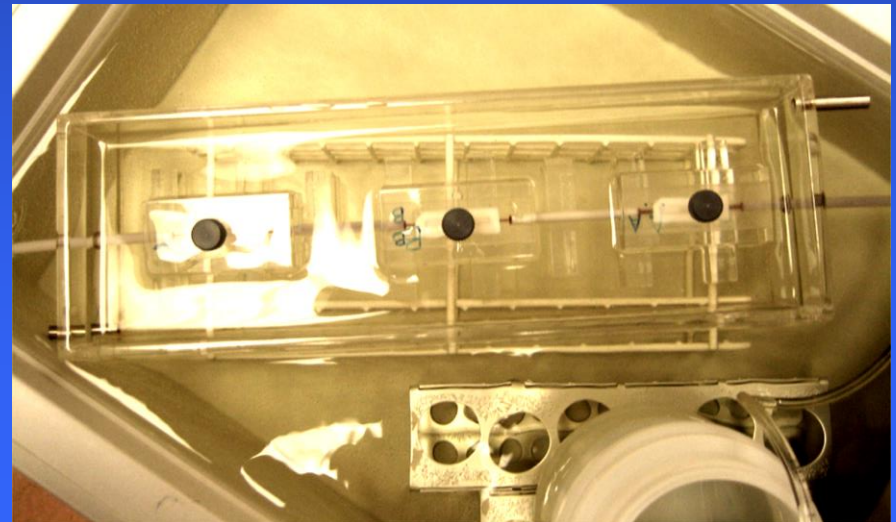
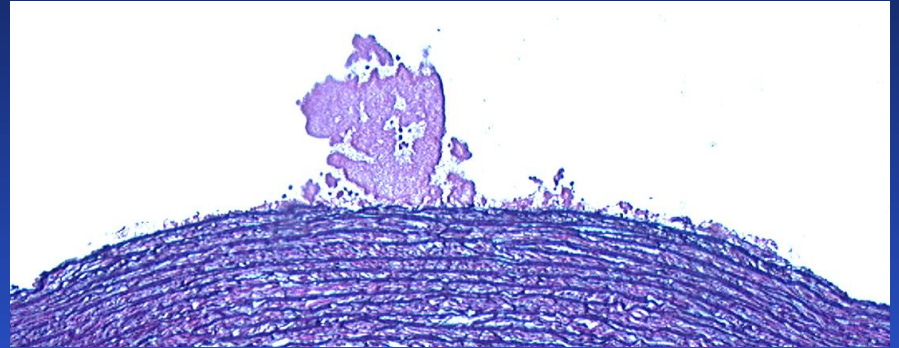
Forearm Blood Flow
(ml/100ml of tissue/min)



Air Pollution Impairs Endothelial Function and Endogenous Fibrinolysis



Badimon Chamber

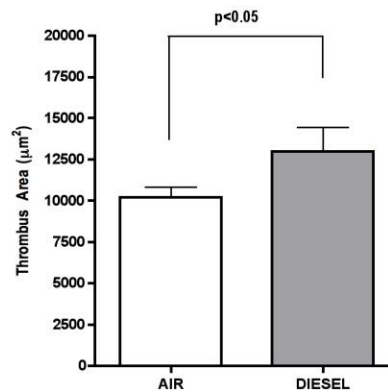


Procoagulant Effects of Air Pollution

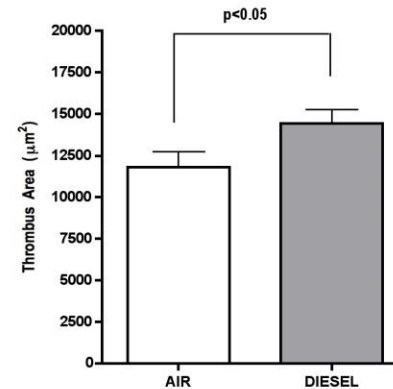


Low Shear Chamber

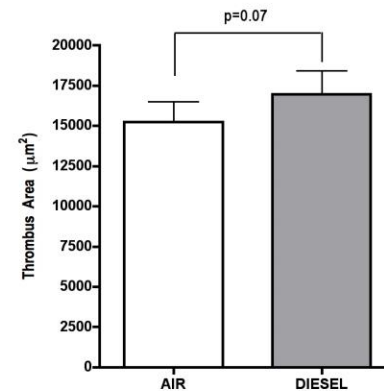
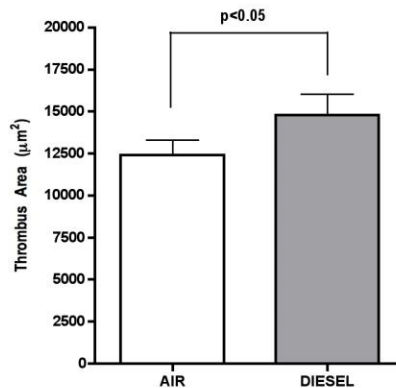
2 HOURS



6 HOURS



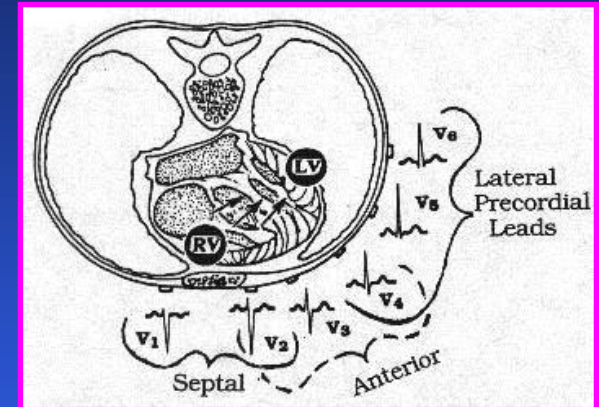
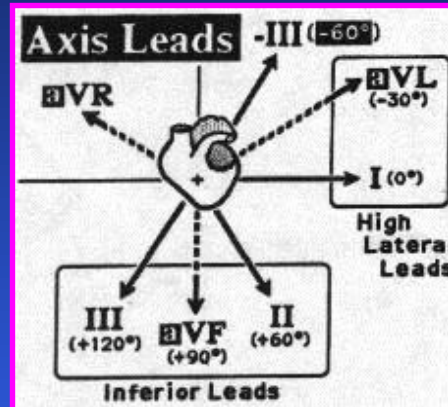
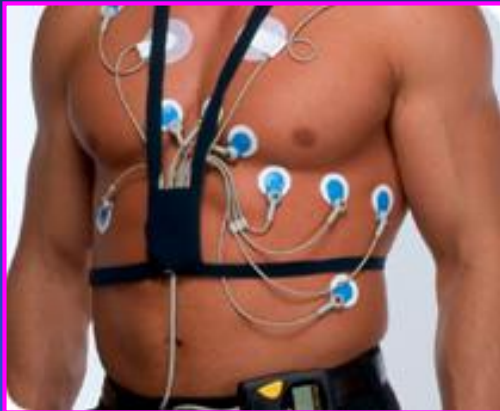
High Shear Chamber



What About Patients with Heart Disease?

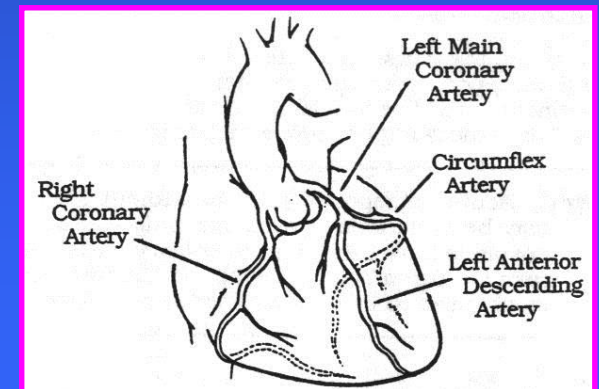


Assessment of Myocardial Ischaemia



Lead II, V₂ and V₅

Regions correspond to distribution of three main coronary arteries and reflect global ischaemia





The NEW ENGLAND JOURNAL of MEDICINE

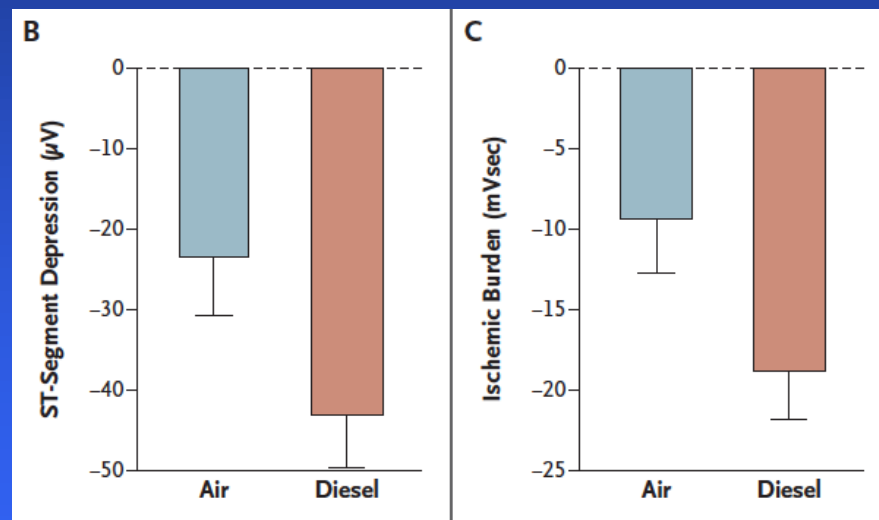
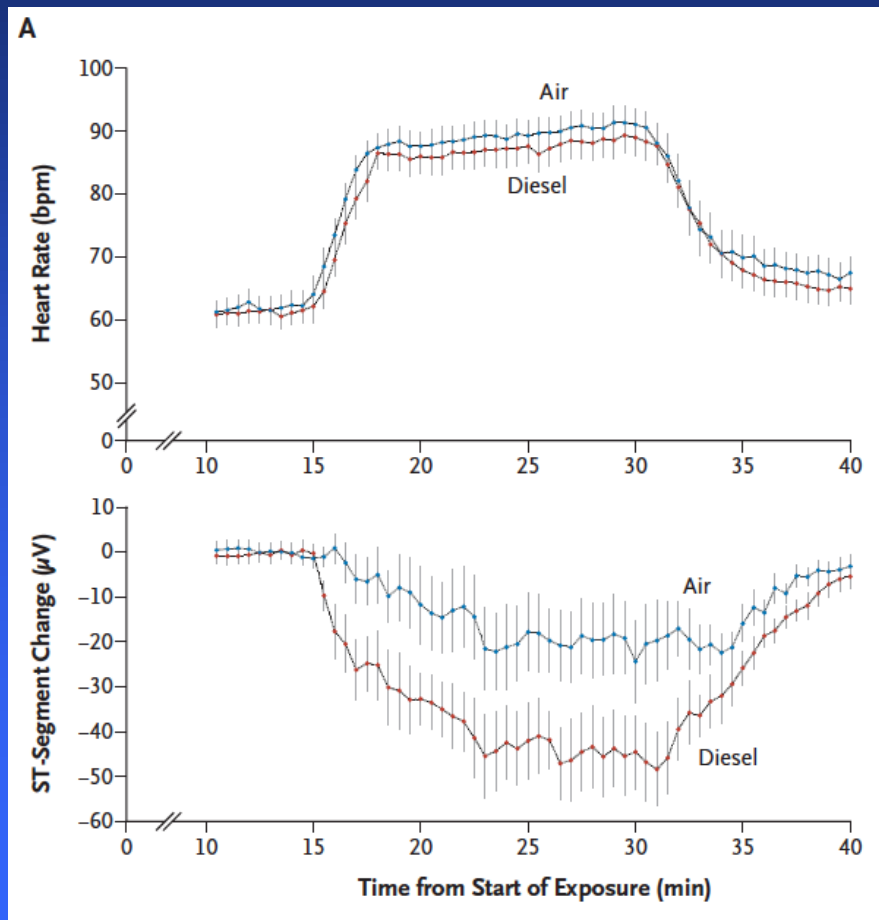
ESTABLISHED IN 1812

SEPTEMBER 13, 2007

VOL. 357 NO. 11

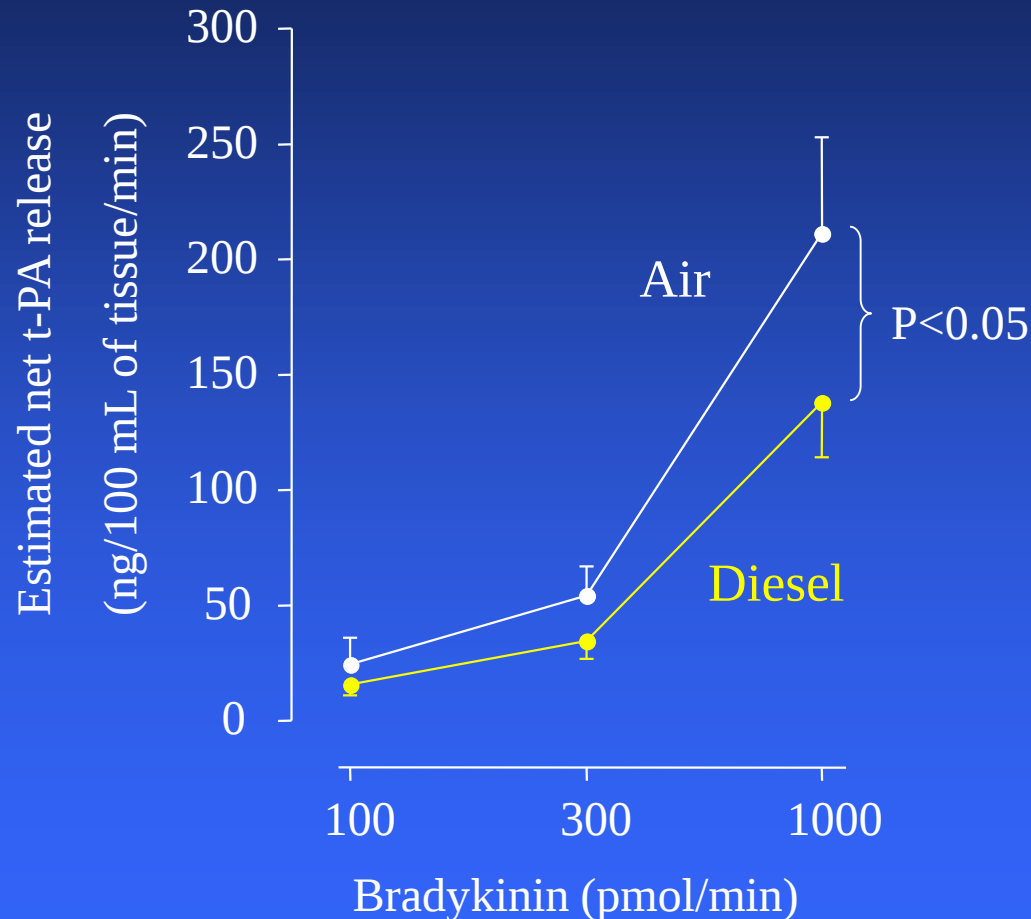


Ischemic and Thrombotic Effects of Dilute Diesel-Exhaust Inhalation in Men with Coronary Heart Disease



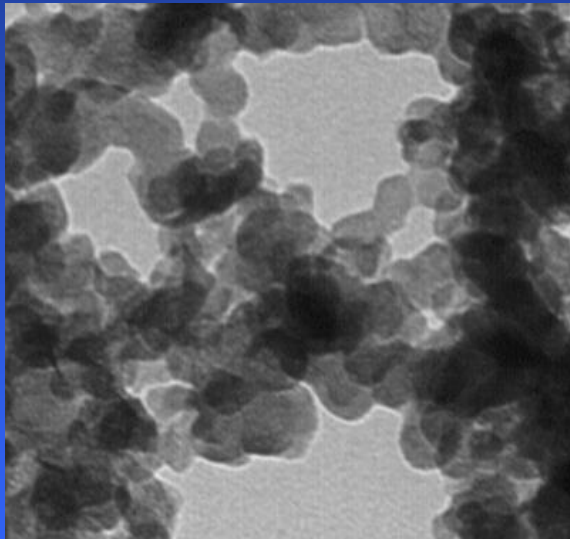
Mills *et al.* *N Engl J Med* 2007;357:1075-1082

Air Pollution Impairs Endogenous Fibrinolysis



What Component is Responsible for the Adverse Effects of Diesel Exhaust

Gases, Particles or Combustion-derived Nanoparticles



rivm

Rijksinstituut
voor Volksgezondheid
en Milieu

MAPCEL

Mobile Ambient Particle Concentrator Exposure Laboratory



Are combustion-derived nanoparticulates responsible for the adverse effects?

16 Healthy
volunteers



Double blind randomised
cross-over study



Filtered
air

Dilute diesel exhaust

Filtered diesel
exhaust

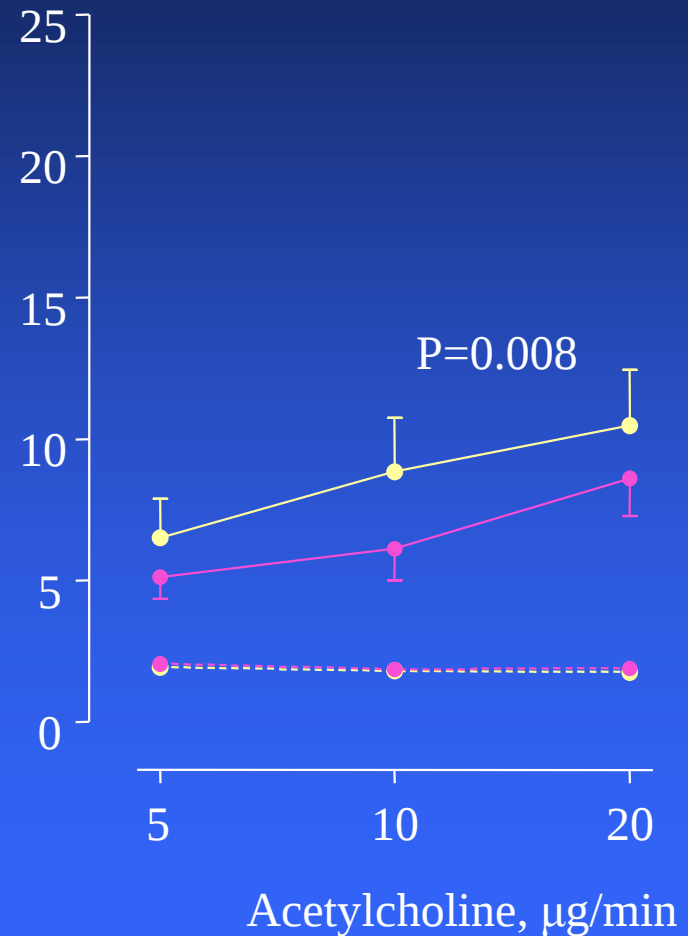
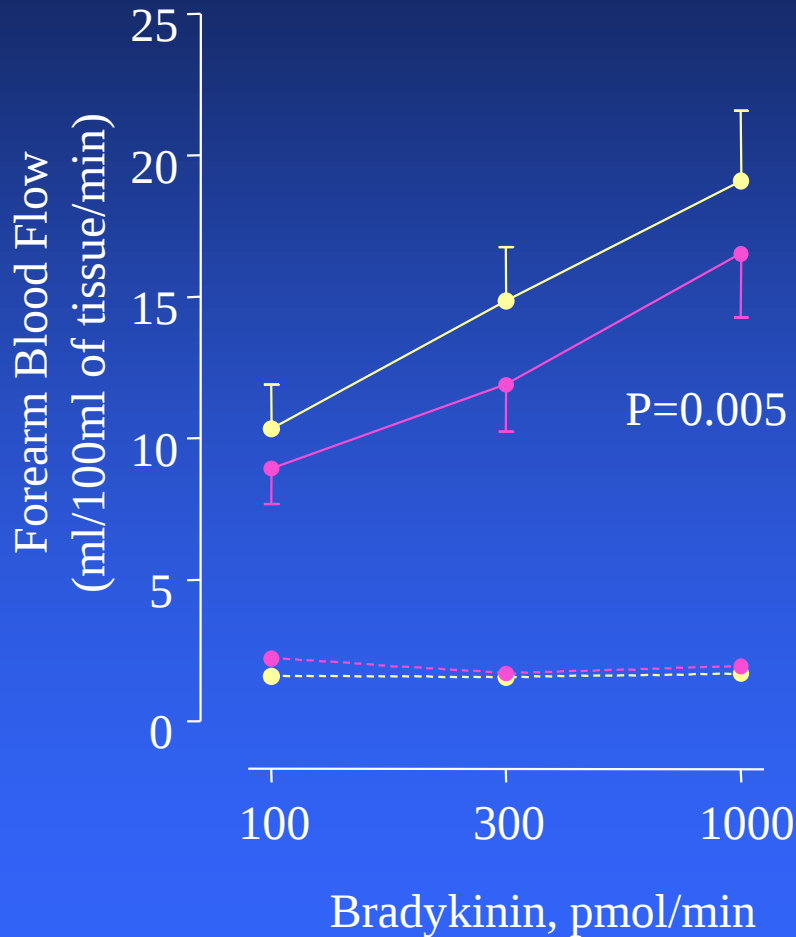
Ultrafine carbon
particles



Forearm vascular studies to assess vasomotor and fibrinolytic function

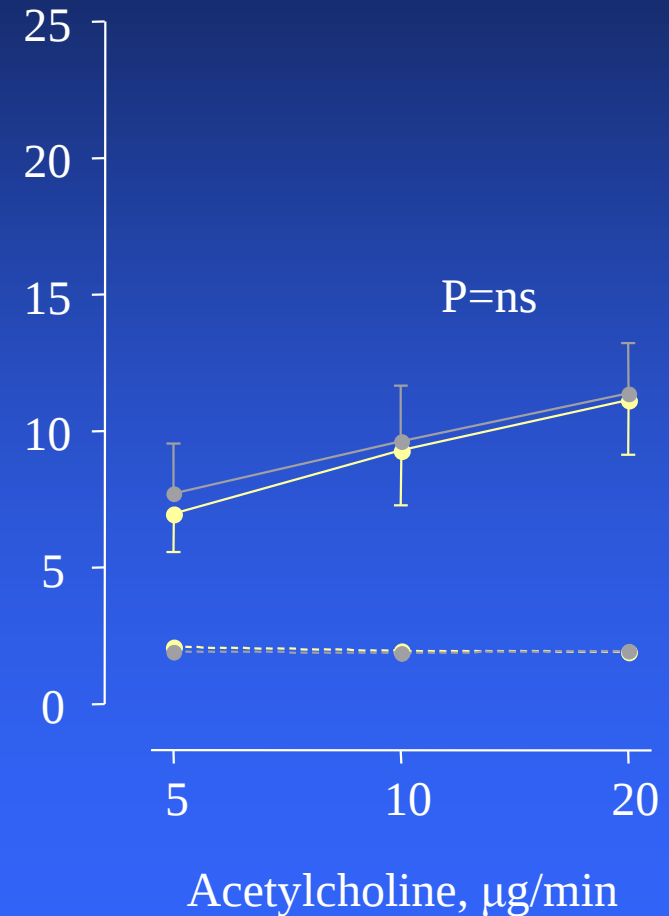
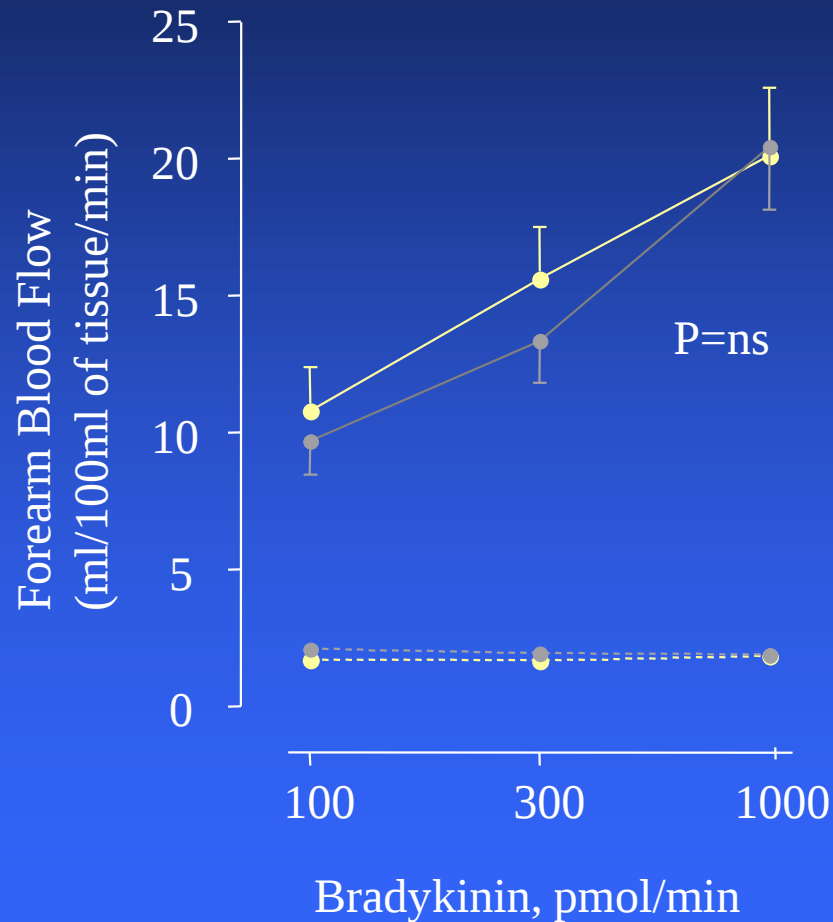
Endothelium-dependent Vasodilatation

FILTERED AIR *versus* DIESEL EXHAUST



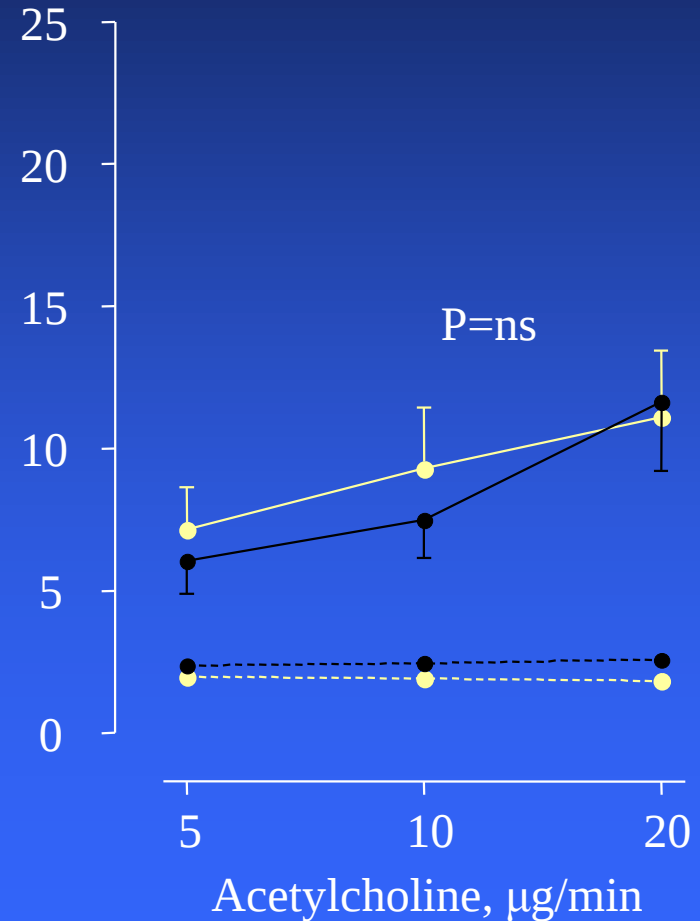
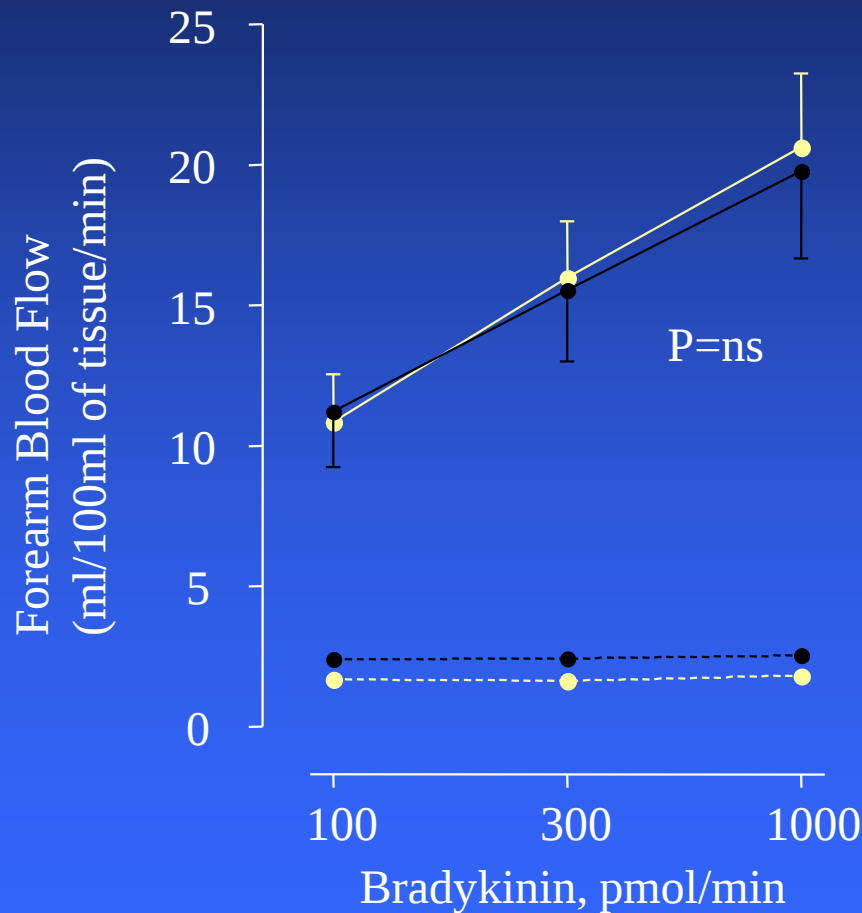
Diesel Gaseous Exposure

FILTERED AIR *versus* FILTERED DIESEL

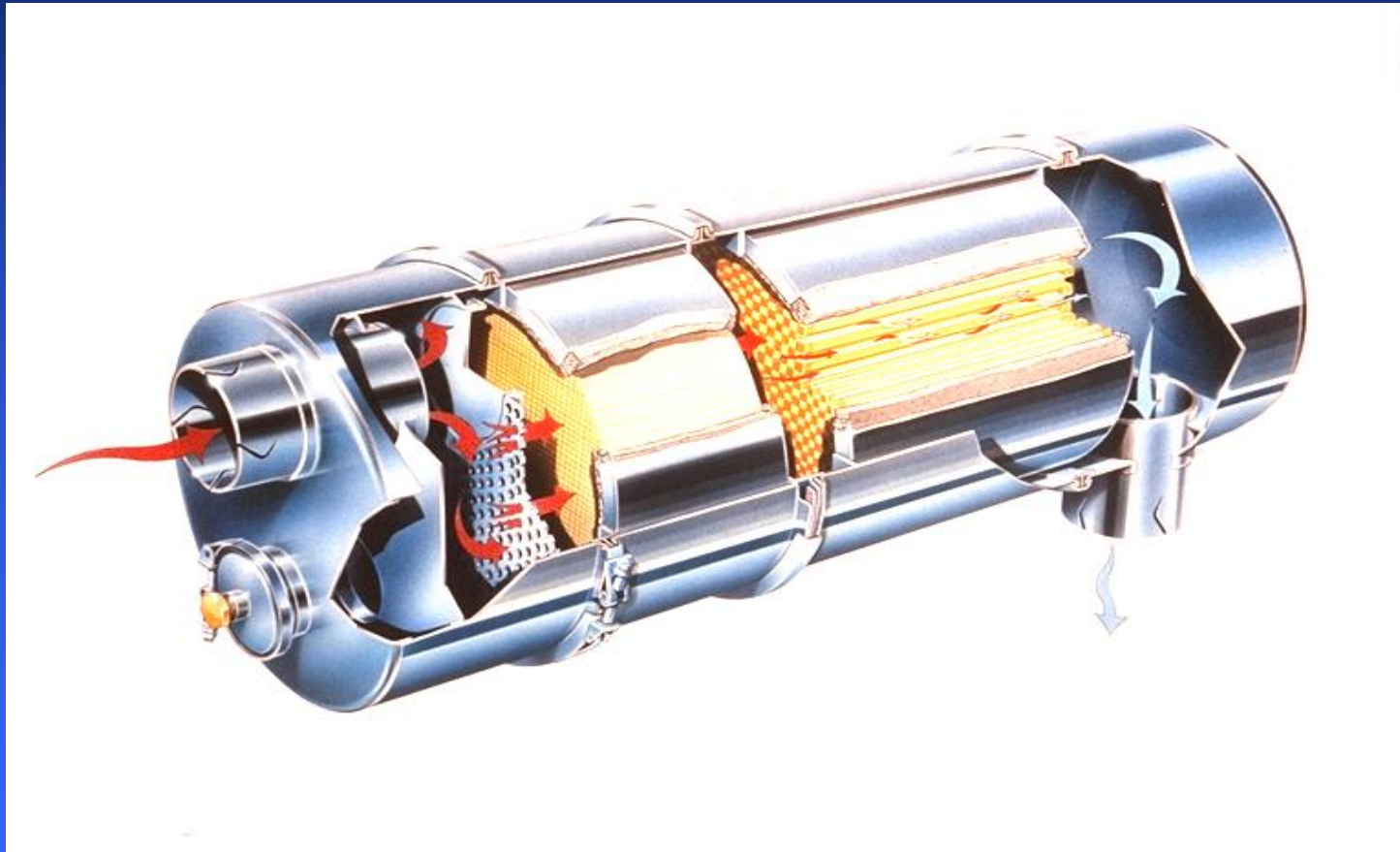


Carbon Particle Exposure

FILTERED AIR *versus* PALAS



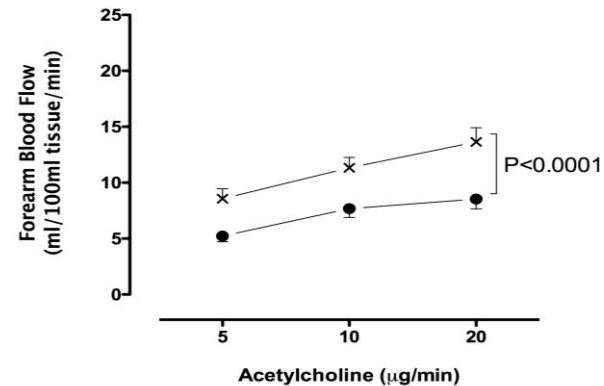
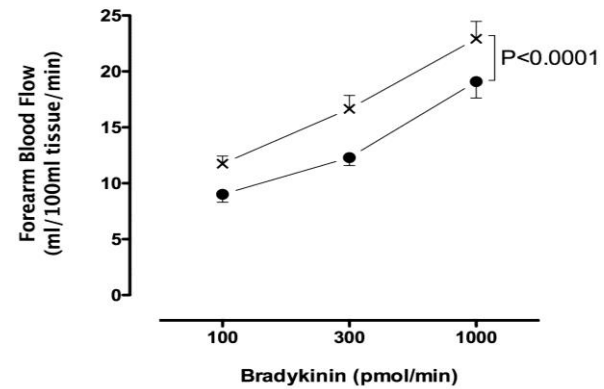
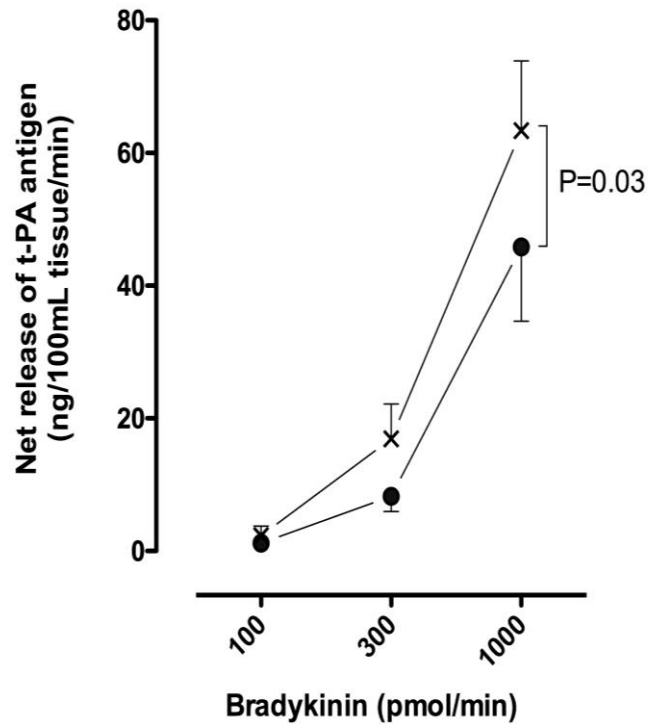
Alternative interventions to reduce exposure: *Retrofit Exhaust Particle Traps*



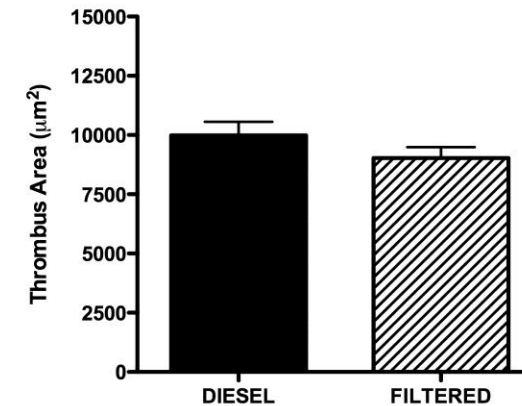
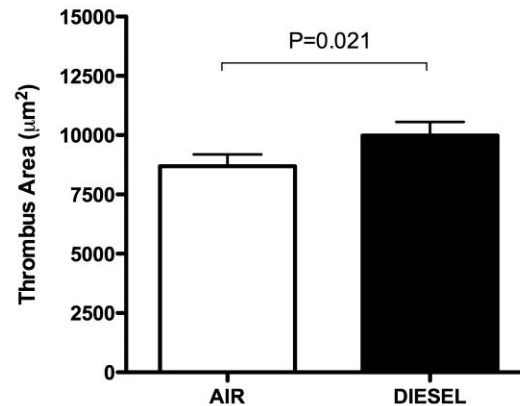
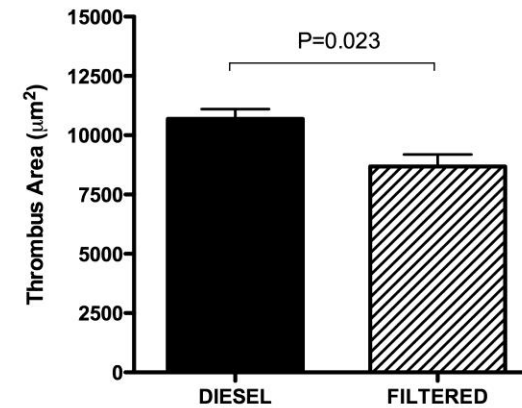
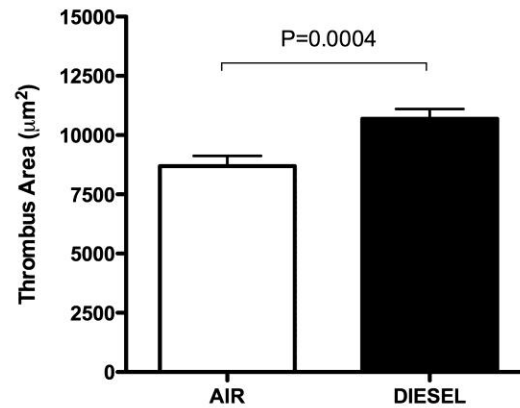
Particle Trap Efficiency

	Filtered Diesel Exhaust	Diesel Exhaust	<i>P</i>
NO, ppm	2.09 ± 0.15	5.72 ± 0.33	<0.001
NO ₂ , ppm	3.44 ± 0.33	0.69 ± 0.02	<0.001
NO _x , ppm	5.53 ± 0.44	6.40 ± 0.34	0.049
Total gaseous hydrocarbons, ppm	0.84 ± 0.06	0.91 ± 0.05	0.387
Total PM mass concentration, $\mu\text{g}/\text{m}^3$	7.2 ± 2.0	320 ± 10	<0.001
Fine particle number concentration, n/cm^3	30–300	150 000–200 000	<0.001

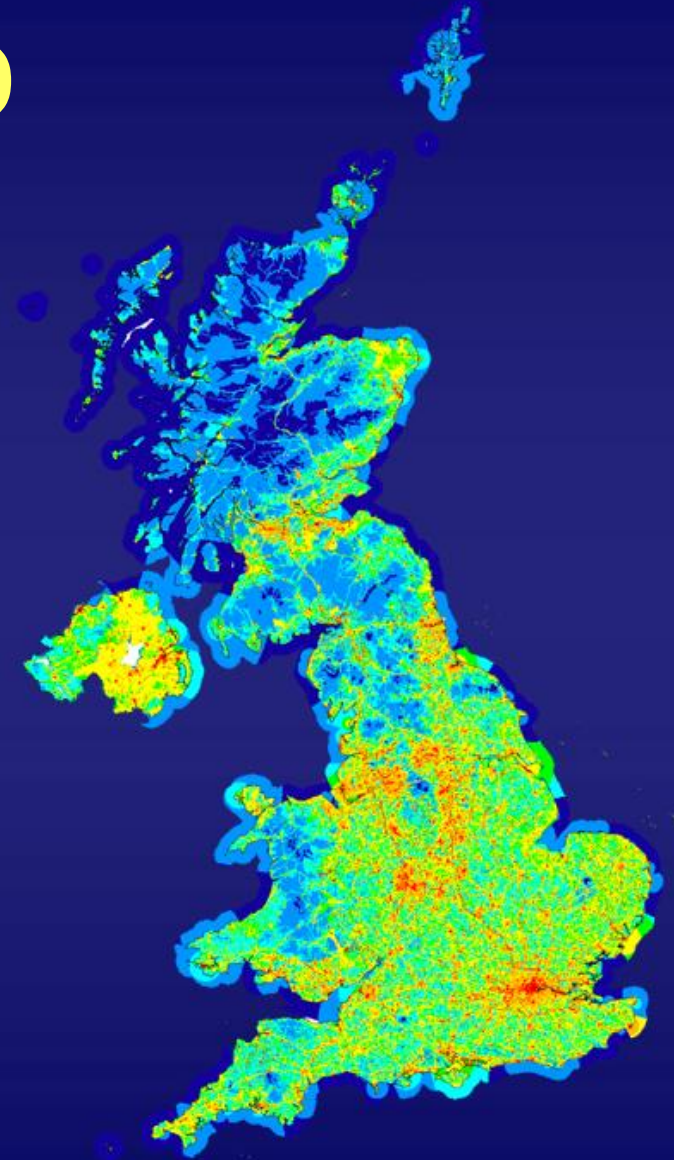
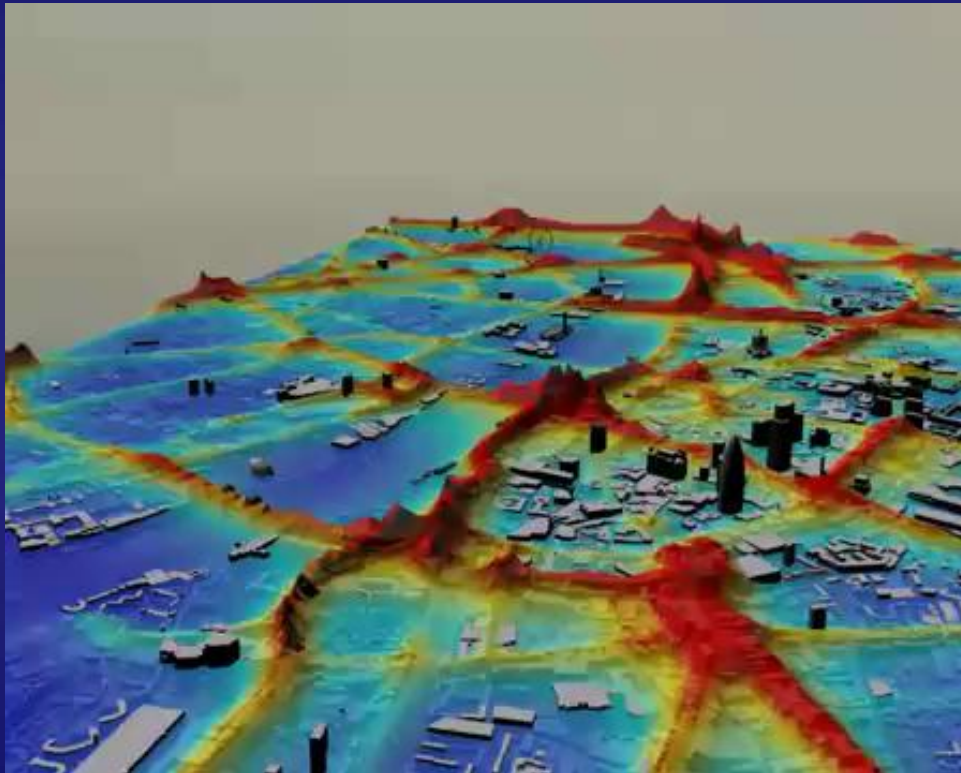
Particle Traps Improve Blood Flow and Clot Dissolution



Reduces Blood Clot Formation

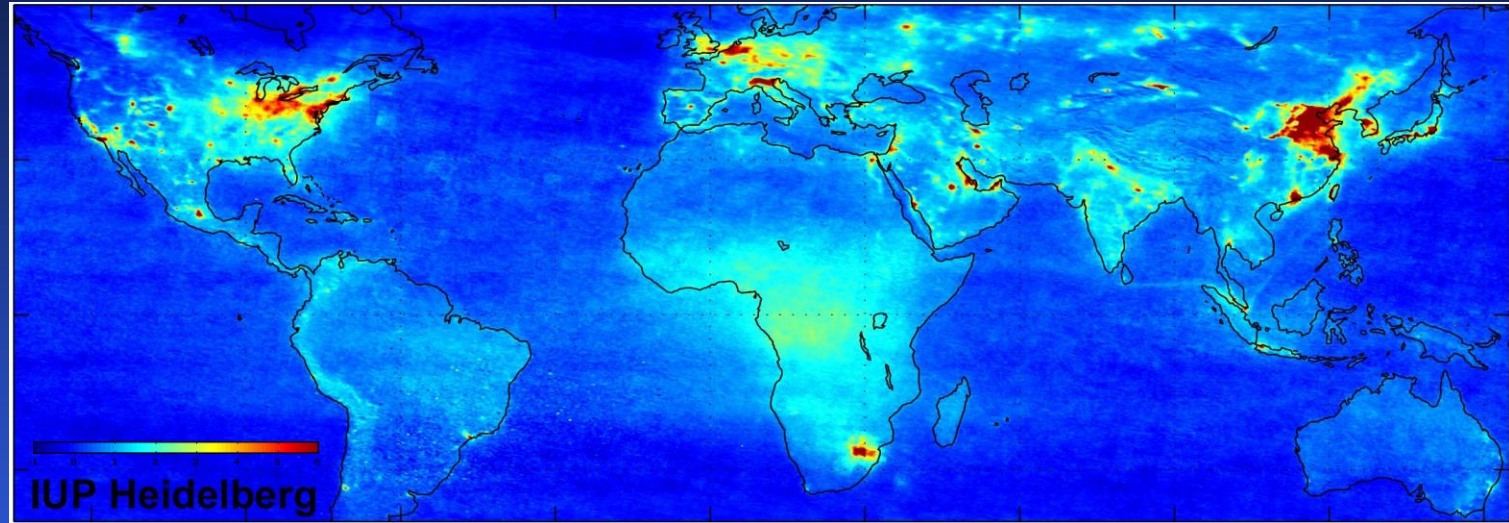


Air Pollution Goes With the Flow (of Traffic!)



National Atmospheric Emissions Inventory (NAEI), 2005

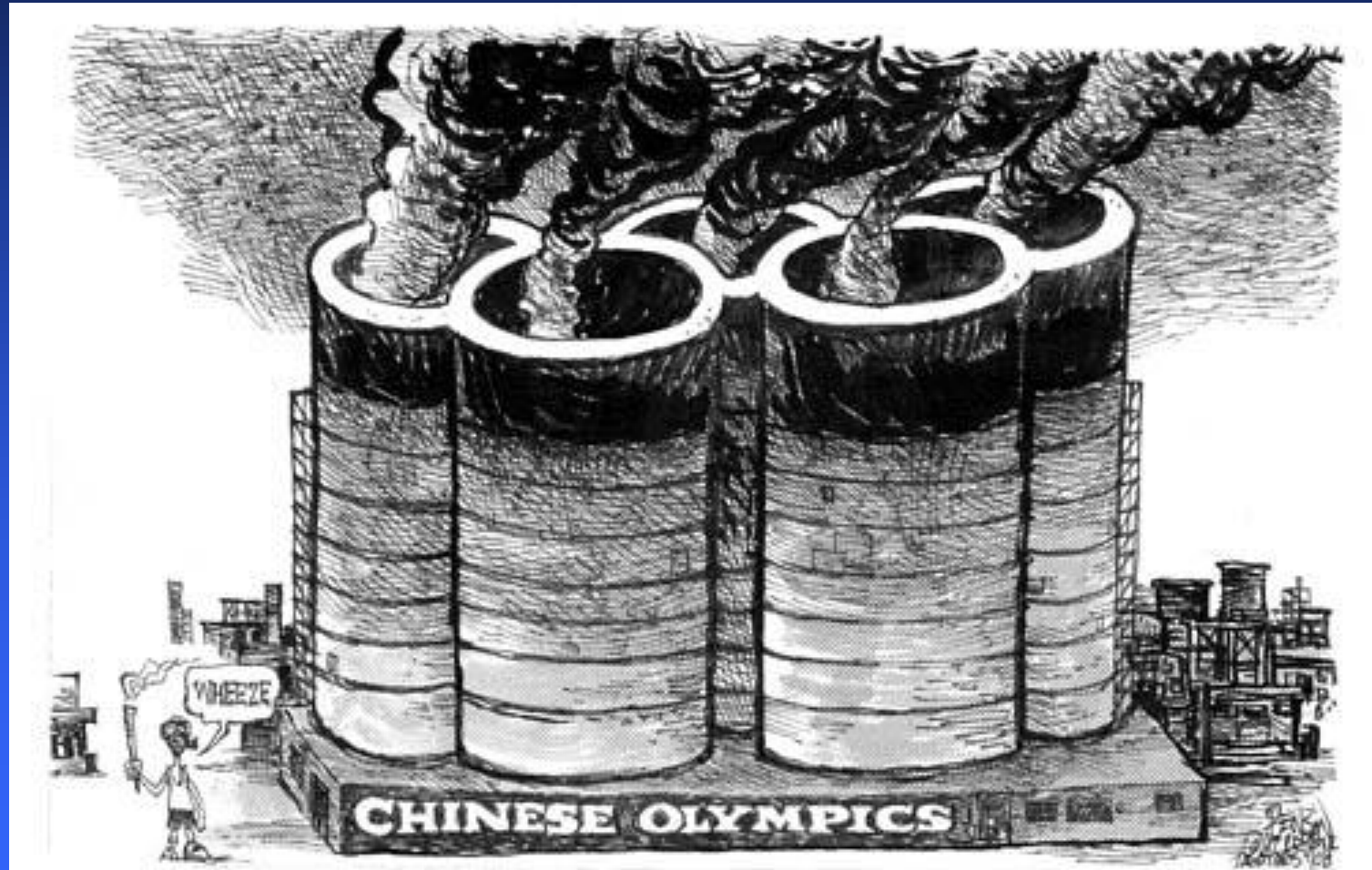
Global Air Pollution Emissions



Annual mean PM₁₀ in residential areas ($\mu\text{g}/\text{m}^3$)

Beijing	106	Edinburgh	18
Buenos Aires	107	London	40
Calcutta	153	Los Angeles	38
Delhi	187	Mexico City	69
Karachi	220	Tokyo	43

XXIX Olympic Games Beijing

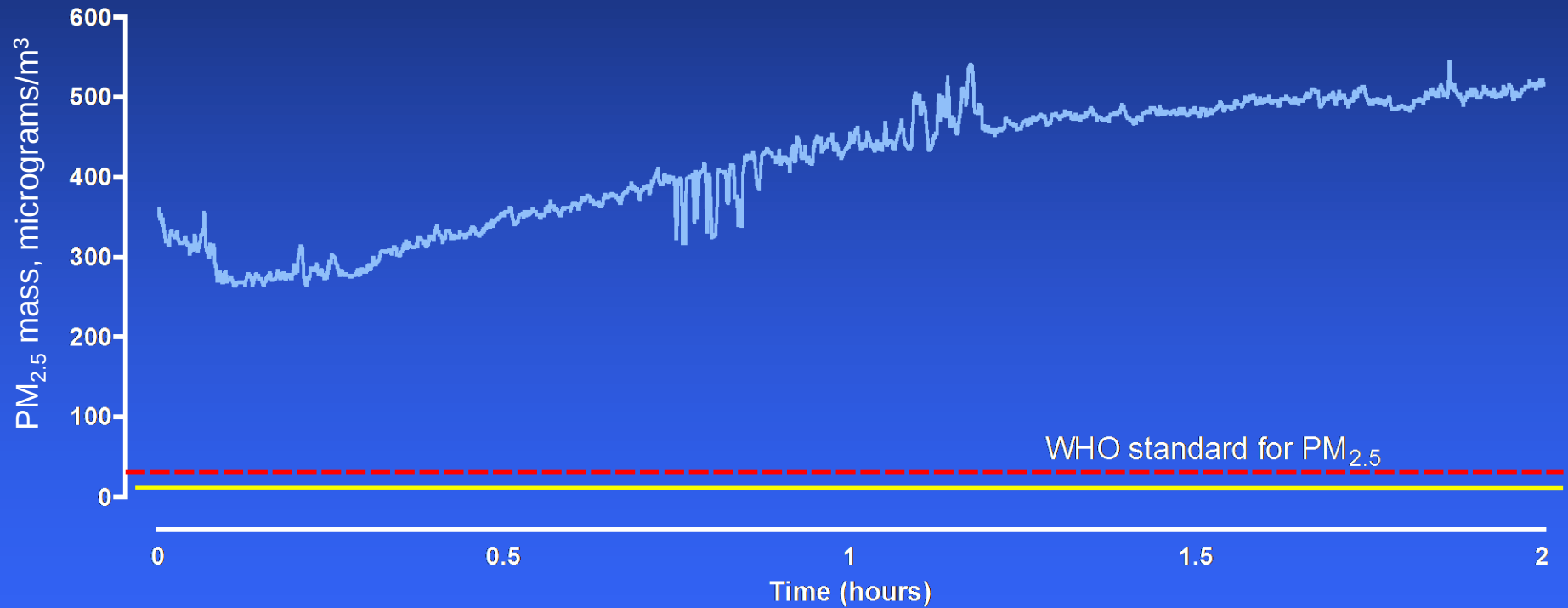


Air Quality in Beijing

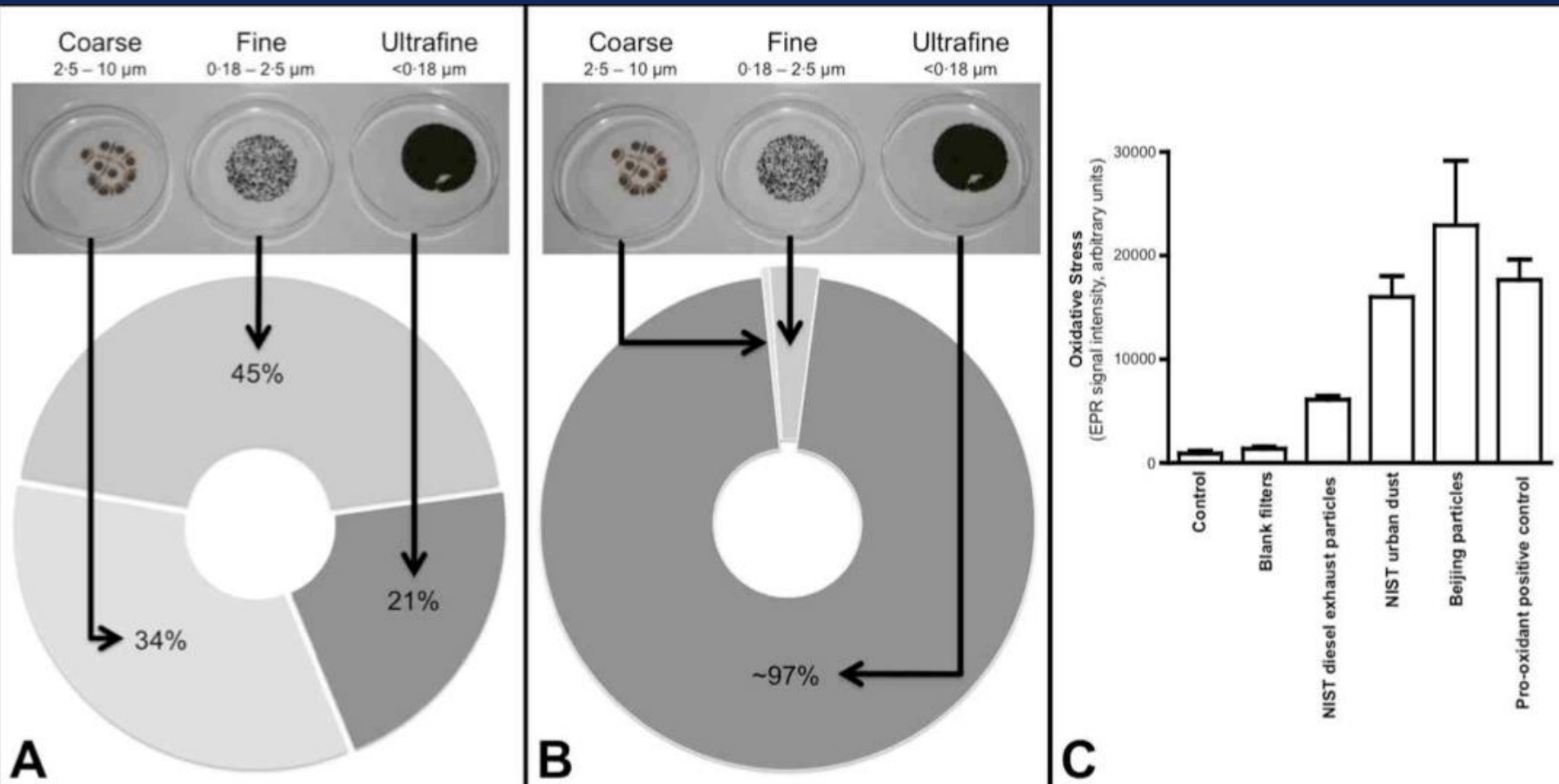
"Real-time" PM_{2.5} Concentration

24th July 2008

Beijing City Centre



Air Quality in Beijing





阜外心血管病医院

空气污染研究数据采集过程说明 Air Pollution Study

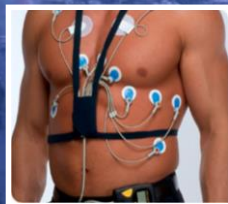


爱丁堡大学

病人在八点到达阜外医院
08:00 - Attend the Fuwai
Hospital

安上心率血压测试仪器
Heart rate and blood
pressure monitors applied

开启空气污染监测仪
Air pollution monitors
applied and switched on



在研究人员的陪同下在市区内步行两小时
Walk for 2 hours in the city
with researcher

病人可以自由活动
Free to do own
activities

十八点返回医院
18:00 - Reattend
the Fuwai Hospital

扯掉监控装置
Monitors removed

此次数据采集过程结束
Study complete

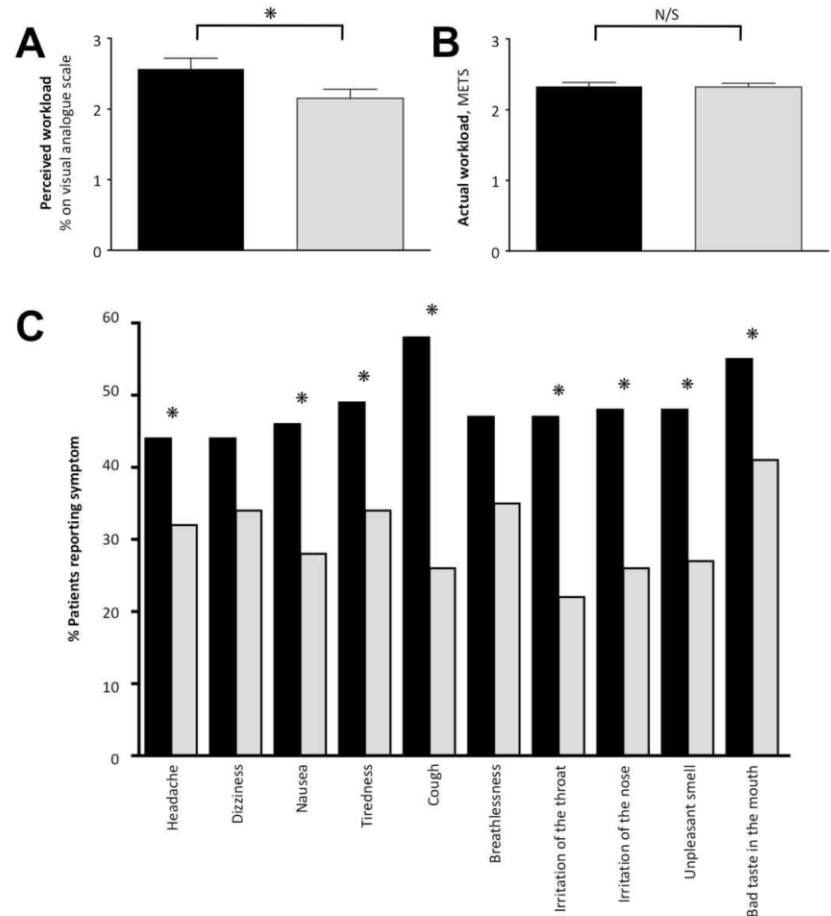
下一次数据采集过程将在奥林匹克运动会之后进行
One more visit to complete after Olympic games

Alternative interventions to reduce exposure: face masks



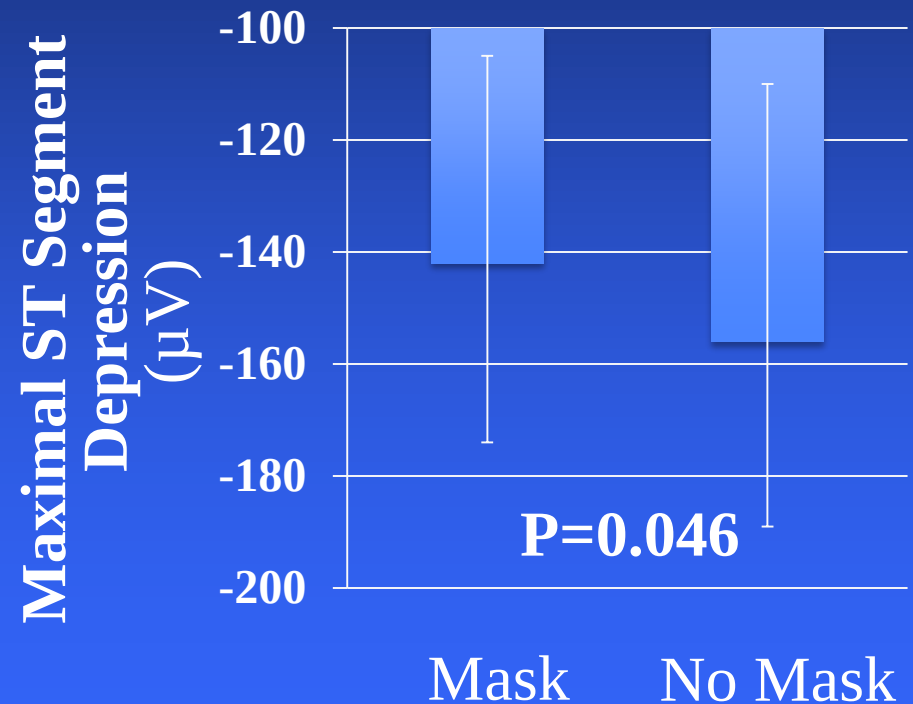
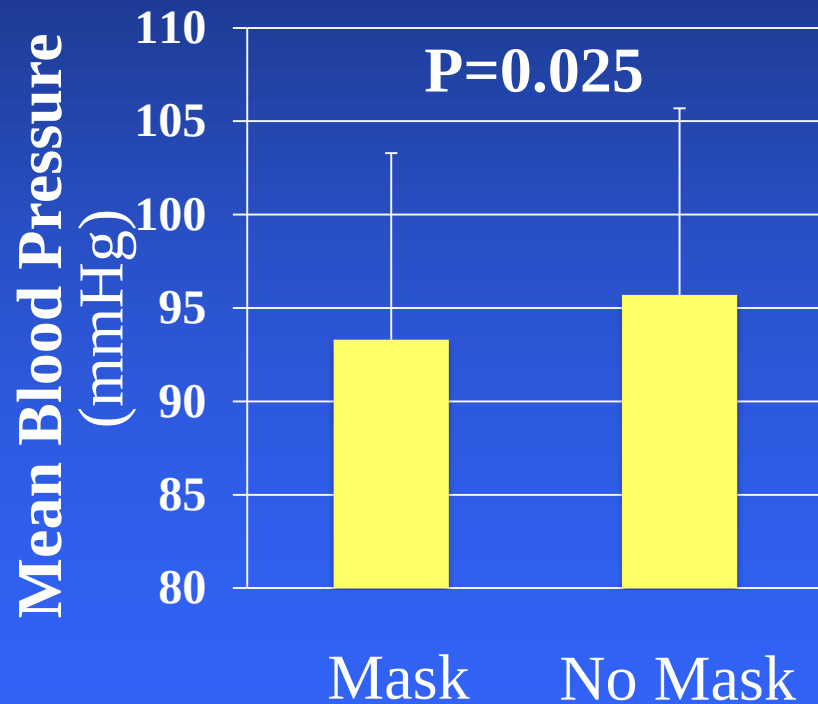
Face Masks

Less Symptoms & Perceived Effort



Face masks

Lower Blood Pressure & Less Heart Stress



Scotland

Land of the Brave!







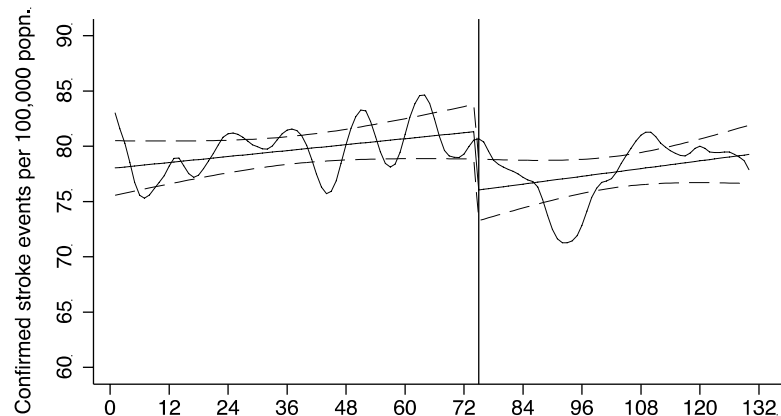
The STOPIT Study



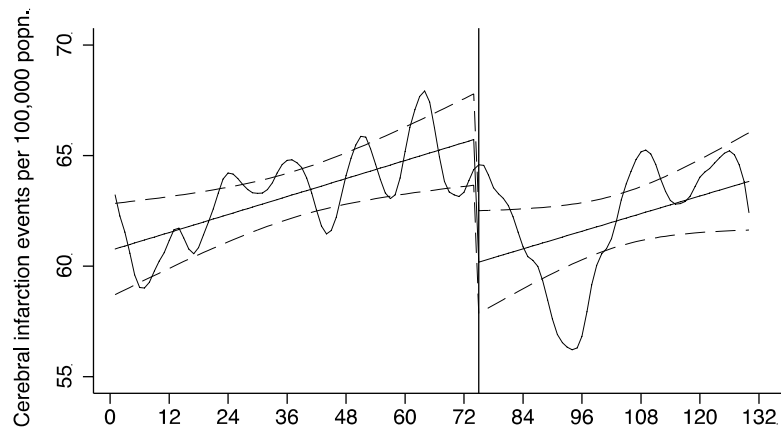
Figure 1. Admissions for Acute Coronary Syndrome According to Month before and after Smoke-free Legislation.



The STOPIT Study Stroke



Time in months since Jan 2000.



Time in months since Jan 2000.

Conclusions

- Self-induced and environmental air pollution is associated with acute and chronic cardiovascular disease
- Air pollution causes adverse effects on endothelial function, fibrinolysis and coagulation
- Combustion-derived nanoparticulate appears to be the primary mediator of these adverse effects
- Strategies to eliminate or reduce particle exposure appears to reduce the harmful effects of air pollution



Acknowledgments



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Nicholas Boon Paddy Hadoke
Keith Fox
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Paul Fokkens
Daan Leseman



ELEGI

Ken Donaldson Rodger Duffin
William MacNee Simon Brown



University of Glasgow

Jill Pell
Stuart Cobbe



University of Umeå, Sweden

Thomas Sandström
Anders Blomberg
Håkan Törnqvist
Manuel Gonzalez
Stefan Soderberg



Hjärt & Lungfonden

Department of Chemistry, Edinburgh

Robert Donovan
Matt Heal
Evelyn Freney



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Kareen Darnley
Sharon Cameron



Mount Sinai, New York, USA

Juan Badimon

