New and old inhaled toxins and children with asthma

#AskAboutAsthma 2023

Chaired by:
Jonathan Grigg, Professor of Paediatric Respiratory and Environmental Medicine, Queen Mary University of London

Housekeeping

Attendees are automatically muted with camera switched off during the webinar.

Use the group chat feature to ask questions and please like any questions that you would like answered.

This session is being recorded. A link will be available after the webinar with the slides.

Agenda

#AskAboutAsthma webinar: New and old inhaled toxins and children with asthma

Friday 15 September 2023 1:00 – 2:00pm

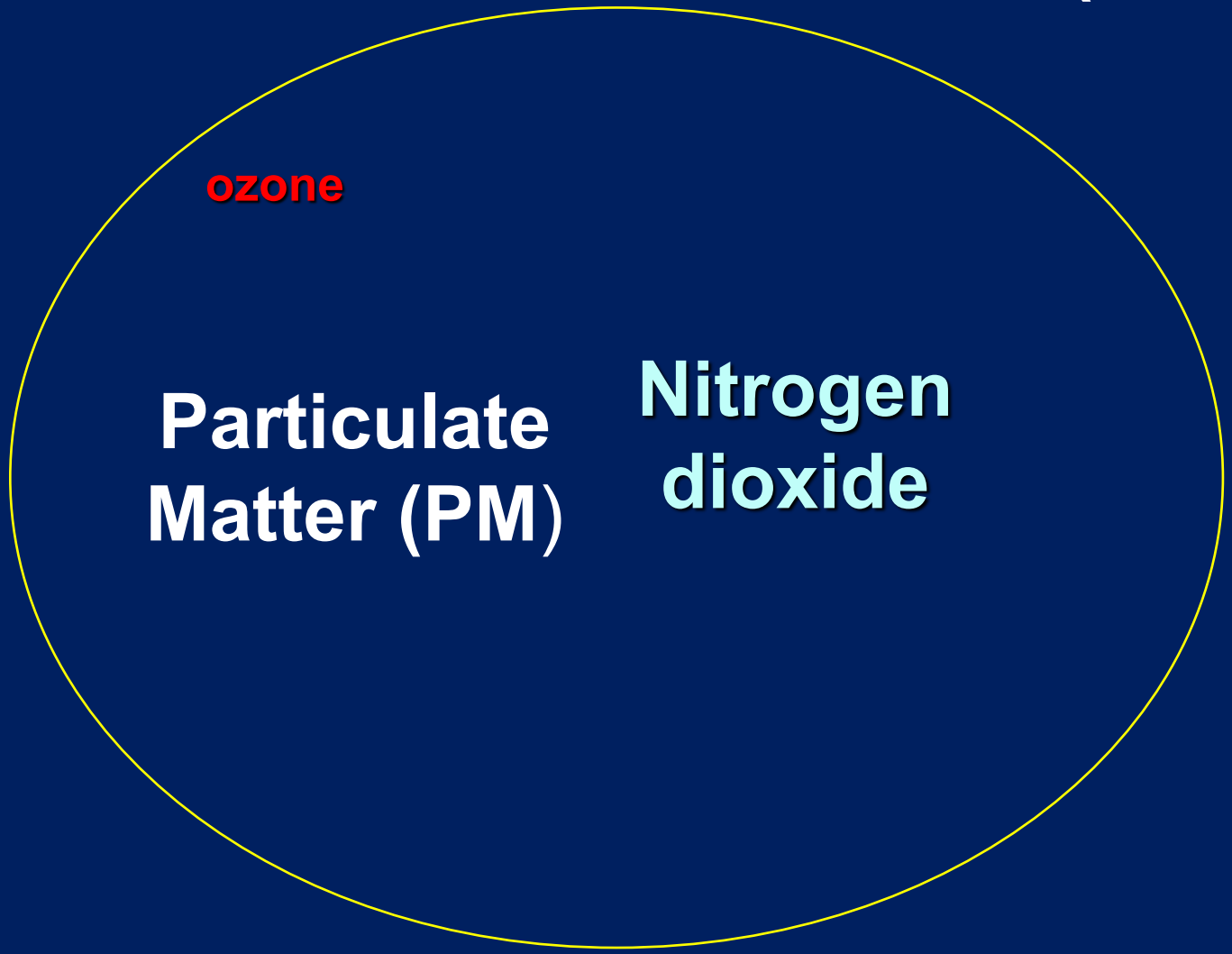
Click here to join the meeting

Topic	Speaker
Chair: Jonathan Grigg **Professor of Paediatric Respiratory and Environmental Medicine** **Queen Mary University of London**	
Air pollution and children's respiratory health	**Jonathan Grigg** Professor of Paediatric Respiratory and Environmental Medicine, Queen Mary University of London
Improving air quality in schools and healthcare settings	**Joe Harrison** Programme Manager, Global Action Plan
Health Effects of Air Pollution on Children	**Ian Mudway** Senior Lecturer in Environmental Toxicology Gresham College Visiting Professor for Environmental Health
Q & A	**All**

Air pollution and children's respiratory health

Jonathan Grigg
Queen Mary University of London

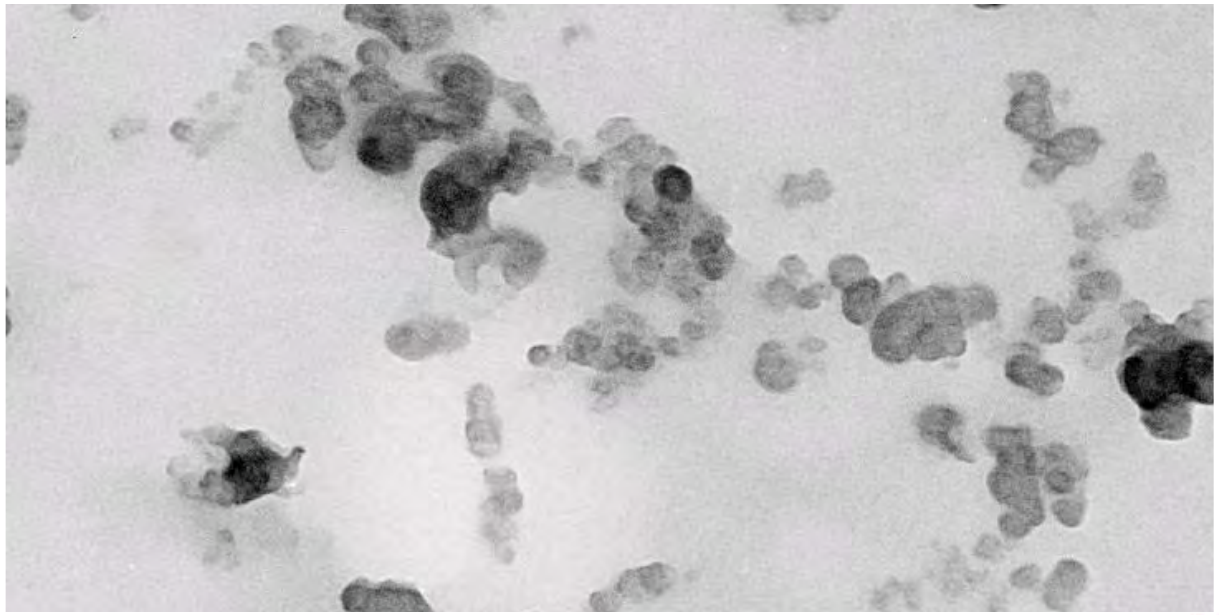
Air pollution mix
Traffic-Related Air Pollution (TRAP)

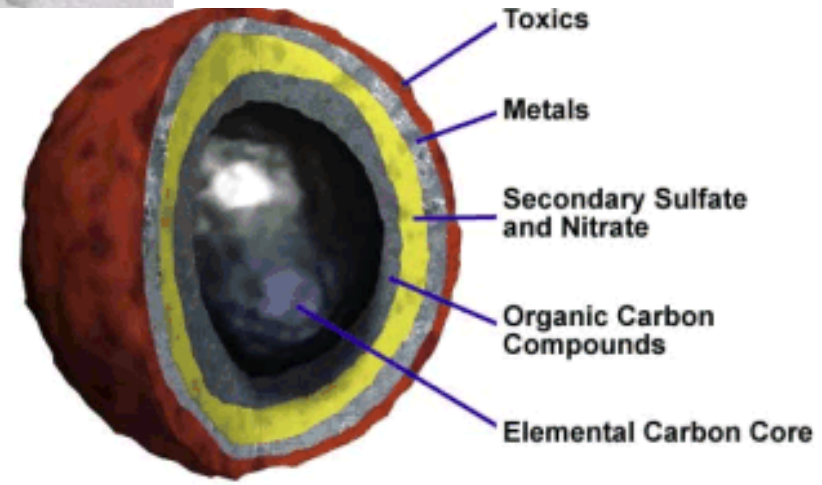



IVECO

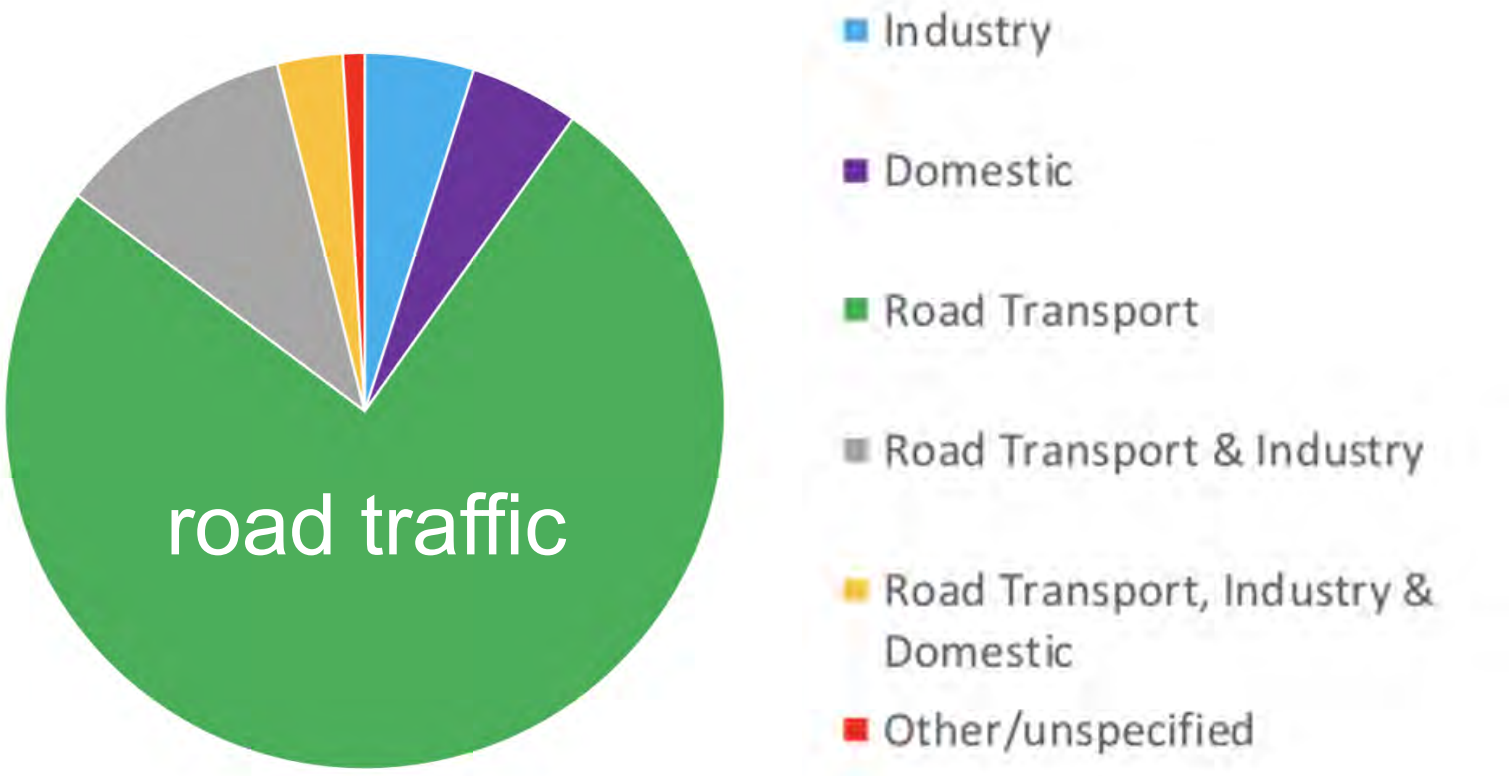

RAPALCAR STUDIOS

PM_{10} = less than 10μm



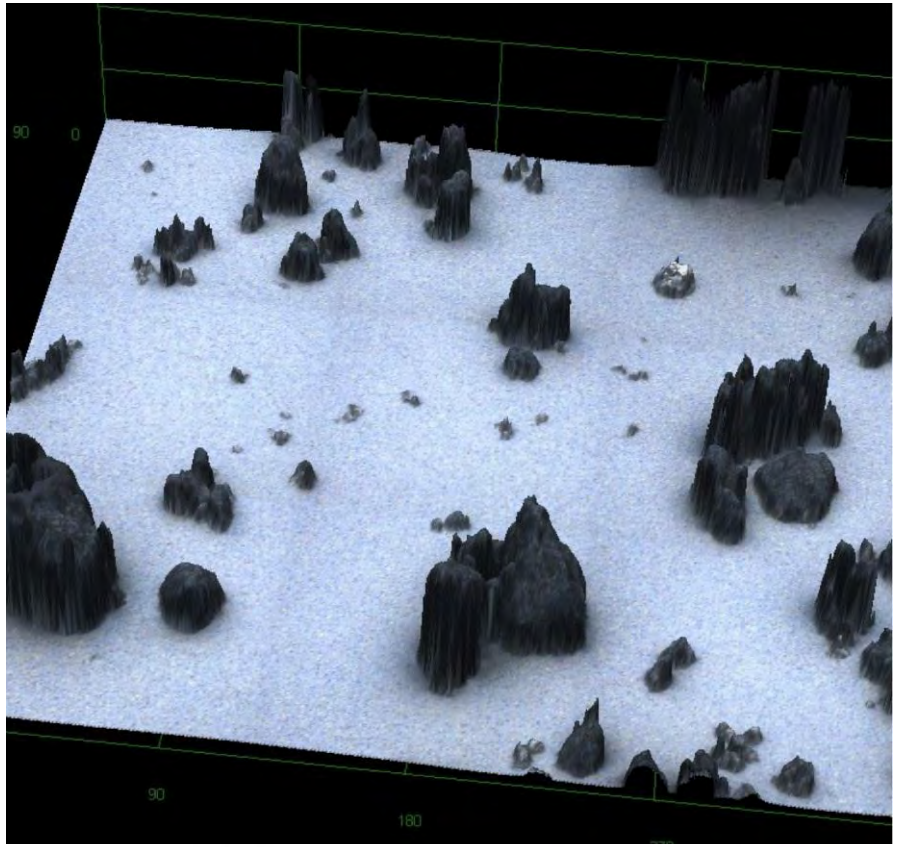


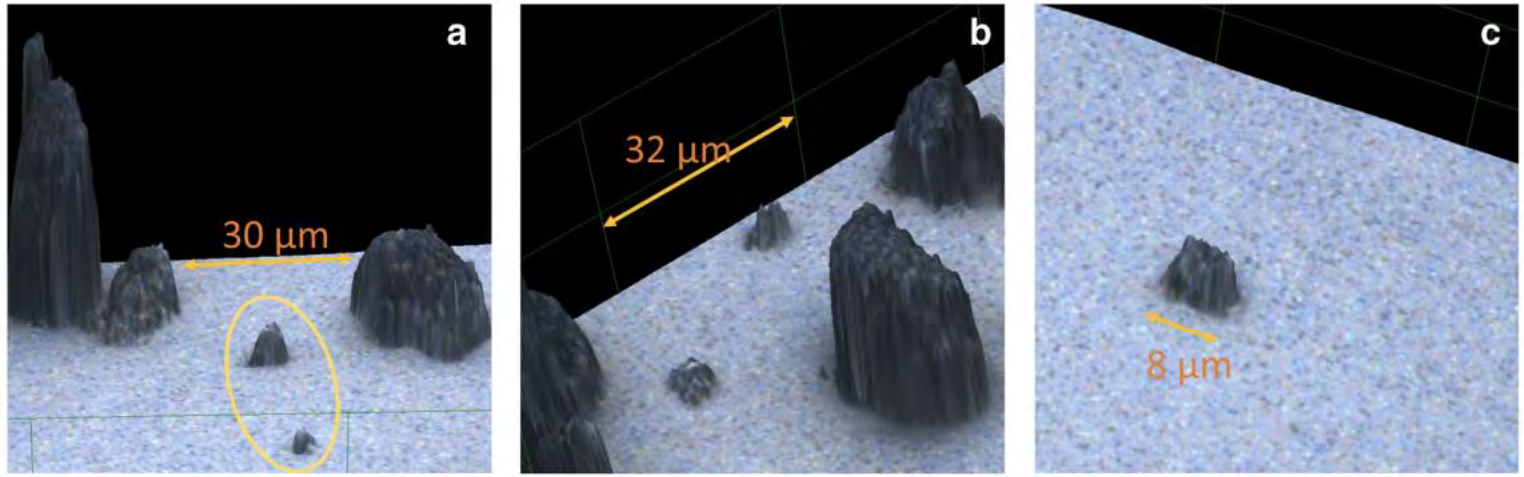
PM sources; UK urban



https://uk-air.defra.gov.uk/

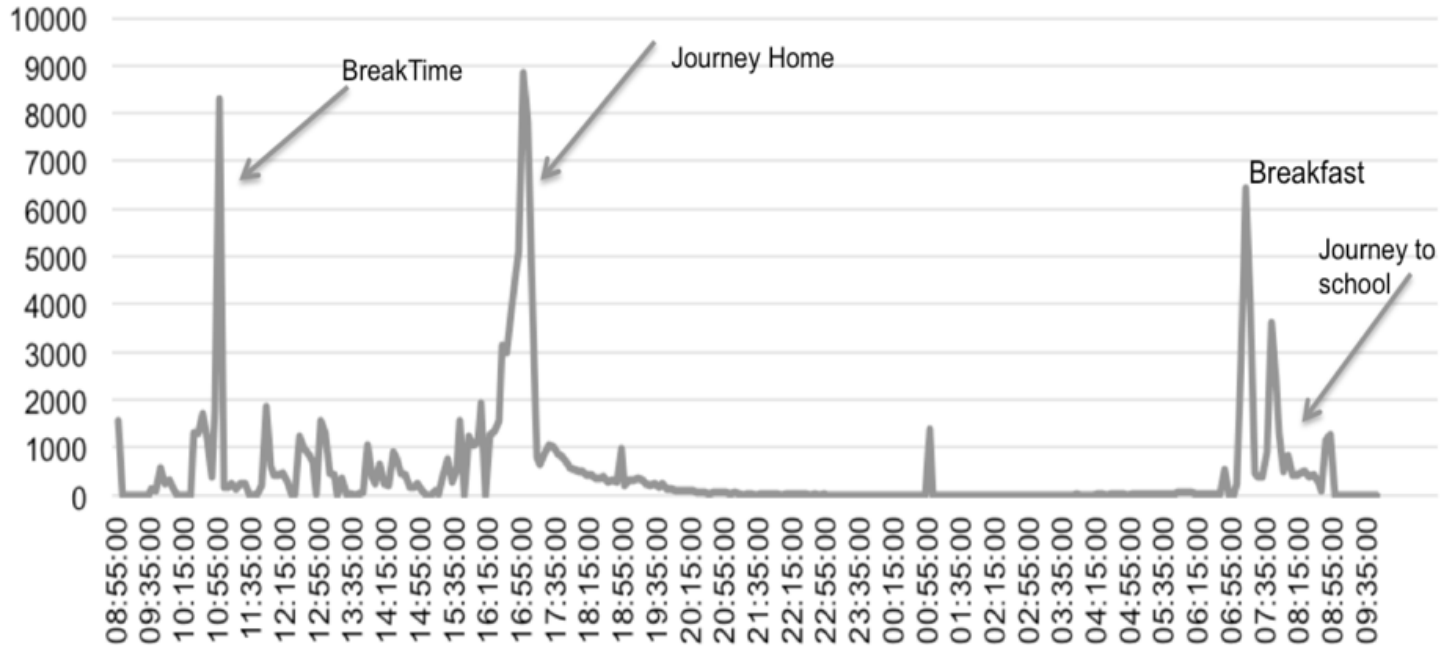
Collecting kerbside-PM_{10}



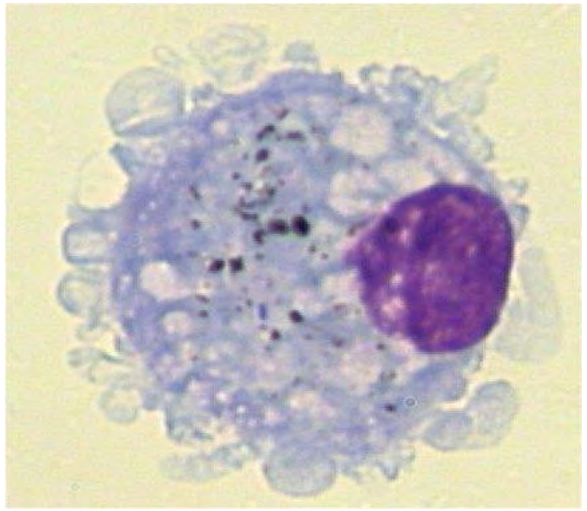


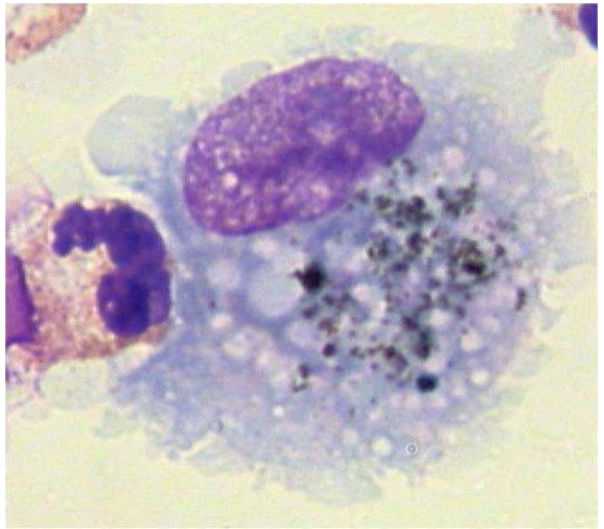
Environ Sci Pollut Res Int 2021

Figure 1 - An example of a child's exposure to air pollution over 24 hours

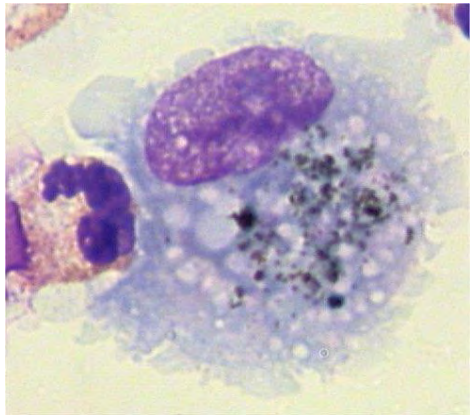


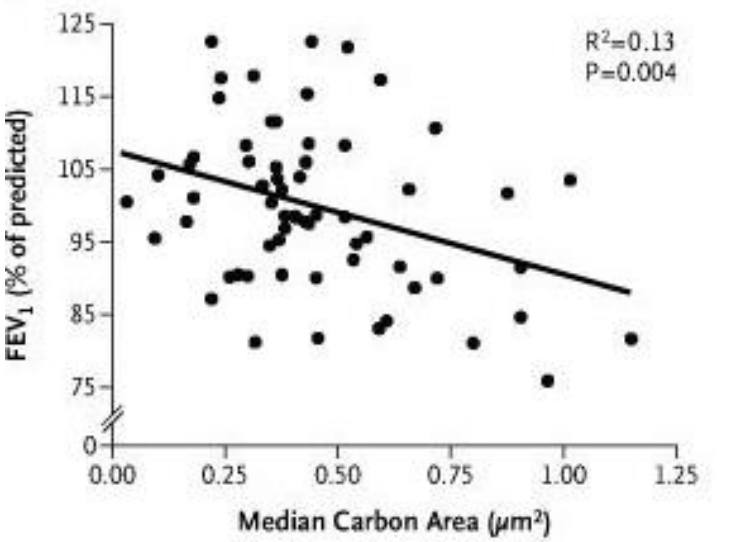
https://www.unicef.org.uk/publications/the-toxic-school-run/

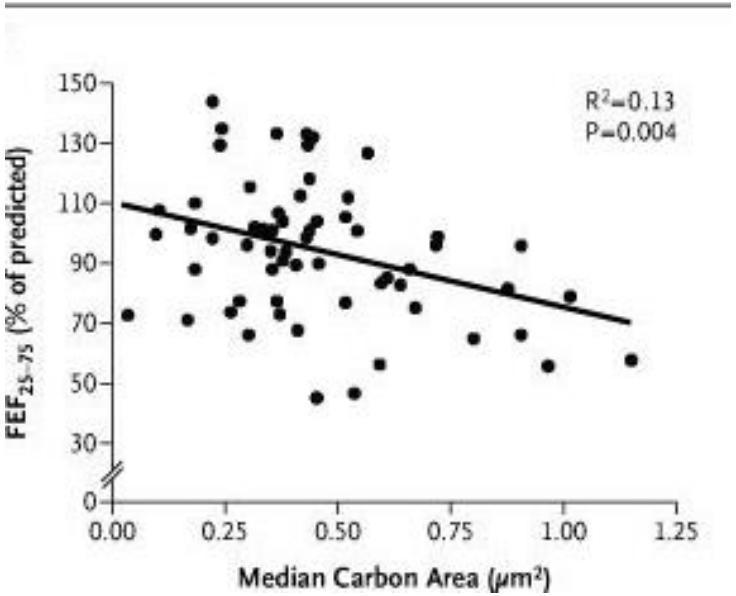




NEJM 2006 355:21-30




125
115
105
95
85
75
0
R^2=0.13
P=0.004
FEV_1 (% of predicted)
0.00
0.25
0.50
0.75
1.00
1.25
Median Carbon Area (μm^2)


150
130
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0
R^2=0.13
P=0.004
FEF_{25-75} (% of predicted)
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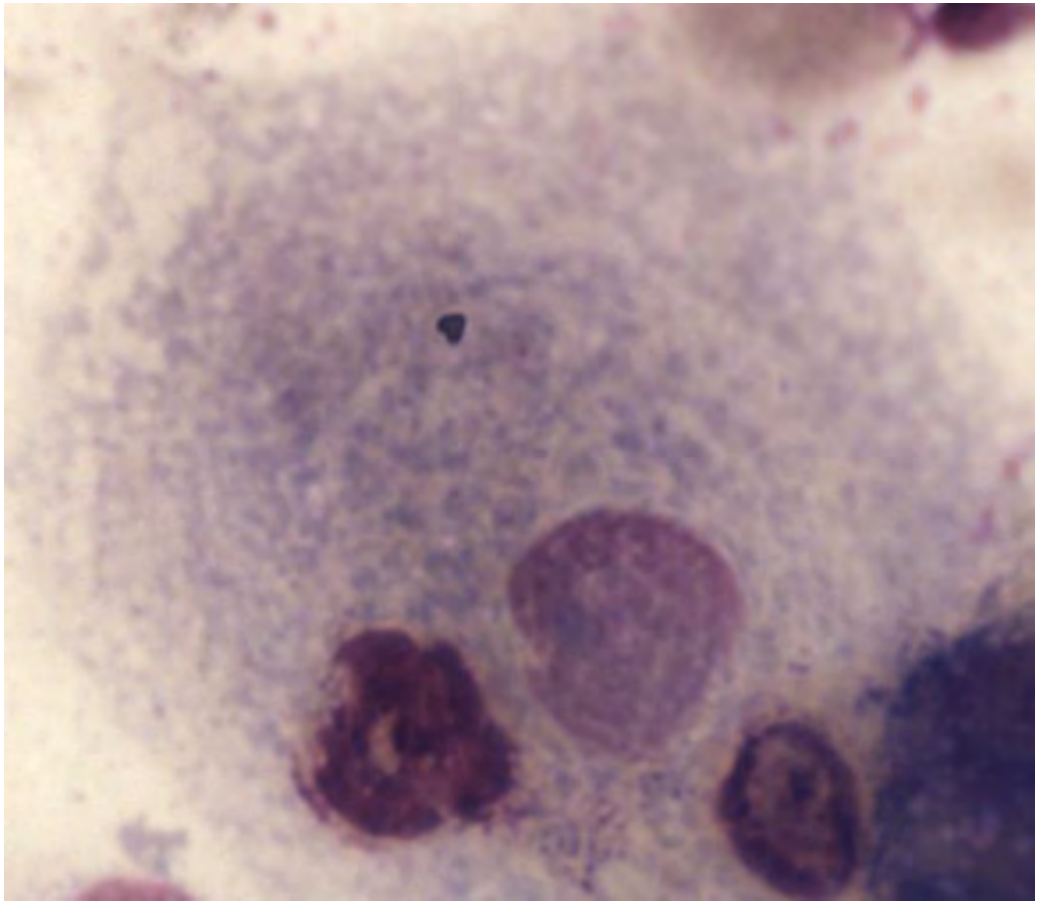
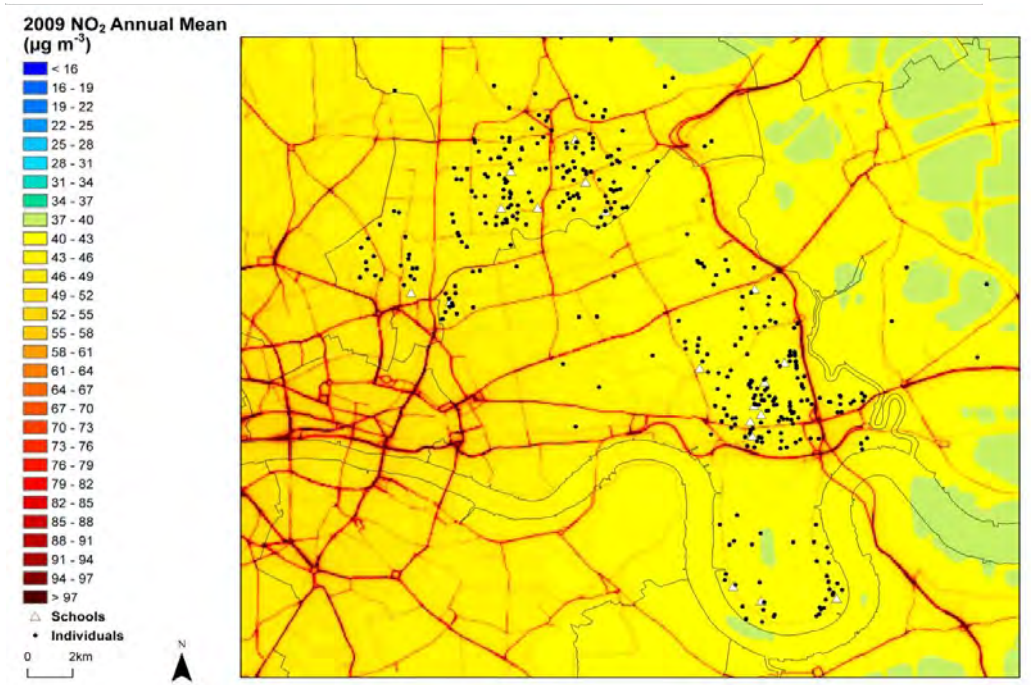
0.50
0.75
1.00
1.25
Median Carbon Area (μm^2)

NEJM 2006

Placental cells

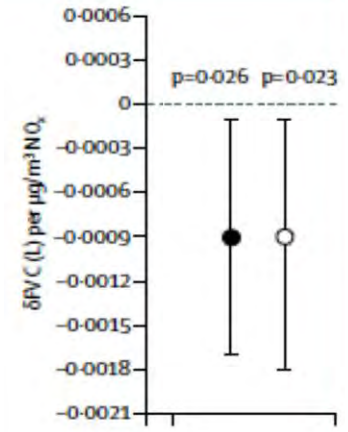


Sci Total Environ 2020

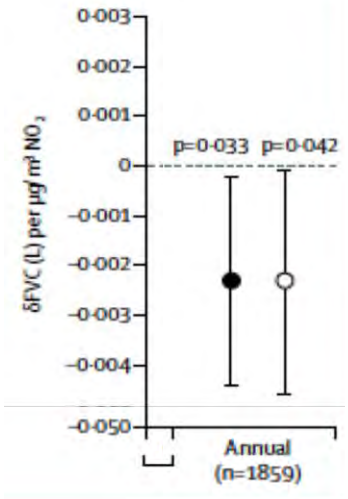


Lancet Public Health 2018

NOx



NO_2



- FVC loss
- 5% over 5 yr.

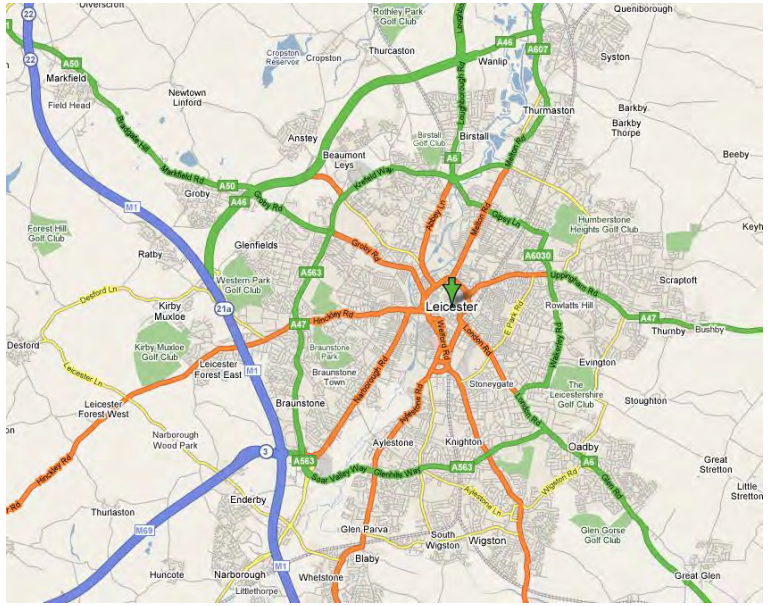
Lancet Public Health 2018

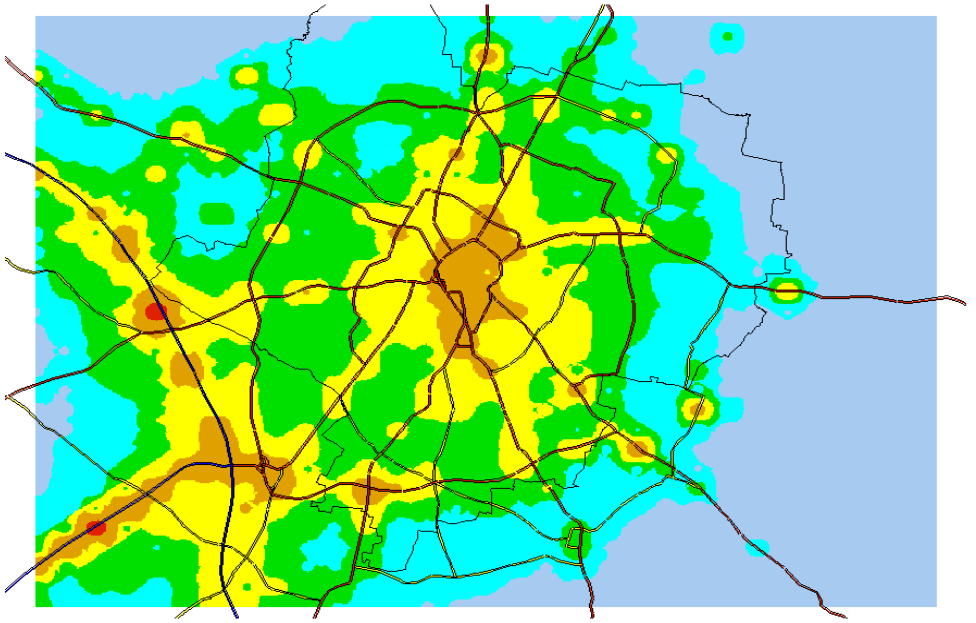
New cases of preschool wheeze

- 4,400 preschool children
- 1 to 5 yrs
- Surveyed in 1998 and 2001

Thorax 2006

New cases of preschool wheeze





Thorax 2006

New cases of preschool wheeze

	Adjusted*		
	OR†	95% CI	n‡
Cough without a cold	1.62	1.31 to 2.00	1287
Night time cough	1.19	0.96 to 1.47	1191
Wheeze	1.42	1.02 to 1.97	1319

Thorax 2006

New cases of school age asthma

- 4 million new asthma cases in children per year attributable to traffic-related pollution

Global, national, and urban burdens of paediatric asthma incidence attributable to ambient NO_2 pollution: estimates from global datasets

Pattanun Achakulwisut, Michael Brauer, Perry Hystad, Susan C Anenberg

Achakulwisut *Lancet Planet Health. 2019 Apr;3(4):e166-e178.*

Record of Inquest

Following an Inquest opened on the 17 December 2019, And an inquest hearing at Main on the 30 November 2020 heard before Philip Barlow in the coroner's area for London Inner South ,

The following is the record of the inquest (including the statutory determination and, where required, findings).

1. Name of Deceased (if known)

   Ella Roberta ADOO KISSI-DEBRAH

2. Medical cause of death

   1a Acute Respiratory Failure

   1b Severe Asthma

   1c Air Pollution exposure

Brain: *Stroke, Dementia, Parkinson's Disease*

Eye: *Conjunctivitis, Dry Eye Disease, Blepharitis, Cataracts*

Heart: *Ischemic Heart Disease, Hypertension, Congestive Heart Failure, Arrhythmias*

Lung: *Chronic Obstructive Pulmonary Disease Asthma, Lung Cancer, Chronic Laryngitis, Acute and Chronic Bronchitis*

Liver: *Hepatic Steatosis, Hepatocellular carcinoma*

Blood: *Leukemia, Intravascular Coagulation, Anemia, Sickle Cell Pain Crises*

Fat: *Metabolic Syndrome, Obesity*

Pancreas: *Type I and II Diabetes*

Gastrointestinal: *Gastric Cancer, Colorectal Cancer, Inflammatory Bowel Disease, Crohn's Disease, Appendicitis*

Urogenital: *Bladder Cancer, Kidney Cancer, Prostate Hyperplasia*

Joints: *Rheumatic Diseases*

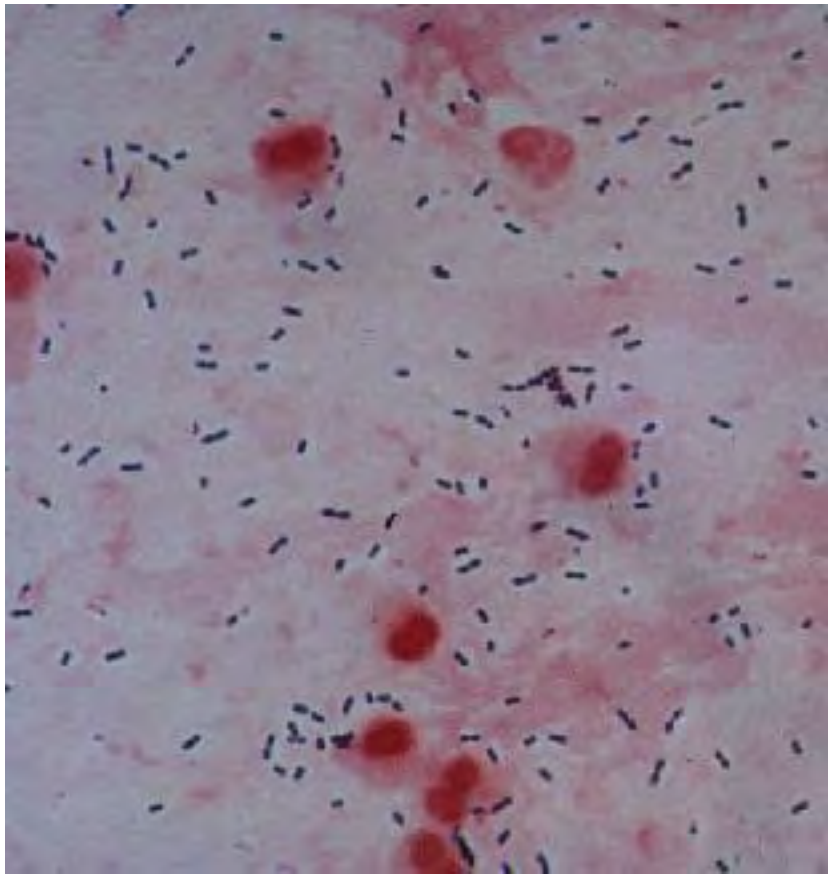
Bone: *Osteoporosis, Fractures*

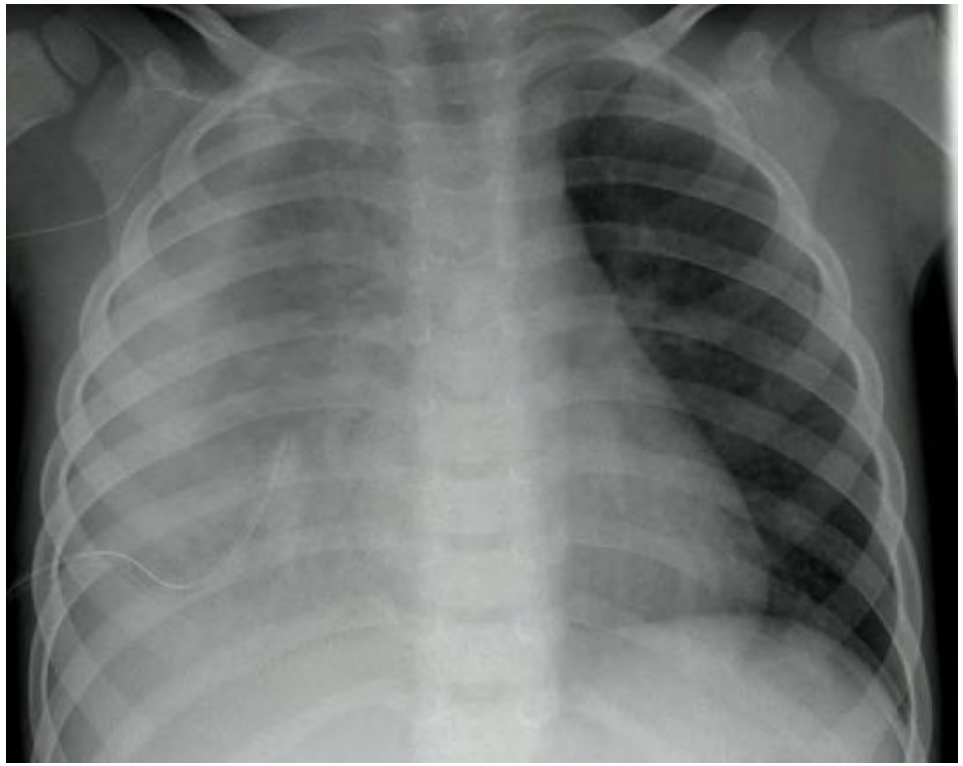
Nose: *Allergic Rhinitis*

Skin: *Atopic Skin Disease, Skin Aging, Urticaria, Dermographism, Seborrhea, Acne*

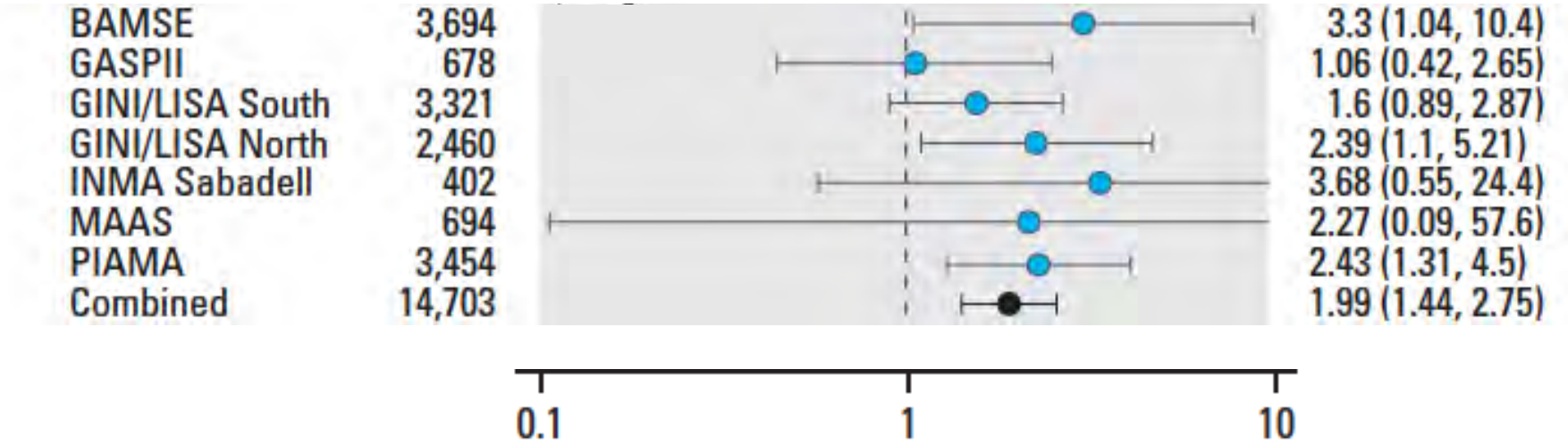
Schraufnagel *Chest* 2019

S. pneumoniae





Pneumonia in children and $PM_{2.5}$



MacIntyre *EHP* 2014

London Underground

Advice

- low pollution routes
- indoor air
- advice to patients and public

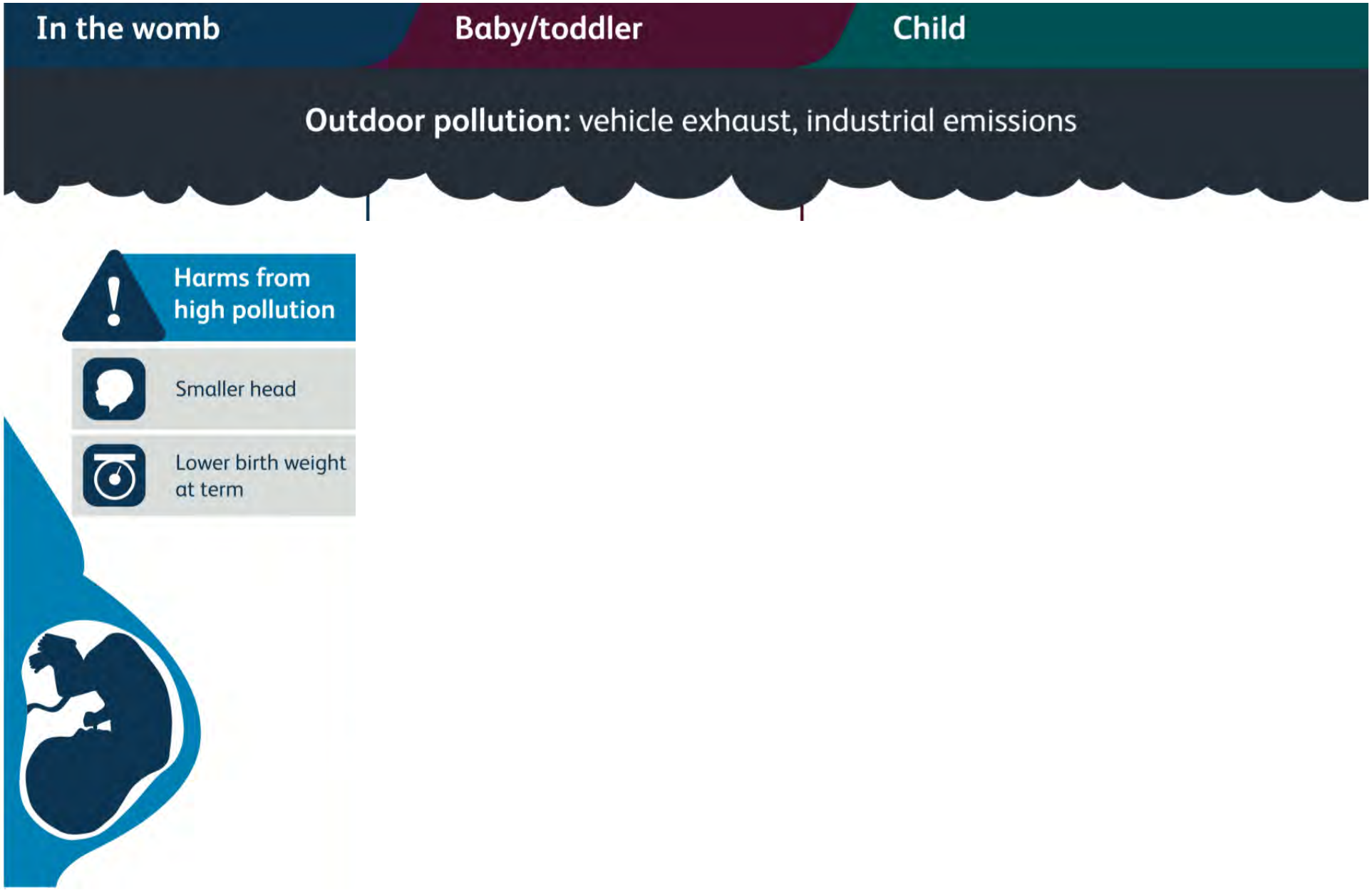
Royal College of Physicians

RCPCH
Royal College of Paediatrics and Child Health
Leading the way in Children's Health

Every breath we take: the lifelong impact of air pollution

Report of a working party
February 2016

https://www.rcplondon.ac.uk/projects/outputs/every-breath-we-take-lifelong-impact-air-pollution



The inside story:
Health effects of indoor air quality on children and young people

Published January 2020

Royal College of Physicians

RCPCH
Royal College of Paediatrics and Child Health
Leading the way in Children's Health


ODOURS
VOLATILE CHEMICALS FROM FURNITURE AND CONSTRUCTION MATERIALS
WHY DOES INDOOR AIR MAKE US SICK?
NANOSIZED POLLUTION PARTICLES FROM OUTDOORS
FIBERS
FINE PARTICLES AND CHEMICALS FROM HUMANS AND PROCESSES
MOULD TOXINS

Birth and infancy

- Respiratory problems – wheeze, rhinitis, atopic asthma, respiratory infections
- Low birthweight and pre-term birth

Pre-school

- Respiratory problems – wheeze, allergies, asthma, risk of respiratory diseases and pneumonia
- Eczema and atopic dermatitis
- Greater hyperactivity, impulsivity and inattention

School age

- Respiratory problems – wheeze, rhinitis, asthma, throat irritation, nasal congestion, dry cough
- Eczema, dermatitis, conjunctivitis, skin and eye irritation
- Reduced cognitive performance, difficulty sleeping

Advice for high pollution days?

- **Reduce strenuous, outdoor exercise.** if possible, keep doing your exercise indoors in a well-ventilated room or gym.
- **Stay away from pollution hotspots** such as main roads and busy road junctions.
- If you cycle, run or walk as part of your commute, **use back streets** away from the bulk of vehicle congestion.
- Make sure you **carry your reliever inhaler with you** if you use one.
- If you have asthma, **use your preventer inhaler regularly**.

https://www.blf.org.uk/support-for-you/air-pollution/tips

TOWER HAMLETS TOGETHER

Delivering better health through partnership

Air pollution can worsen asthma symptoms – take action today

Check the air pollution forecast

www.cleanairhub.org.uk/tower-hamlets

My air pollution plan:

Plan out the actions that you and your family can take to reduce the impact of air pollution on your health	**On all days**	**On high pollution days**
I will use my inhaler as recommended by my GP or asthma nurse	❑	❑
I will treat air pollution the same way I treat other asthma triggers	❑	❑
We will walk, cycle or scoot to school	❑	❑
We will look up quieter routes to avoid roads with heavy traffic	❑	❑
We will turn on the extractor fan when cooking	❑	❑
We will swap our cleaning products to low chemical options	❑	❑
We will open the window when cooking	❑	❑
We will open the windows when cleaning	❑	❑
We will always turn the engine off when our car is stationary	❑	❑
If we paint, we will check it is labelled "low VOC"	❑	❑
We will leave the car at home when we can	❑	❑
We will ask people not to smoke in our home	❑	❑

This leaflet was designed in collaboration with:
children with asthma, their families, GPs and clinicians.
Thank you to Tower Hamlets Together and Global Action Plan as the original creators.

Evening Standard

First clinic to look at dirty air's impact on children to open in London

VIEW 1 COMMENTS

By Ross Lydal @RossLydall18 March 2022

Advocacy

DOCTORS AGAINST DIESEL

About Why Diesel? How you can help Contact Sign Up!

Doctors Against Diesel is an evidence-based campaign led by doctors, nurses and health professionals.

Our mission is to reduce the impacts of air pollution on children's health.

Conclusions

- major effects of air pollution on asthma and other childhood diseases
  - long- and short-term exposure
  - outdoors and indoors
- need to detoxify the breathed environment

Thank you


Barts and The London
School of Medicine and Dentistry
www.smd.qmul.ac.uk

global action plan

OUR LIVES. OUR PLANET.

Improving air quality in schools and healthcare settings

Hannah Battram, Senior Manager Clean Air for Children

15 September 2023

Notcutt House, 36 Southwark Bridge Road, London, SE1 9EU, Telephone 0204 566 9904
Charity registered in England and Wales No. 1026148, in Scotland No. SC041260, Registered company in England and Wales No. 2838296, VAT No. 625 994 009

Air pollution causes upwards of 36,000 deaths each year in the UK

Air pollution causes over 6 million sick days a year in the UK

Air pollution has an estimated total social cost of £22.6 billion per year in the UK

Air pollution causes over 20,200 respiratory and cardiovascular hospital admissions a year in the UK

Royal Colleges Round Table Discussions:

NHS commitments on air pollution: Chief Medical Officer

Halve contribution to poor air quality within a decade, while reducing health inequalities.

Healthcare staff training to include the health effects of air pollution, how to minimise these, and communicate this with patients.

Include air pollution in your Green Plan.

Integrated Care System Clean Air Framework

global action plan

OUR LIVES. OUR PLANET.

ICS

Integrated Care System

North East & North Cumbria

Boehringer Ingelheim

Integrated Care for Cleaner Air

https://youtu.be/wXdv-vdDoMc

Local authorities have commitments on air pollution

They must regularly review and assess air quality in every district and unitary authority.

Where standards are not being met, authorities must produce action plans to improve air quality.

Schools' commitments on air pollution

Asthma Friendly Schools Guide:

"In relation to children with asthma, this means that an ICS should, within reason, make sure support and health care is in place to improve their health or at least keep them healthy."

Recognises air pollution at school as an asthma trigger that needs to be managed

ICS Clean Air Framework

www.actionforcleanair.org.uk/health

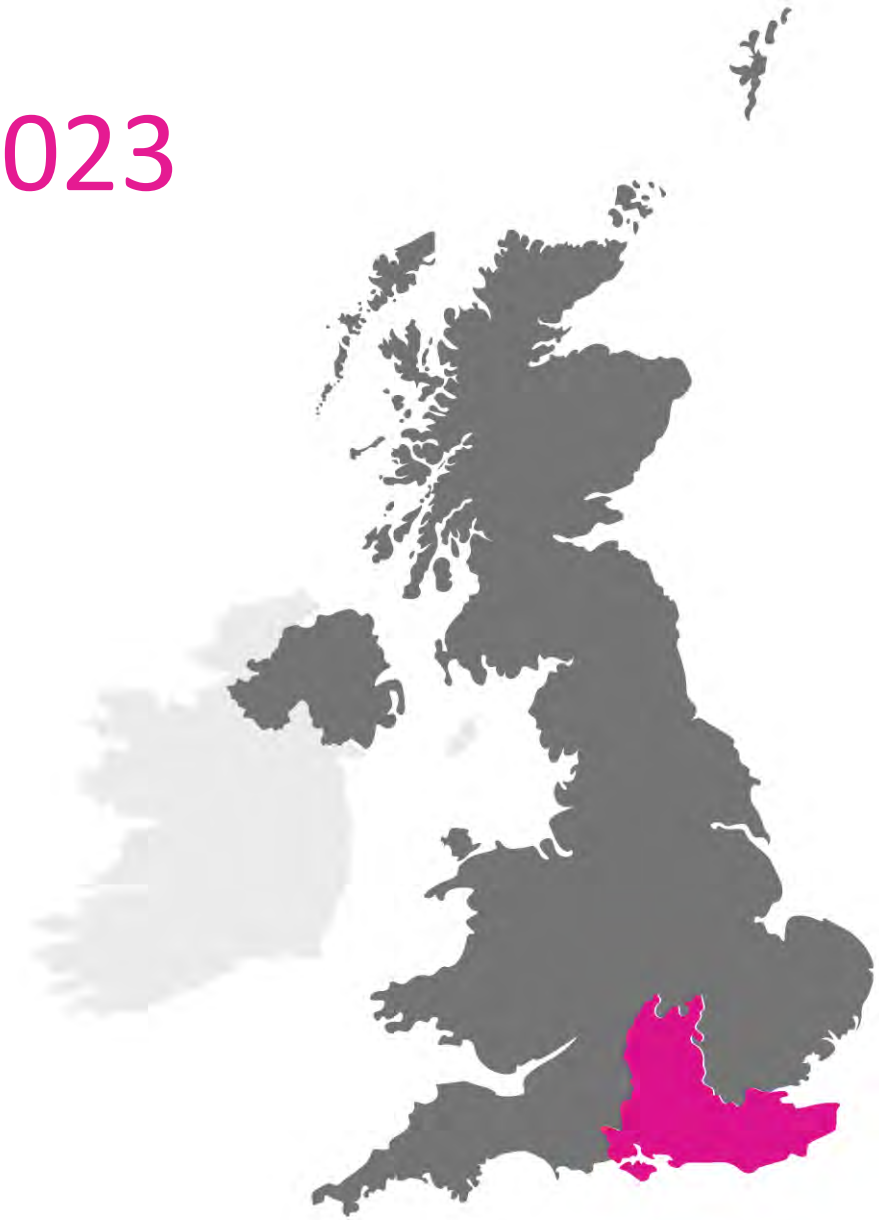
	#
Clinical Commissioning Groups	
Acute Trusts	
Mental Health Trusts	
Ambulance Trusts	
Hospitals	
Primary Care Networks	
Community Providers	
GP Practices	
Local Authorities	
Cities	
Population	

	Not started	In progress	Complete	Total
Digitalisation	3	0	0	**3**
Educating Staff	7	0	0	**7**
Infrastructure	10	0	0	**10**
Local Authority Collaboration	5	0	0	**5**
Strategic Decision Making	9	0	0	**9**
Supply Chain	8	0	0	**8**
Transport	15	0	0	**15**
Whole Health Care Approach	5	0	0	**5**
Total	**62**	**0**	**0**	**62**

Home | Framework | Trust Tracker | Glossary | Useful resources

South-East ICS Cluster Pilot - 2023

- Surrey
- Kent & Medway
- Hampshire & Isle Of Wight
- Frimley
- Berkshire, Oxford & Buckinghamshire



Case studies and impact modelling to be shared in autumn 2023.

www.actionforcleanair.org.uk/health

global action plan

Home | CAPIT | Business | Health | Schools | Campaigns

ICS Clean Air Framework

The **ICS Clean Air Framework** is freely available for an ICS to use to enable healthcare leaders to pursue action on cleaner air and secure a healthier future for their region. The Framework can be used as the basis of a Clean Air Strategy for an ICS working to improve their own emissions and reduce the effects of air pollution on the population.

FIND OUT MORE

Clean Air Hospital Framework

The Clean Air Hospital Framework is a free resource being used by hospitals across the UK to clean up their air. It is a self-assessment tool designed to improve air quality across the hospital site, and in the local community.

FIND OUT MORE

The Islington Primary Care for Clean Air Project

We're working with health professionals in GP surgeries across Islington to help them share information on air p
with their patients.

FIND OUT MORE

Knowledge Hub - Health

Browse the knowledge hub for information and resources on clean air for health professionals.

GO TO THE HUB

https://www.actionforcleanair.org.uk/health/knowledge-hub-health

global action plan

SIGN UP

Home | CAPIT | Business | Health | Schools | Clean Air Day | News & Stories

Training videos

- Air pollution and health
- Talking to patients about air pollution
- Impacts of air pollution on patients

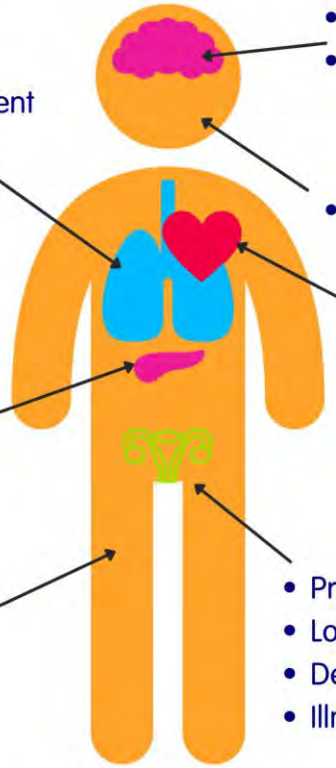
Downloadable resources

We've made a set of downloadable resources for you that you can use with your colleagues and with your patients.

- Guides
- Leaflets and posters
- Reports

How air pollution impacts the body

- Lung diseases
- Asthma
- Lung cancer
- Lung development
- Pneumonia
- Stroke
- Brain development
- Mental health
- Dementia
- Skin ageing
- Heart disease
- High blood pressure
- Insulin resistance & diabetes
- Bone metabolism
- Blood clots
- Premature birth
- Low birthweight
- Decreased sperm quality
- Illness during pregnancy

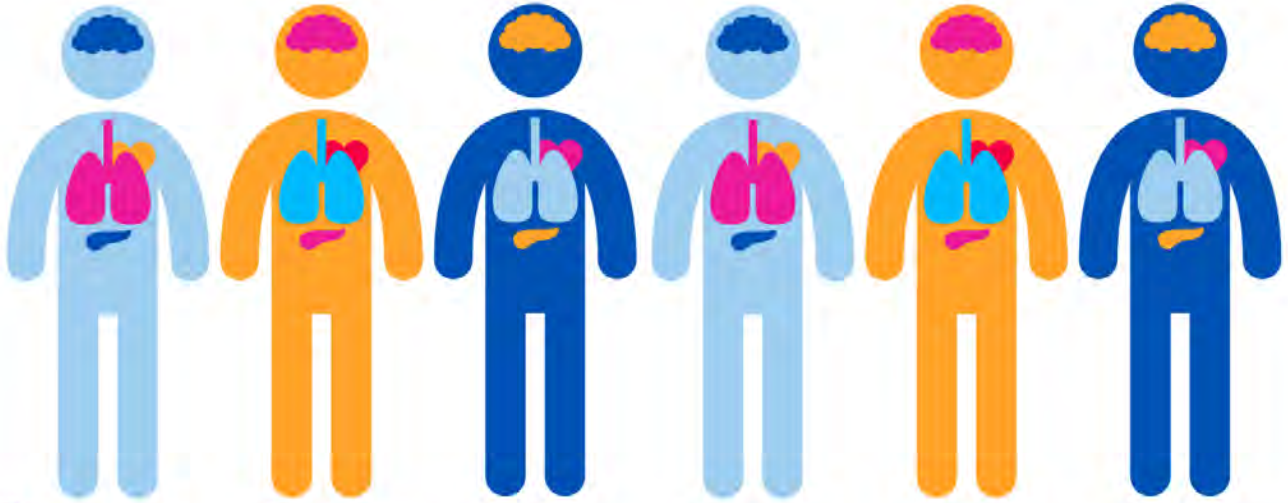


cleanairhub.org.uk

global action plan

Department for Environment Food & Rural Affairs

Air pollution impacts us all



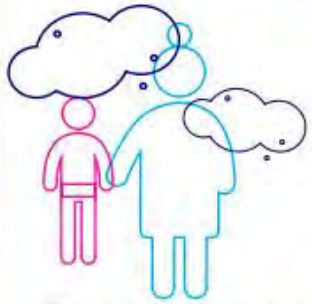
global action plan

cleanairhub.org.uk

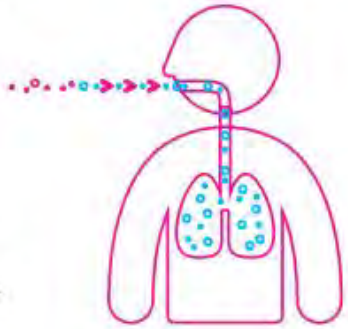
Department for Environment Food & Rural Affairs

Air Pollution & Child Health

How does air pollution damage your child's health?



- Air pollution is generally invisible but affects our health from before birth right through to old age. It enters our lungs when we breathe and gets into our blood, leading to effects throughout the body. There is no safe level of air pollution and there are many causes, inside and outside the home.
- Children are especially sensitive to dirty air because their bodies are still growing. Their lungs, immune systems and brains are impacted by air pollution, and it also affects their ability to learn.
- We are all affected by air pollution whether we live in the town or countryside. It is generally worse near main roads because of traffic and, because children are small, they often are closer to sources of air pollution such as car exhausts.
- Air pollution can play a part in causing asthma and can make symptoms worse.



But there are things we can all do to help.

You can learn more about air pollution and find some simple ways to tackle it and protect your health at

cleanairhub.org.uk

Simple steps can have a big impact on the air your family breathes

Make travel choices for cleaner air

Use people power – Walk, scoot or cycle to school as often as you can.

Discover the side streets – Use quieter streets when you're walking or on a bike to avoid the higher levels of air pollution on main roads.

Don't idle – If you have to drive, turn off the engine when you are not moving, and it is safe to do so. Consider switching to an electric vehicle. Air quality can be worse inside the vehicle than outside.

Make cleaner air decisions in the home

Use fragrance-free, milder cleaning products and avoid plug-in fragrances.

When decorating, choose safer paints and varnishes labelled 'low VOC' (volatile organic compounds).

Ask people not to smoke in your home.

Reduce home burning as much as possible (e.g. log burners, coal fires or candles).

Ventilate your home - Open windows and use extractor fans when cooking or using cleaning products, but close windows near busy roads during rush hours.

global action plan

Department for Environment Food & Rural Affairs

Air Pollution and Children

Air pollution can worsen asthma symptoms including coughing, wheezing and breathlessness. The actions below can help:

1. Discover the side streets

Use quieter roads and paths to keep away from heavy polluting traffic.

2. Leave the car behind

Encourage your whole family to walk, cycle and scoot more - air pollution can be higher inside a car than outside.

3. Turn the engine off

If you do need to use a car, ask the driver to turn the engine off when the car isn't moving.

4. Check the pollution forecast

Check air pollution levels in your local area at uk-air.defra.gov.uk - this site provides hourly measurements and forecasts. Remember that air pollution increases significantly near busy roads, especially during rush hour.

5. Keep the air clean inside too

Use fragrance free and low-chemical cleaning products. Stop air pollution collecting in your home by using extractor fans and opening windows away from busy roads.

You can learn more about air pollution and find some simple ways to tackle it and protect your health at cleanairhub.org.uk

My air pollution plan:

Choose the actions that you and your family are going to do, when you can, to protect your health from air pollution:	Please tick all that apply
We will walk, cycle or scoot to school	❑
We will use quieter routes to avoid roads with heavy traffic	❑
We will turn the engine off when the car is stationary and it is safe	❑
We will leave the car at home whenever we can	❑
I will use my inhaler as recommended by my GP or asthma nurse	❑
I will treat air pollution the same way I treat other asthma triggers	❑
We will buy fragrance-free, milder cleaning products and avoid plug-in fragrances	❑
When decorating, we will choose paints and varnishes labelled "low VOC"	❑
We will ask people not to smoke in our home	❑
We will avoid home burning as much as possible (e.g. log burners, coal fires or candles)	❑
We will turn on the extractor fan when cooking	❑
We will open a window when cooking and cleaning	❑

global action plan

Department for Environment Food & Rural Affairs

Clean air schools

How can we support asthmatic children and benefit all children?

Almost all schools in the UK are in areas with air pollution above safe levels, exposing young people to dangerously high levels in their daily lives.

(based on WHO limits, 2021)

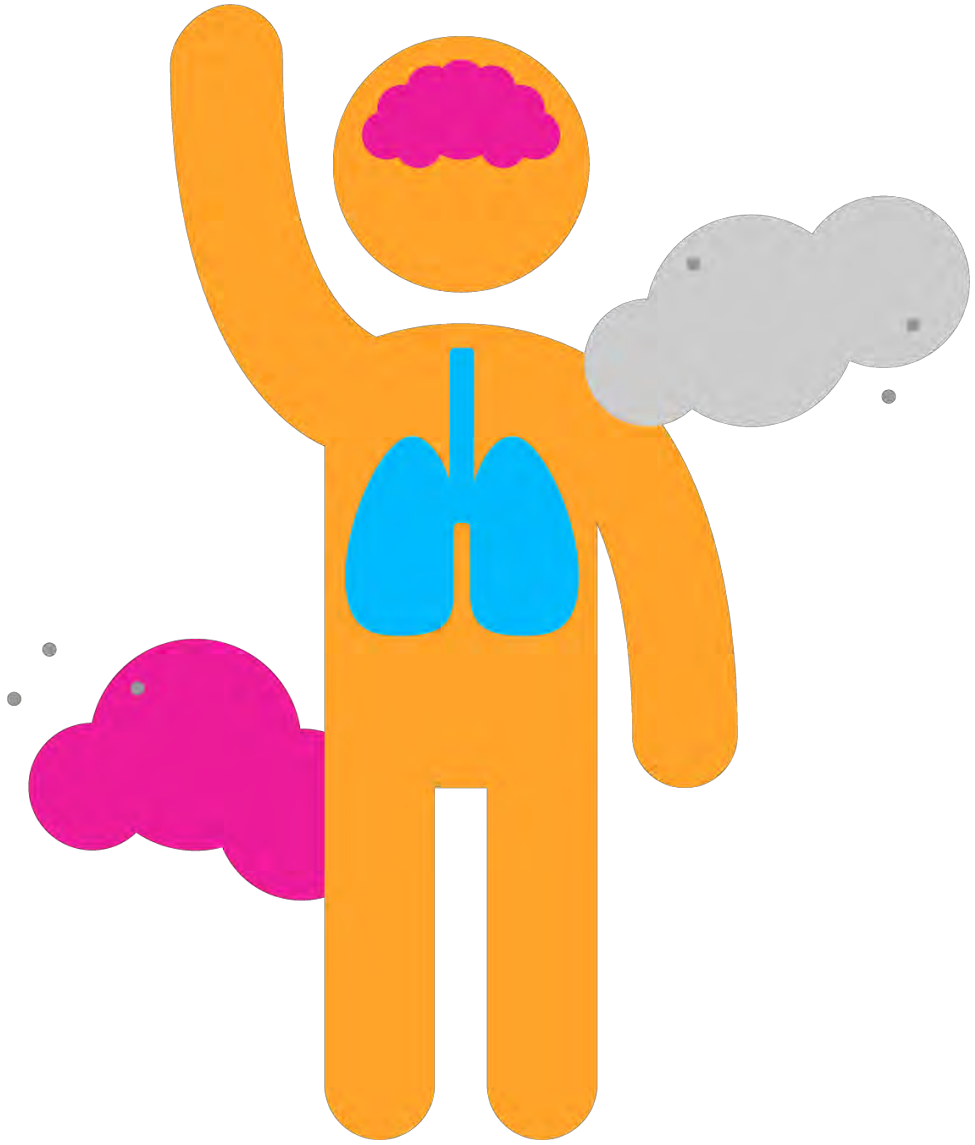
Children are particularly at risk from air pollution

Children's **immune systems, lungs and brains** are still developing.

Air pollution can affect their:

- Physical health
- Mental health
- Ability to learn

Children with **health conditions** are more vulnerable to the impacts of air pollution



Clean air schools benefit asthmatic children and all other children!

Co-benefits of improving air quality in schools

Supports climate change mitigation.

Improves children's ability to learn. Protects their physical/mental health & wellbeing.

Reduces strain on healthcare systems.

Co-benefits of improving air quality in schools

Increases sense of community and provides spaces for children to play.

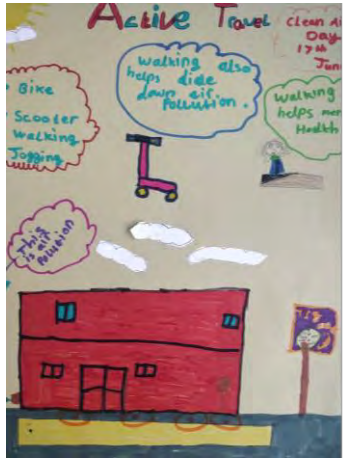
Reduces vehicle usage, lowers emissions and improves air quality.

Creates safer streets & reduces traffic casualties.

Source reduction is key

but it needs policy and legislative support or change

Exposure reduction: within school control, minimal cost



Free or low-cost options and supporting resources

global action plan

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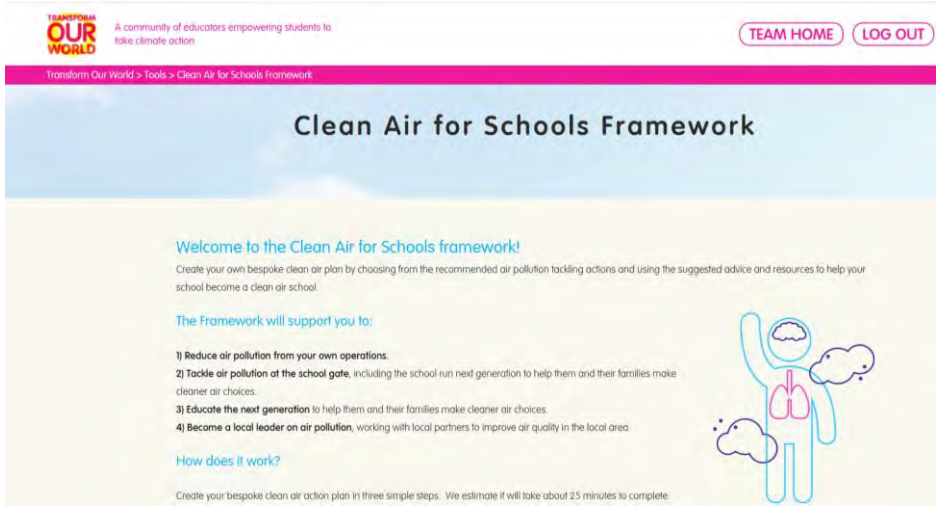
Clean Air for Schools Framework

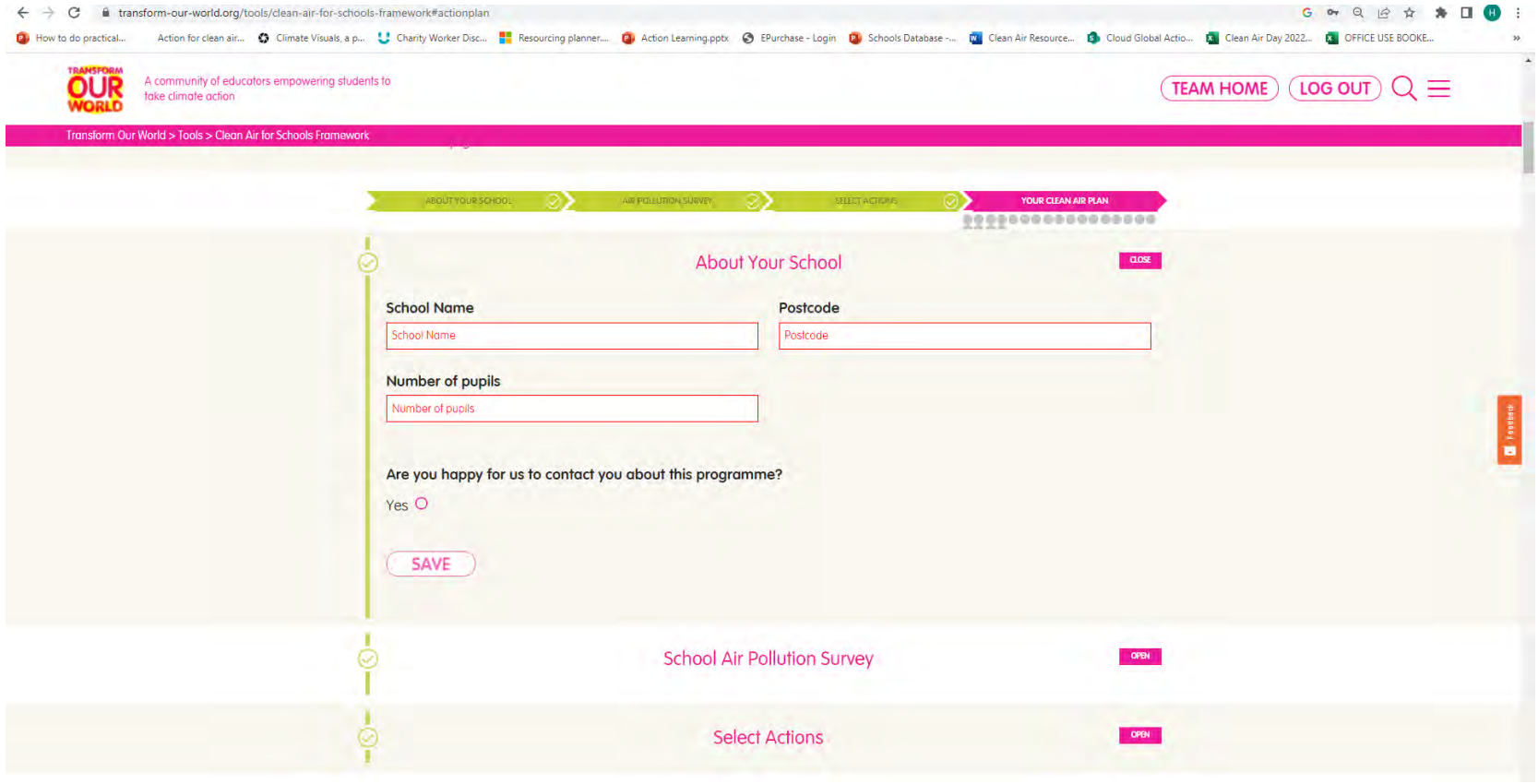


global action plan

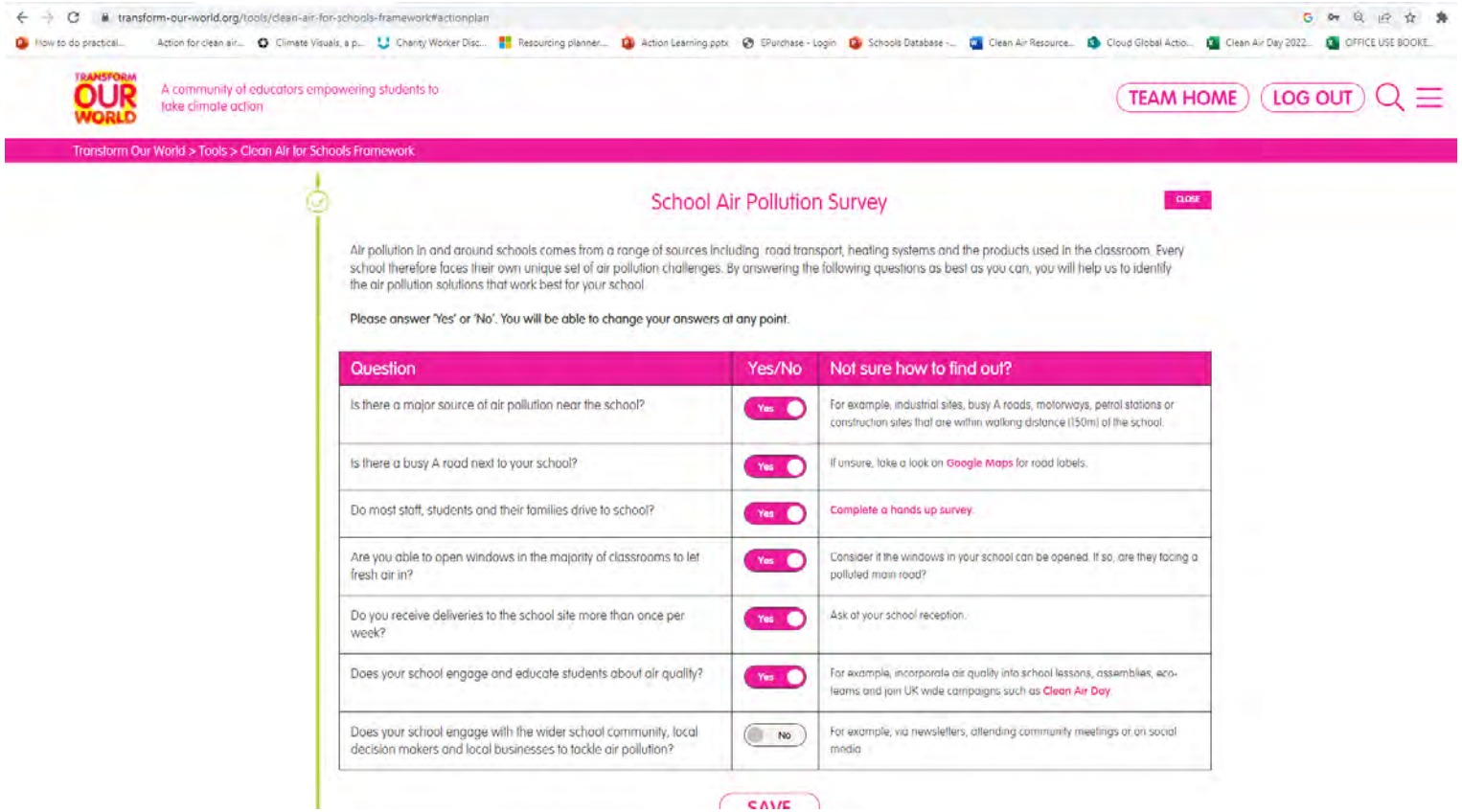
PHILIPS Philips Foundation

MANCHESTER 1824 The University of Manchester

Step 1: enter the school name, postcode & number of pupils

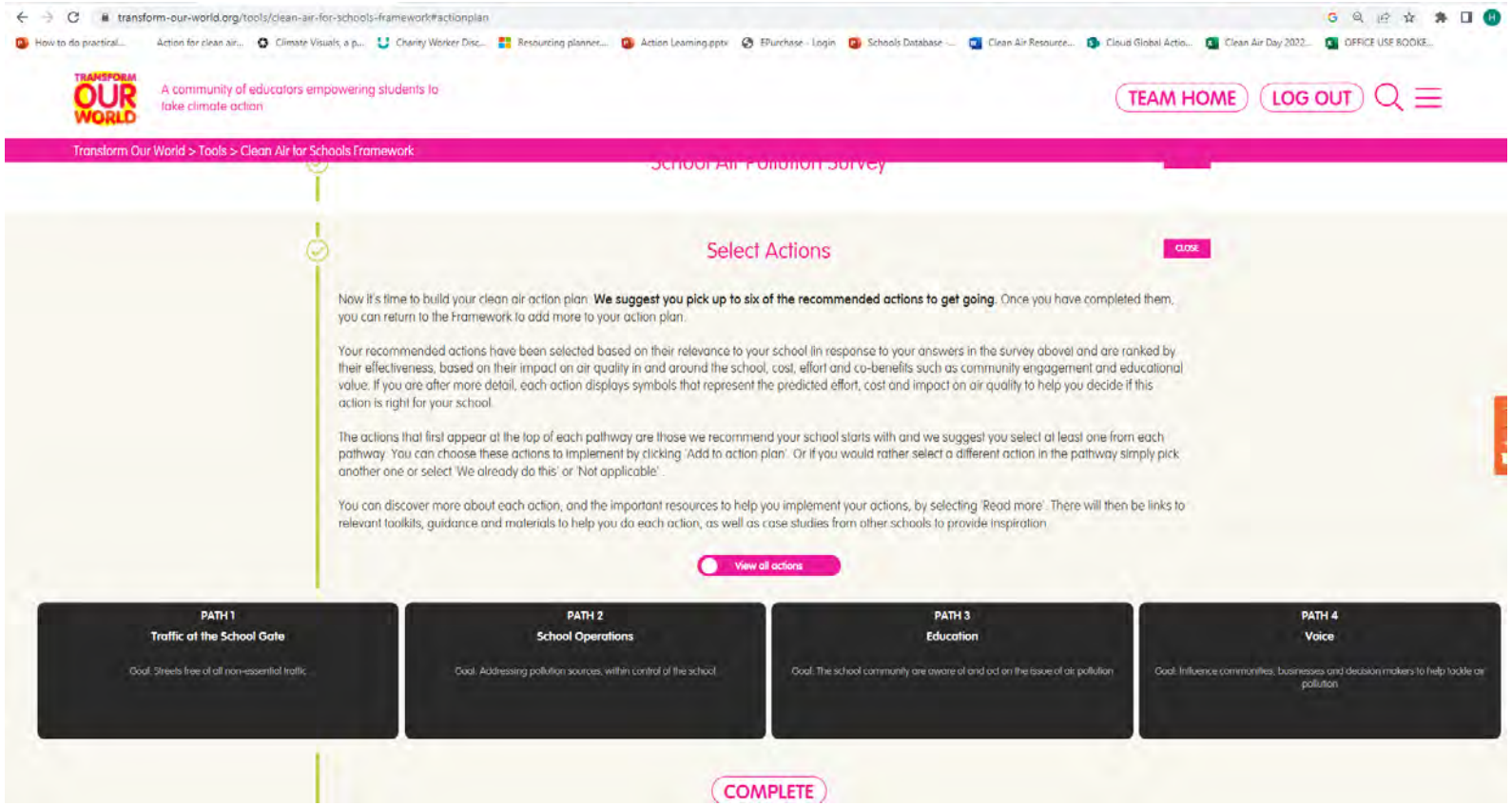


Step 2: Complete a short ‘school air pollution survey’



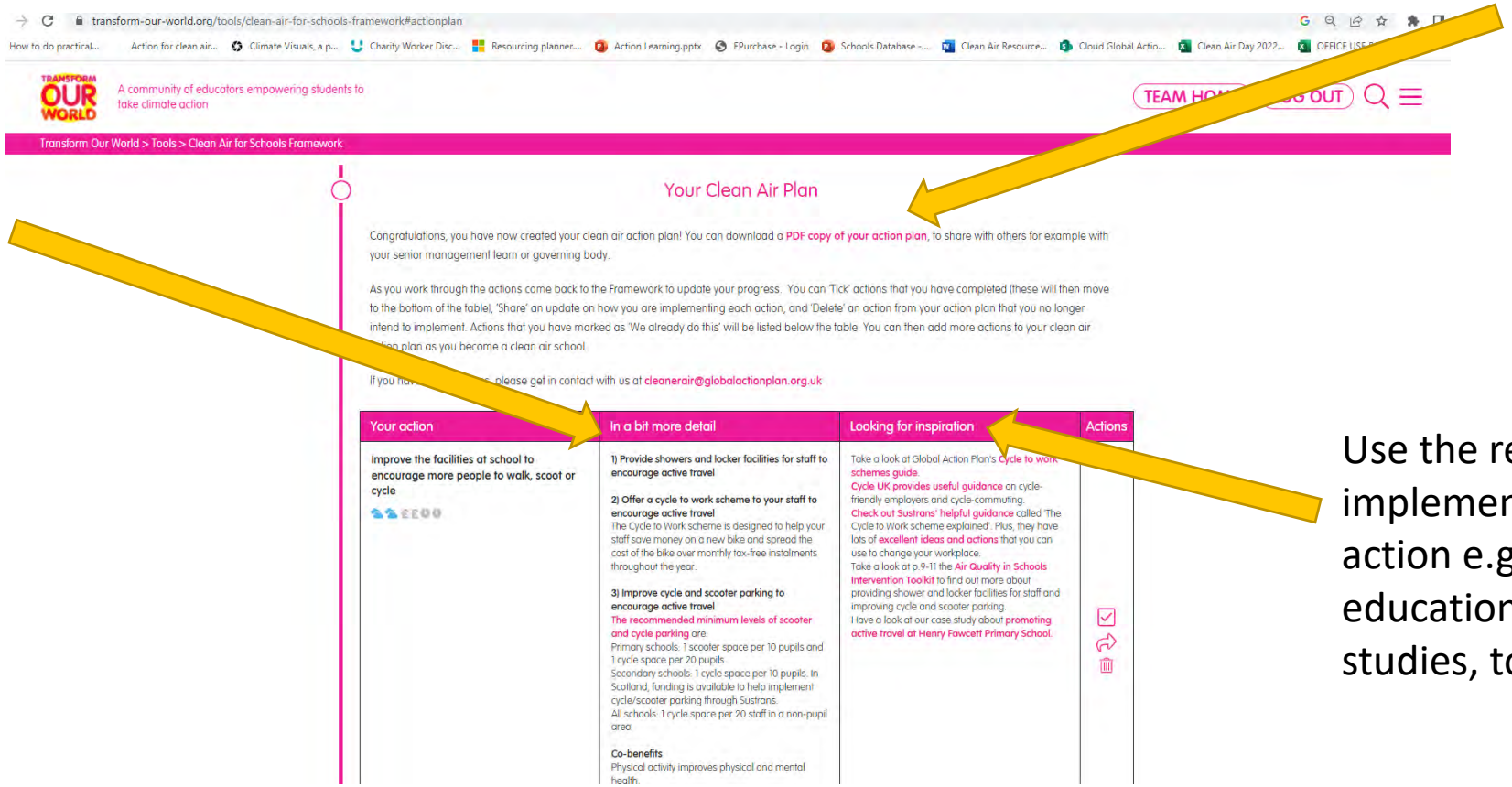
Step 3: select 6 of your recommended actions

(you can add more later if you want to)



Step 4: use your bespoke action plan to help your school become a cleaner air school

Review different options of how the selected action could work best at your school.



Download a PDF copy of your action plan or use the online version.

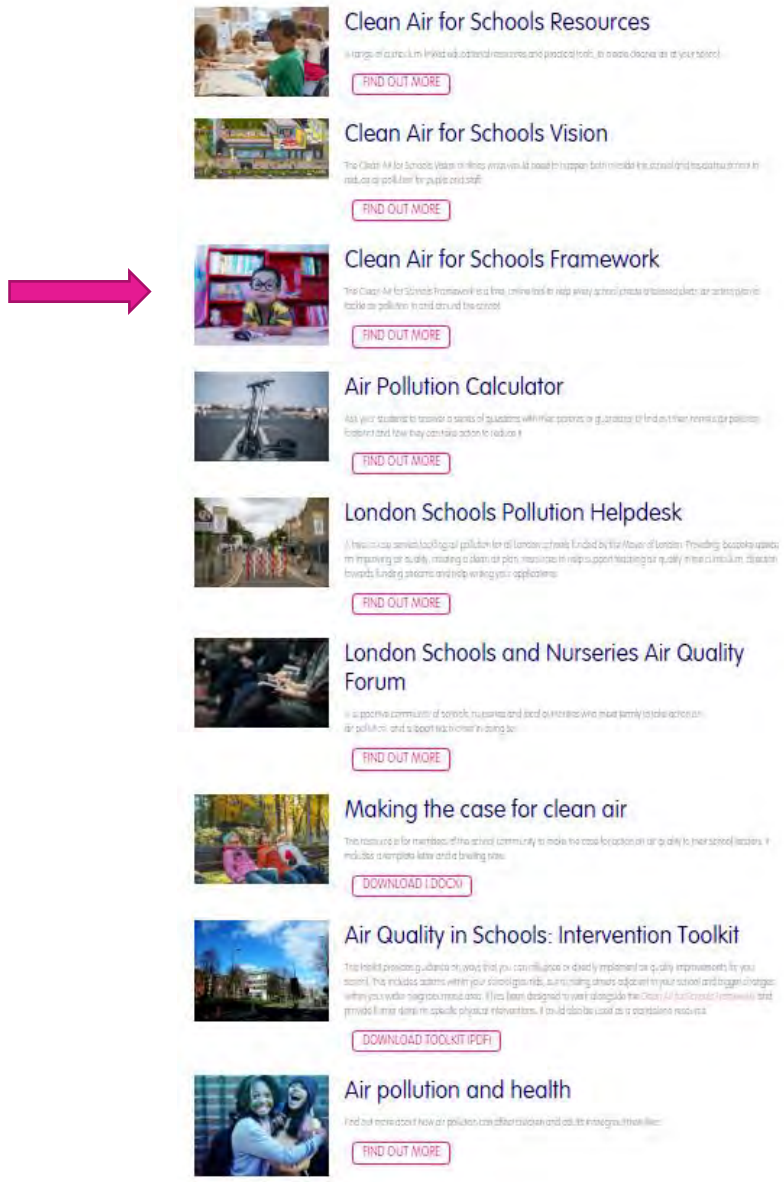
Use the resources to help implement your chosen action e.g. curriculum linked education materials, case studies, toolkits and guides.

Everything you need to know about air pollution in one place

www.actionforcleanair.org.uk

Free resources for schools – collated in one place:

https://www.actionforcleanair.org.uk/schools

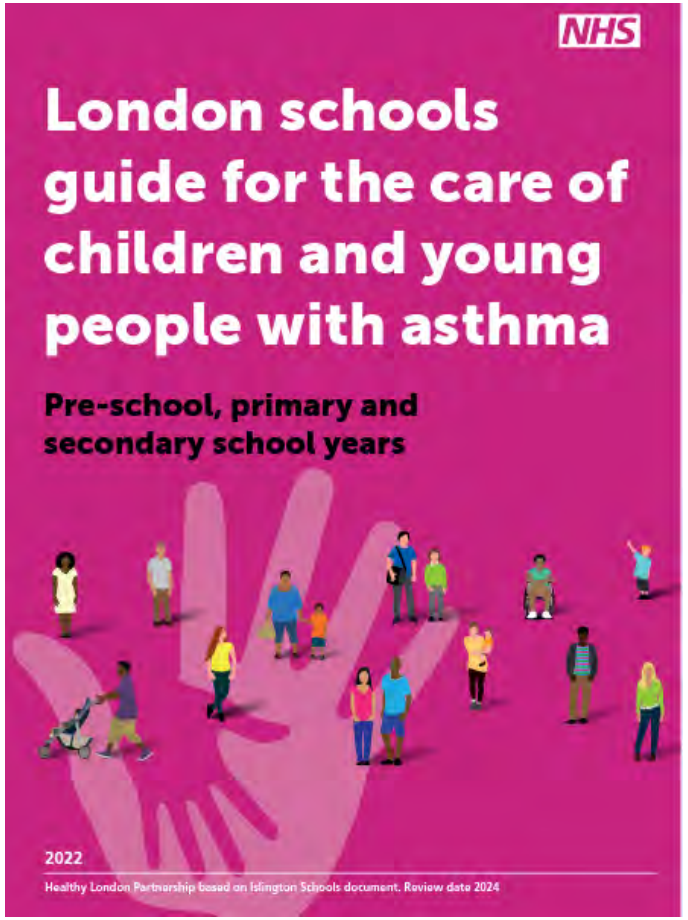


Could clean air be part of asthma friendly schools?

- NHS colleagues asked GAP to review guide and provide practical suggestions to include clean air.

Global Action Plan's suggested approach:

- Main focus must always be asthma
- Clean air schools benefit asthmatic individuals and have wider benefits
- Suggested adding *"create a clean air action plan using the Clean Air for Schools Framework. Start working towards completing 6 actions."*
- Focus is on completing the self-audit and 'working towards', not completing all actions.



Thank you!

Any questions or reflections?

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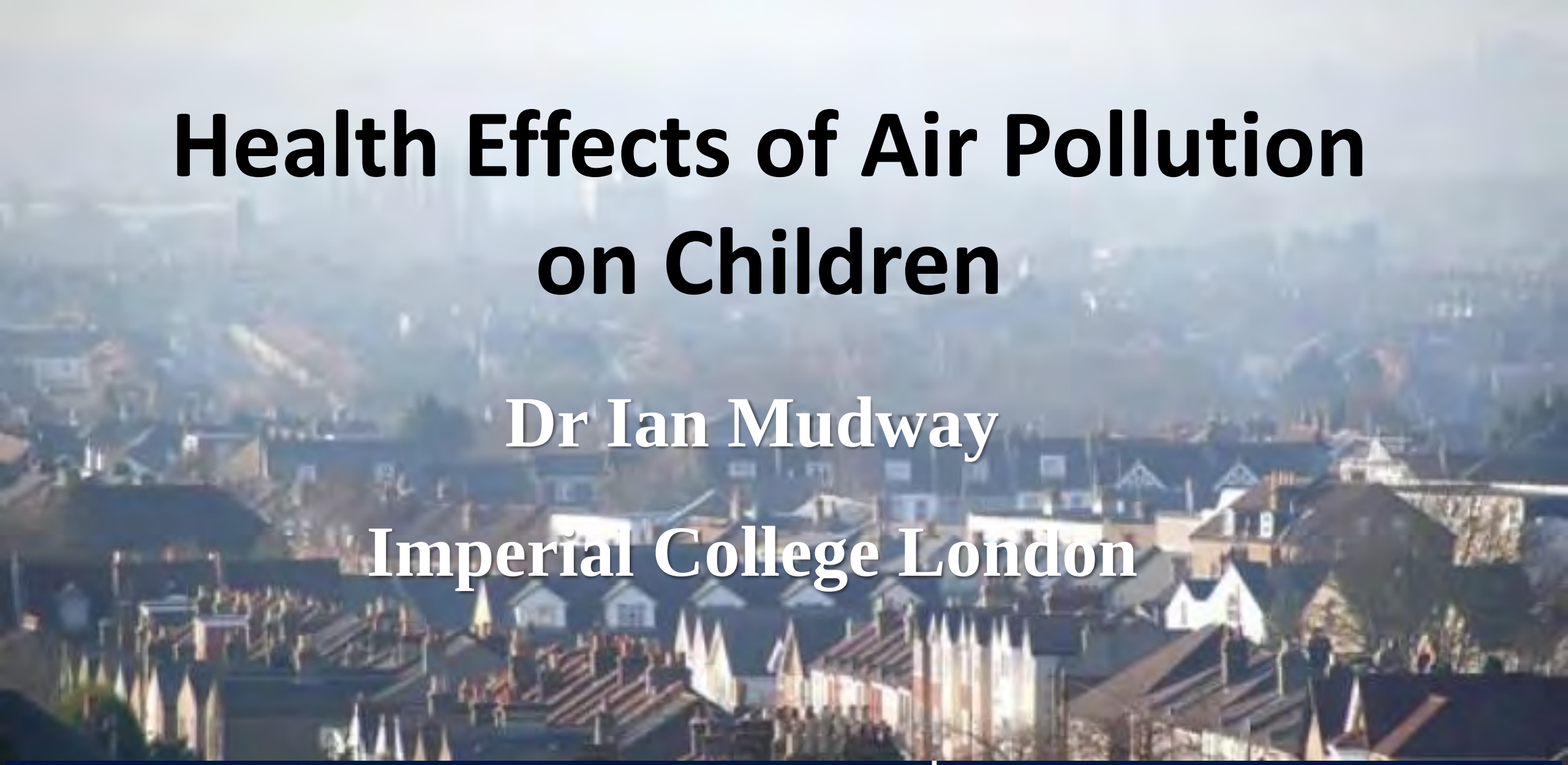
Health Effects of Air Pollution on Children

Dr Ian Mudway

Imperial College London



MRC Centre for Environment & Health

Medical Research Council

Imperial College London

NIHR | Health Protection Research Unit in Environmental Exposures and Health at Imperial College London

NIHR | Health Protection Research Unit in Chemical and Radiation Threats and Hazards at Imperial College London

Impacts of Air Pollution across the Life Course

Low birth weight

Smaller lungs
Cognitive ability?

Increased risk of chronic disease
Acute respiratory exacerbations

Acute and chronic
Premature death
Dementia

London's road traffic air and noise pollution on birth weight

OPEN ACCESS

Impact of London's road traffic air and noise pollution on birth weight: retrospective population based cohort study

Rachel B Smith,[1,2] Daniela Fecht,[3] John Gulliver,[1] Sean D Beevers,[4] David Dajnak,[4] Marta Blangiardo,[3] Rebecca E Ghosh,[3] Anna L Hansell,[2,3] Frank J Kelly,[2,4] H Ross Anderson,[4,5] Mireille B Toledano[1,2]

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[2]NIHR HPRU in Health Impact of Environmental Hazards, King's College London, London, UK
[3]UK Small Area Health Statistics Unit, MRC-PHE Centre for Environment and Health, Department of Epidemiology and Biostatistics, School of Public Health, Imperial College London, London, UK
[4]MRC-PHE Centre for Environment and Health, Environmental Research

ABSTRACT

OBJECTIVE
To investigate the relation between exposure to both air and noise pollution from road traffic and birth weight outcomes.

DESIGN
Retrospective population based cohort study.

SETTING
Greater London and surrounding counties up to the M25 motorway (2317 km²), UK, from 2006 to 2010.

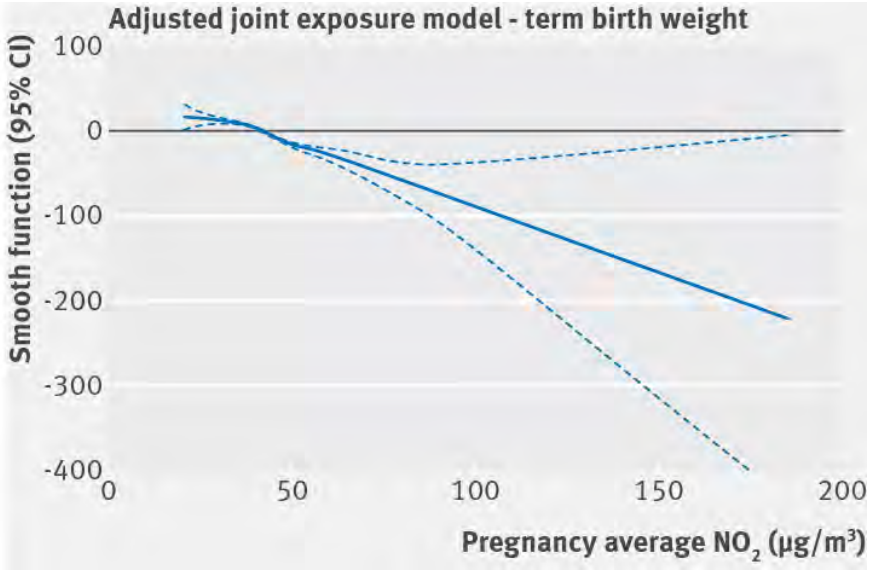
PARTICIPANTS
540 365 singleton term live births.

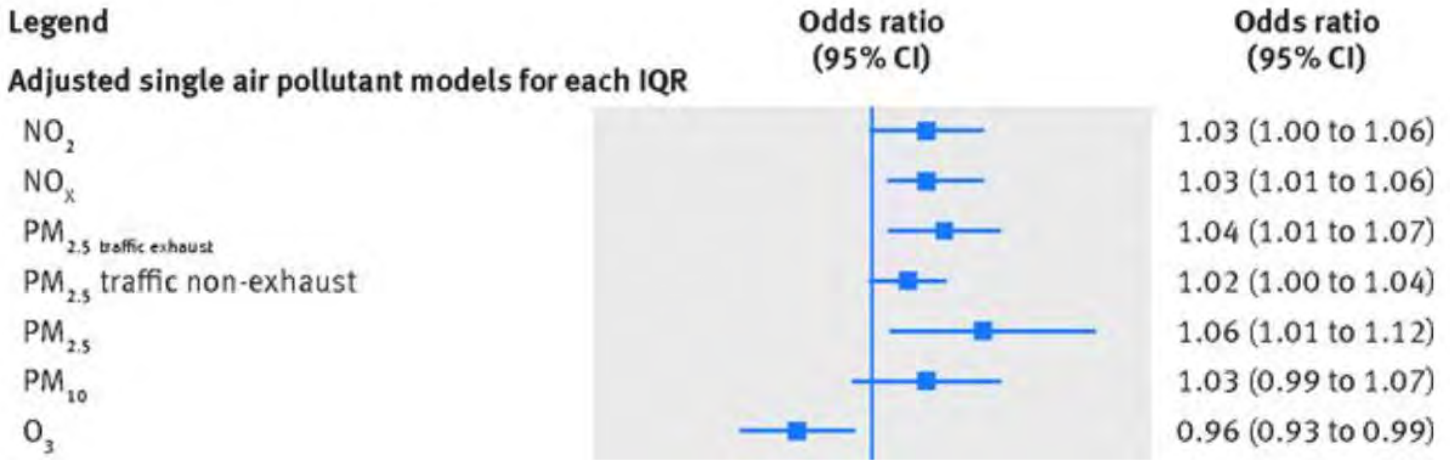
MAIN OUTCOME MEASURES
Term low birth weight (LBW), small for gestational age (SGA) at term, and term birth weight.

RESULTS
increased odds of term SGA. Air pollutant associations were robust to adjustment for road traffic noise. Trends of decreasing birth weight across increasing road traffic noise categories were observed, but were strongly attenuated when adjusted for primary traffic related air pollutants. Only $PM_{2.5\ traffic\ exhaust}$ and $PM_{2.5}$ were consistently associated with increased risk of term LBW after adjustment for each of the other air pollutants. It was estimated that 3% of term LBW cases in London are directly attributable to residential exposure to $PM_{2.5}$>13.8 µg/m³during pregnancy.

CONCLUSIONS
The findings suggest that air pollution from road traffic in London is adversely affecting fetal growth. The results suggest little evidence for an independent exposure-response effect of traffic related noise on birth weight outcomes.

Odds of term low birth weight (LBW) associated with air pollutants





Asthma

Ashworth et al. Environmental Health (2021) 20:54
https://doi.org/10.1186/s12940-021-00730-1

Environmental Health

RESEARCH Open Access

Spatio-temporal associations of air pollutant concentrations, GP respiratory consultations and respiratory inhaler prescriptions: a 5-year study of primary care in the borough of Lambeth, South London

Mark Ashworth[1*], Antonis Analitis[2], David Whitney[1], Evangelia Samoli[2], Sofia Zafeiratou[2], Richard Atkinson[3], Konstantina Dimakopoulou[2], Sean Beavers[1,4], Joel Schwartz[5], Klea Katsouyanni[2,4] on behalf of the STEAM project research group

Abstract

Background: Although the associations of outdoor air pollution exposure with mortality and hospital admissions are well established, few previous studies have reported on primary care clinical and prescribing data. We assessed the associations of short and long-term pollutant exposures with General Practitioner respiratory consultations and inhaler prescriptions.

Methods: Daily primary care data, for 2009–2013, were obtained from Lambeth DataNet (LDN), an anonymised dataset containing coded data from all patients (1.2 million) registered at general practices in Lambeth, an inner-city south London borough. Counts of respiratory consultations and inhaler prescriptions by day and Lower Super Output Area (LSOA) of residence were constructed. We developed models for predicting daily $PM_{2.5}$, PM_{10}, NO_2 and O_3 per LSOA. We used spatio-temporal mixed effects zero inflated negative binomial models to investigate the simultaneous short- and long-term effects of exposure to pollutants on the number of events.

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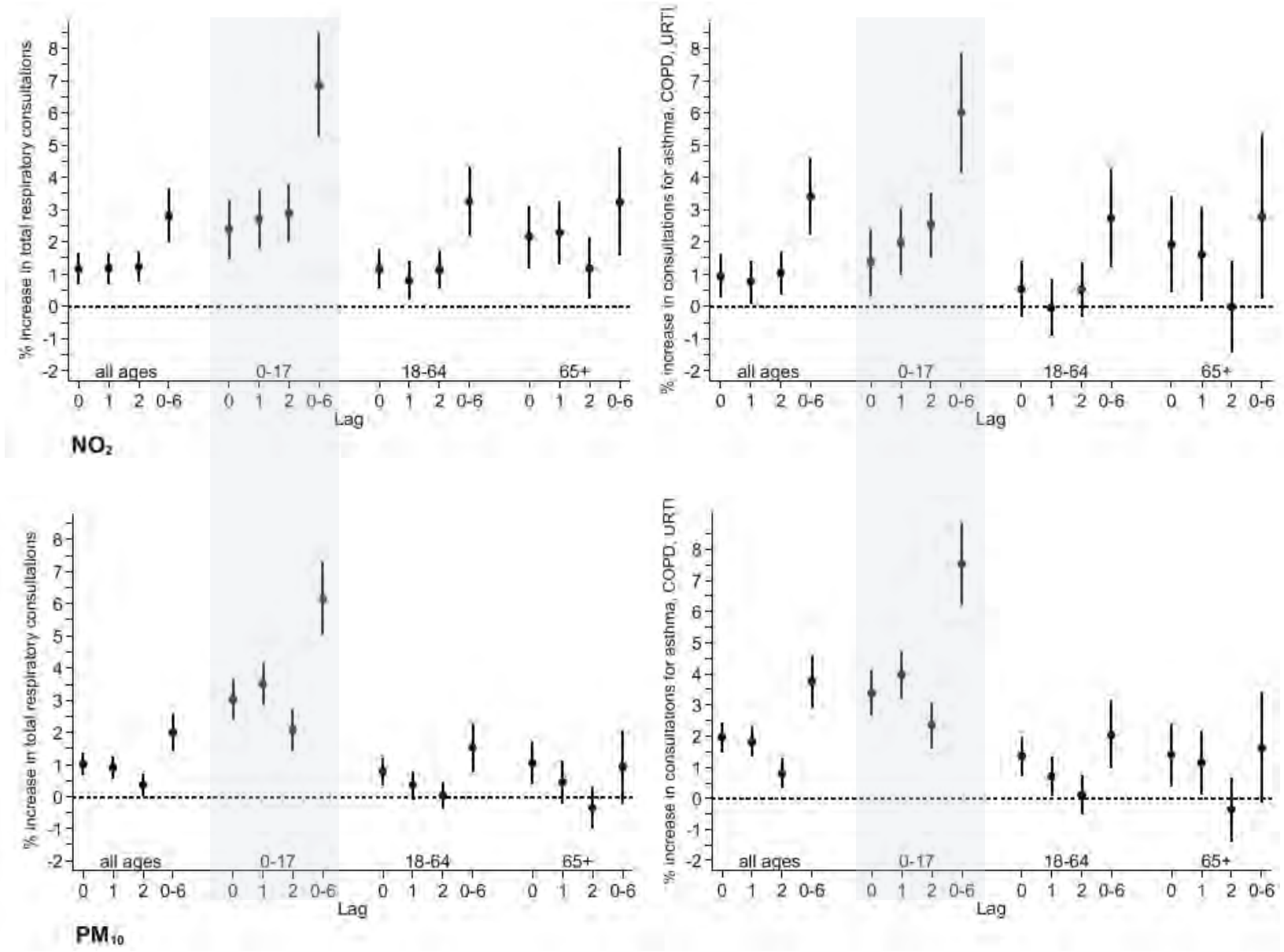


Causes for Optimism

The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 MARCH 5, 2015 VOL. 372 NO. 10

Association of Improved Air Quality with Lung Development in Children

W. James Gauderman, Ph.D., Robert Urman, M.S., Edward Avol, M.S., Kiros Berhane, Ph.D., Rob McConnell, M.D., Edward Rappaport, M.S., Roger Chang, Ph.D., Fred Lurmann, M.S., and Frank Gilliland, M.D., Ph.D.

ABSTRACT

BACKGROUND

Air-pollution levels have been trending downward progressively over the past several decades in southern California, as a result of the implementation of air quality–control policies. We assessed whether long-term reductions in pollution were associated with improvements in respiratory health among children.

METHODS

As part of the Children's Health Study, we measured lung function annually in 2120 children from three separate cohorts corresponding to three separate calendar periods: 1994–1998, 1997–2001, and 2007–2011. Mean ages of the children within each cohort were 11 years at the beginning of the period and 15 years at the end. Linear-regression models were used to examine the relationship between declining pollution levels over time and lung-function development from 11 to 15 years of age, measured as the increases in forced expiratory volume in 1 second (FEV_1) and forced vital capacity (FVC) during that period (referred to as 4-year growth in FEV_1 and FVC).

RESULTS

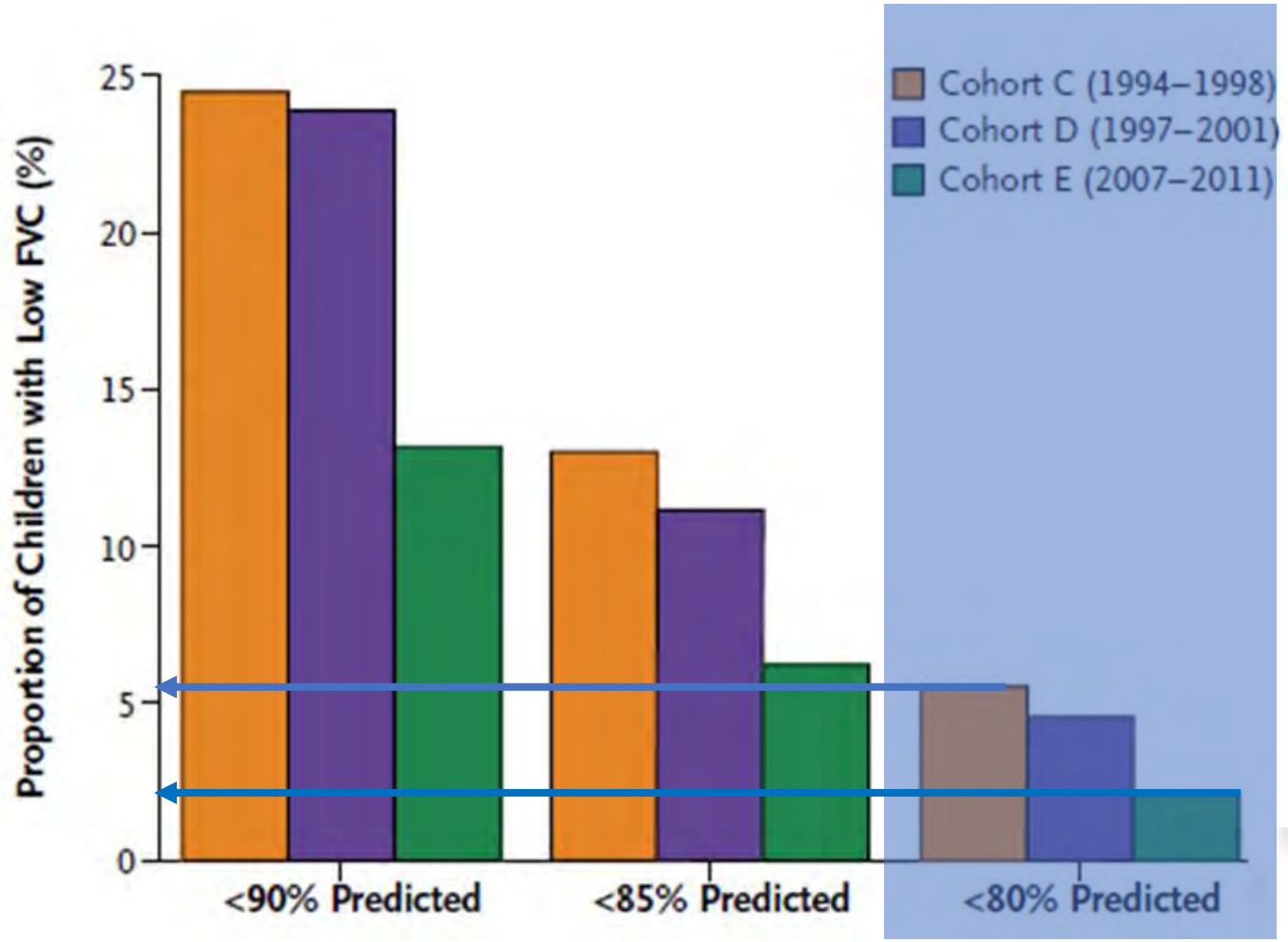
Over the 13 years spanned by the three cohorts, improvements in 4-year growth of both FEV_1 and FVC were associated with declining levels of nitrogen dioxide ($P<0.001$ for FEV_1 and FVC) and of particulate matter with an aerodynamic diameter of less than 2.5 μm ($P=0.008$ for FEV_1 and $P<0.001$ for FVC) and less than 10 μm ($P<0.001$ for FEV_1 and FVC). These associations persisted after adjustment for several potential confounders. Significant improvements in lung-function development were observed in both boys and girls and in children with asthma and children without asthma. The proportions of children with clinically low FEV_1 (defined as <80% of the predicted value) at 15 years of age declined significantly, from 7.9% to 6.3% to 3.6% across the three periods, as the air quality improved ($P=0.001$).

CONCLUSIONS

We found that long-term improvements in air quality were associated with statistically and clinically significant positive effects on lung-function growth in children. (Funded by the Health Effects Institute and others.)

From the Department of Preventive Medicine, University of Southern California, Los Angeles (W.J.G., R.U., E.A., K.B., R.M., E.R., R.C., F.G.) and Sonoma Technologies, Petaluma (F.L.) — both in California. Address reprint requests to Dr. Gauderman at the Department of Preventive Medicine, University of Southern California, 2001 Soto St., 202-K, Los Angeles, CA 90032, or at jimg@usc.edu.

N Engl J Med 2015;372:905-13.
DOI: 10.1056/NEJMoa1414123




16 pm
Ultra low emission
ULEZ
ZONE
At all times

Operating 24/7

ULEZ central London from 8 April 2019

in the same area as the Congestion Charge

ULEZ extension to inner London from 25 Oct 2021

up to North and South Circular roads, including existing central London zone

(all vehicles)

LEZ London-wide from 26 Oct 2020

(lorries and other vehicles more than 3.5 tonnes)

Greater London Authority Boundary

For a full list of affected vehicles see **tfl.gov.uk/ulez**


NO 2 ULEZ
Action Against ULEZ Extension
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STOP
THE
TOXIC
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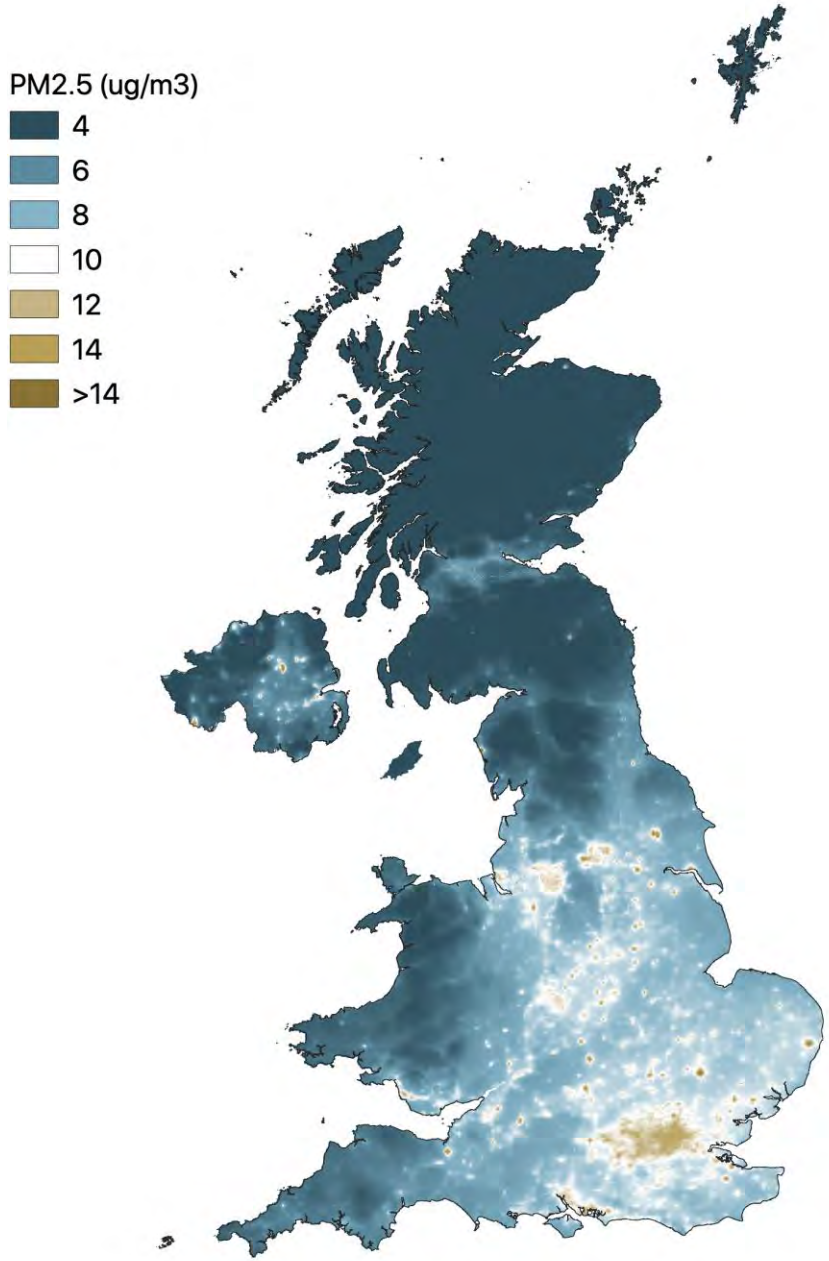
PM2.5 (ug/m3)
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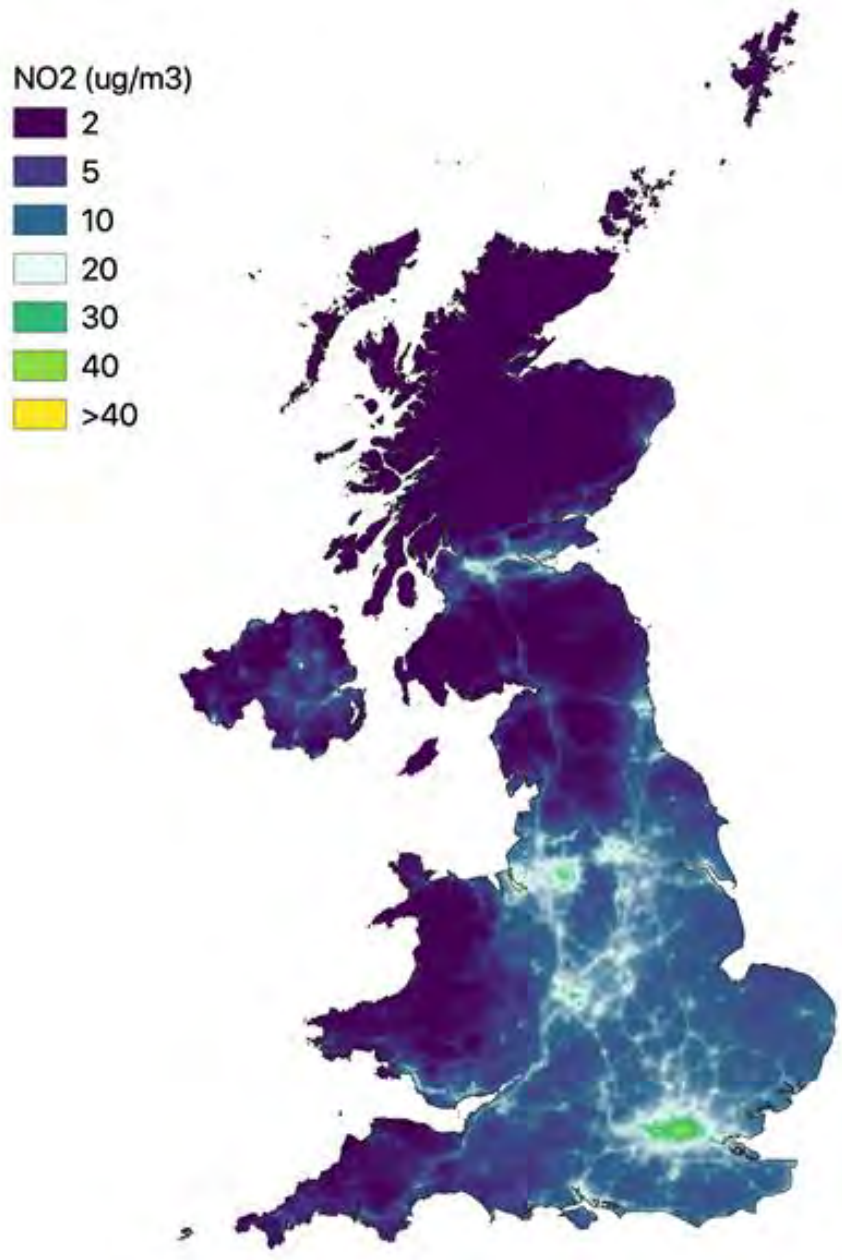
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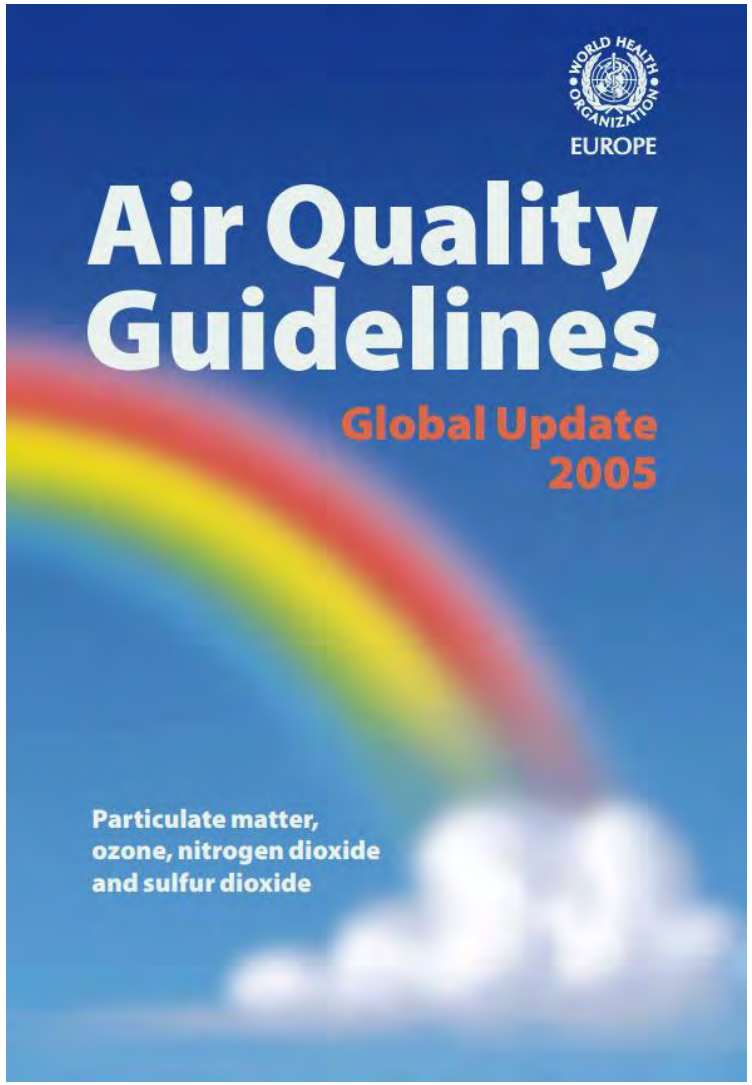
WORLD HEALTH ORGANIZATION
EUROPE
Air Quality Guidelines
Global Update 2005
Particulate matter, ozone, nitrogen dioxide and sulfur dioxide


WHO global air quality guidelines
Particulate matter ($PM_{2.5}$ and PM_{10}), ozone, nitrogen dioxide, sulfur dioxide and carbon monoxide
Executive summary
World Health Organization

Recommended AQG – with interim targets

Pollutant	Averaging time	Interim target				AQG level
		1	2	3	4	
$PM_{2.5}$, µg/m³	Annual	35	25	15	10	5
	24-hour[a]	75	50	37.5	25	15
PM_{10}, µg/m³	Annual	70	50	30	20	15
	24-hour[a]	150	100	75	50	45
O_3, µg/m³	Peak season[b]	100	70	–	–	60
	8-hour[a]	160	120	–	–	100
NO_2, µg/m³	Annual	40	30	20	–	10
	24-hour[a]	120	50	–	–	25
SO_2, µg/m³	24-hour[a]	125	50	–	–	40
CO, mg/m³	24-hour[a]	7	–	–	–	4

[a] 99th percentile (i.e. 3–4 exceedance days per year).
[b] Average of daily maximum 8-hour mean O_3 concentration in the six consecutive months with the highest six-month running-average O_3 concentration.


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Environmental Research Group
Impacts of air pollution across the life course – evidence highlight note
Independent analysis prepared by:
Gary Fuller, Stav Friedman and Ian Mudway
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Air pollution