# *La contaminació del aire i els seus efectes*

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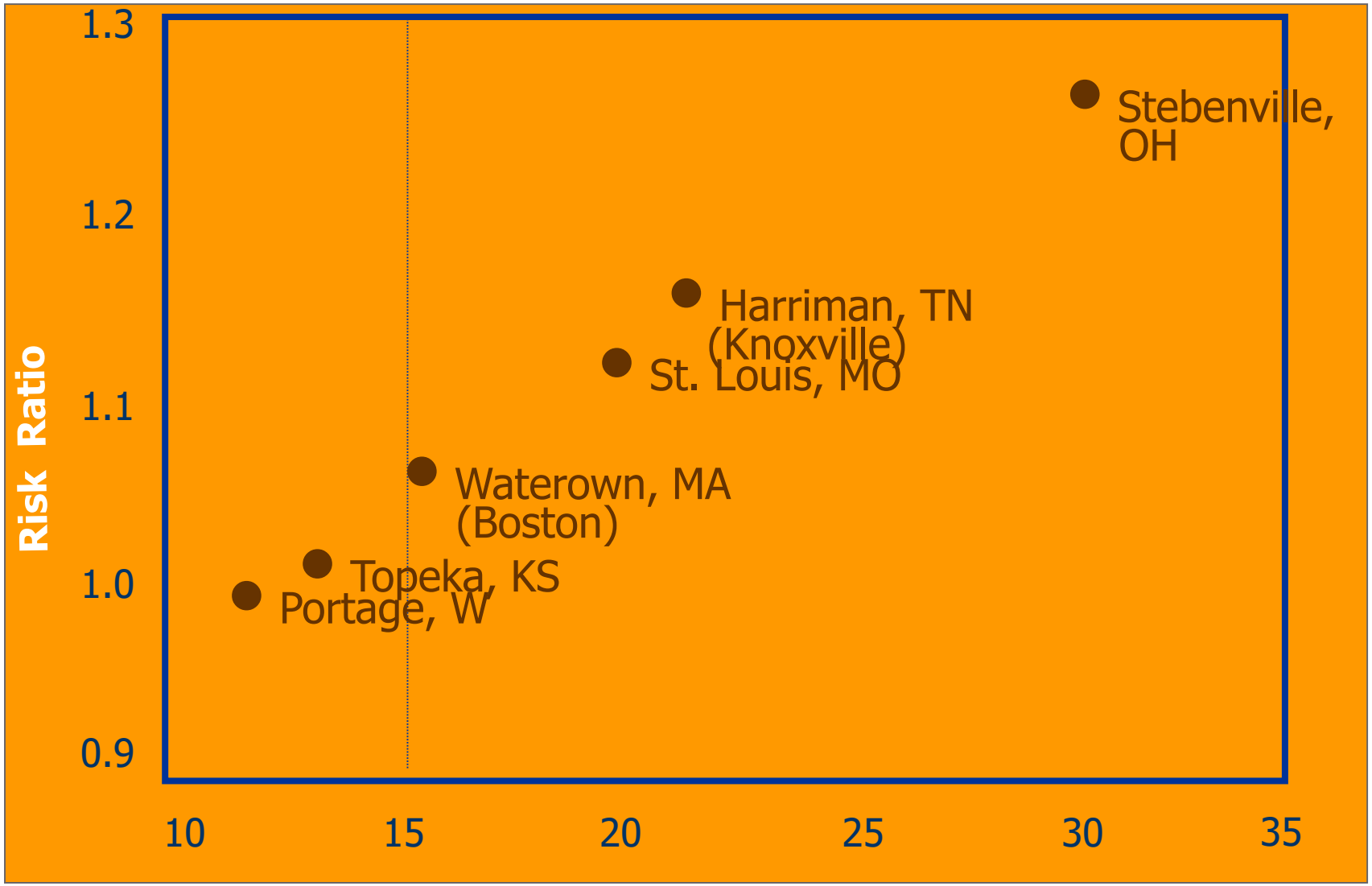
ISGlobal
Institut de Salut Global Barcelona
Una iniciativa de:

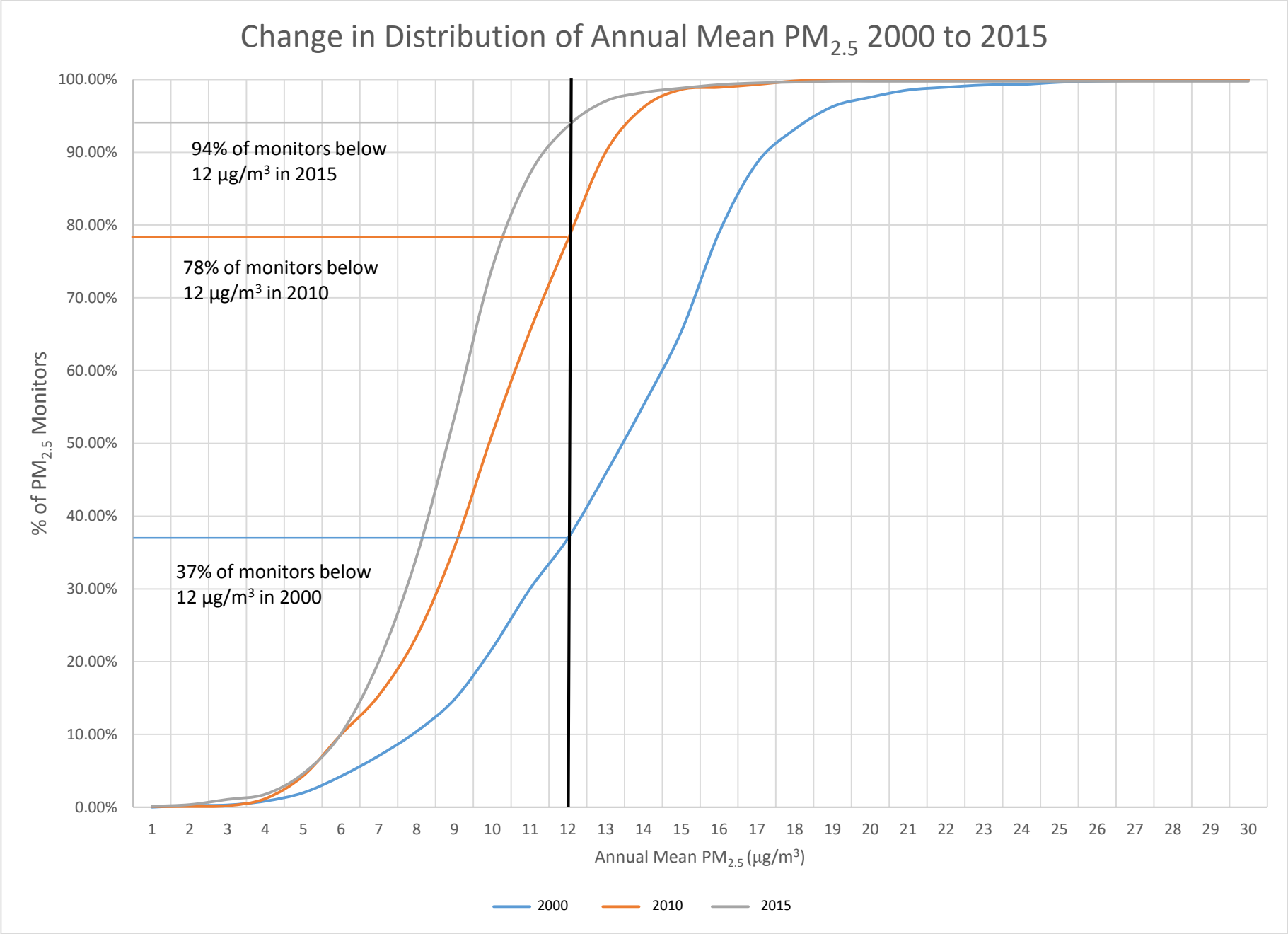
Institució CERCA
Centres de Recerca de Catalunya

Obra Social "la Caixa" · Clínic Barcelona Hospital Universitari · Parc de Salut Mar · Universitat de Barcelona · Universitat Pompeu Fabra Barcelona · Generalitat de Catalunya · Gobierno de España · Ajuntament de Barcelona · Fundación Ramón Areces

The six cities study:
$PM_{2.5}$ –MORTALITY (Dockery , NEJM 1993)

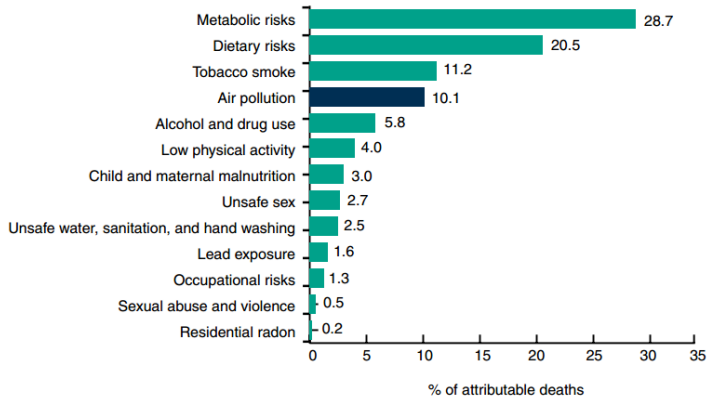


# CHANGE in PM2.5 DISTRIBUTION LOS ANGELES



# Why air pollution

**FIGURE 1.1 Percentage of Attributable Deaths by Risk Factor: Globally, 2013**




*Sources:* World Bank and IHME, using data from IHME, GBD 2013.

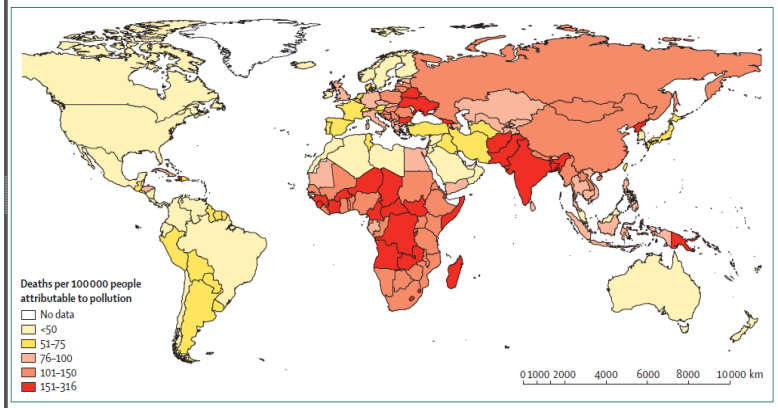



*Figure 8:* Number of deaths per 100 000 people that are attributable to all forms of pollution, 2015
GBD Study, 2016.[42]

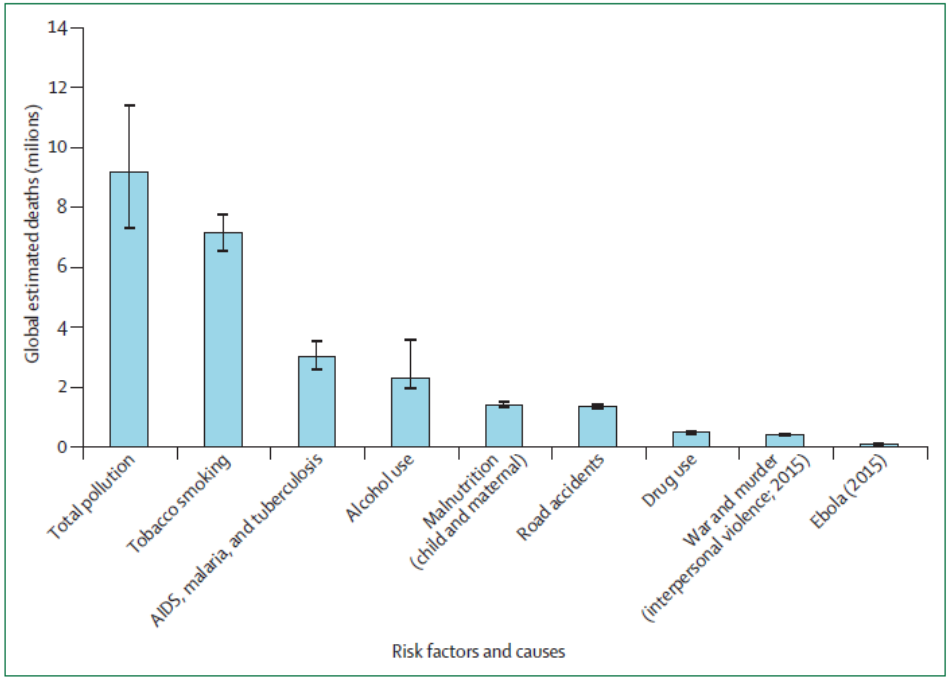
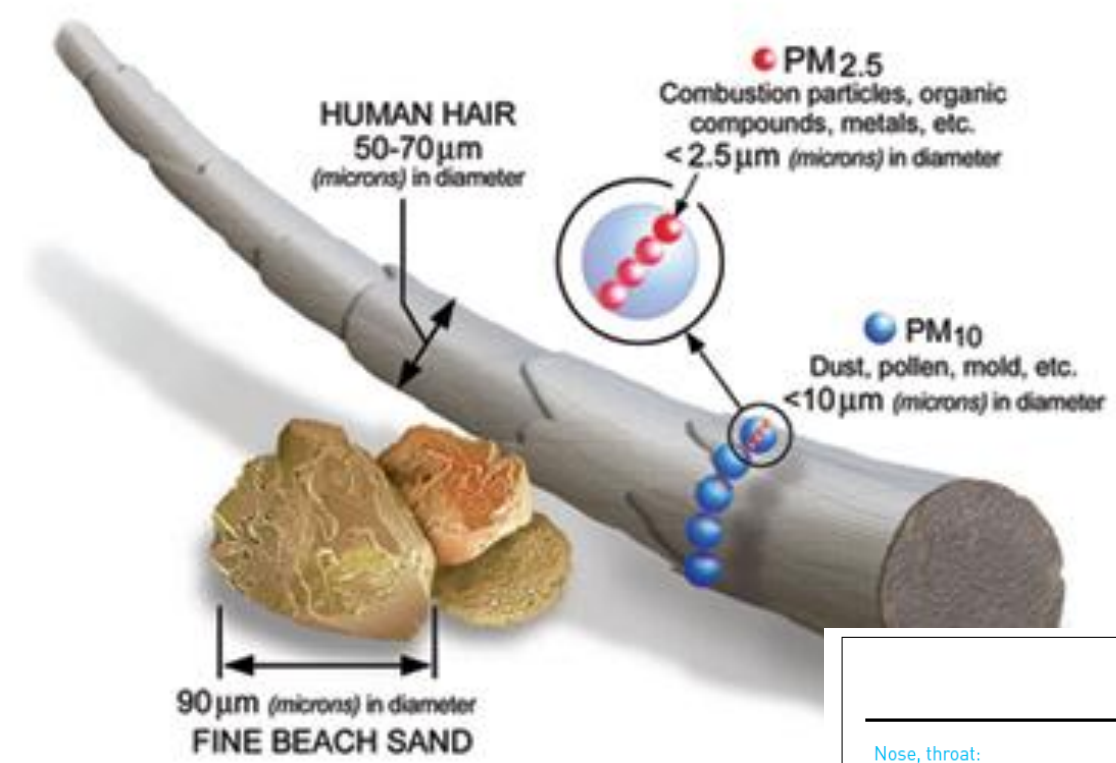
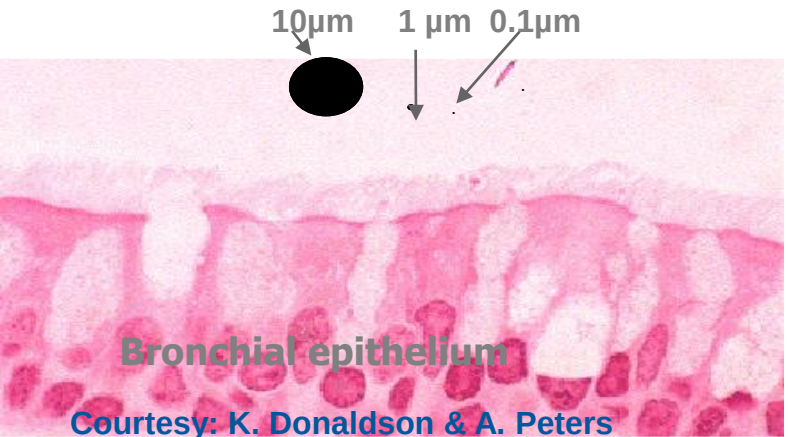



*Figure 5:* Global estimated deaths by major risk factor and cause, 2015
Using data from the GBD Study, 2016.[41]

# How Big is Particle Pollution?

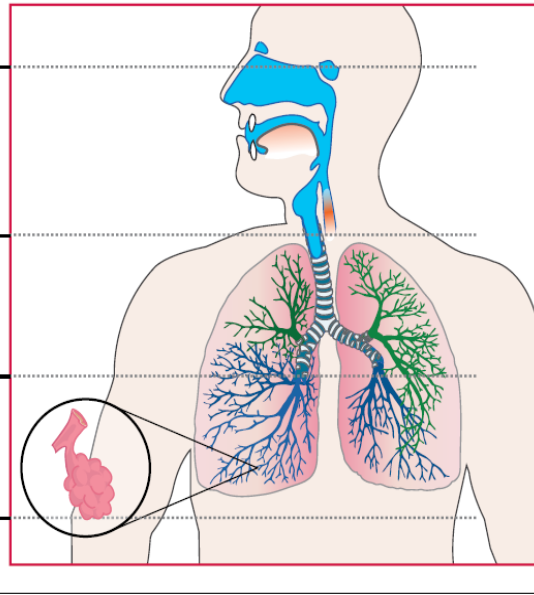



- Gases (NO2)
- Particles (PM2.5, UFP)
  - Organic comp.
  - Soot particles
  - Metals…




Courtesy: K. Donaldson & A. Peters

| | |
|---|---|
| Nose, throat: | Particles <30 µm |
| Trachea, bronchi, bronchioli: | Particles <10 µm<br>$SO_2$, $NO_2$, ozone |
| Pulmonary alveoli: | Particles <2–3 µm<br>$NO_2$, ozone |
| Pulmonary tissue, circulation: | Ultrafine particles <0.1 µm |



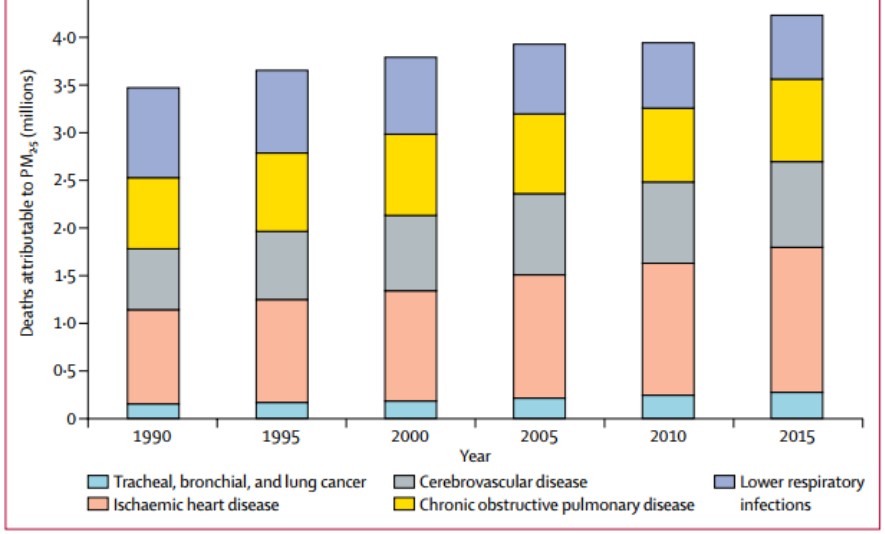



***Figure 4:*** **Deaths attributable to ambient particulate matter pollution by year and cause**
$PM_{2.5}$=particle mass with aerodynamic diameter less than 2·5 µm.

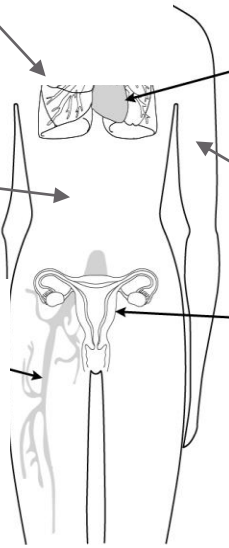
# Air pollution affects multiple organs immediately and has long-term consequences: the FOURTH CAUSE of DEATH

Cohen A. Lancet 2017

- **Respiratory Disease Mortality**
- **Respiratory Disease Morbidity**
- **Lung Cancer**
- **Pneumonia**
- Upper and lower respiratory symptoms
- Airway inflammation
- Decreased lung function
- Decreased lung growth
- Insulin Resistance
- **Type 2 diabetes**
- **Type 1 diabetes**
- Bone metabolism

- **Stroke**
- Neurological development
- Mental Health
- **Neurodegenerative diseases**

- **Cardiovascular Disease Mort**
- **Cardiovascular Disease Morb**
- **Myocardial Infarction**
- **Arrhythmia**
- **Congestive Heart Failure**
- Changes in Heart Rate Variabil
- ST-Segment Depression
- Skin Aging

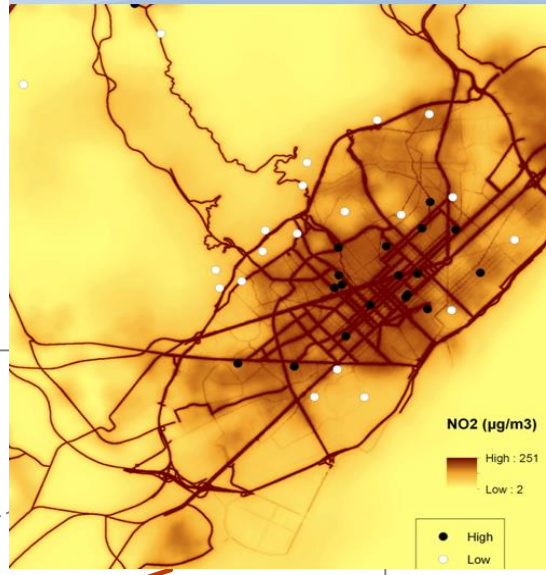


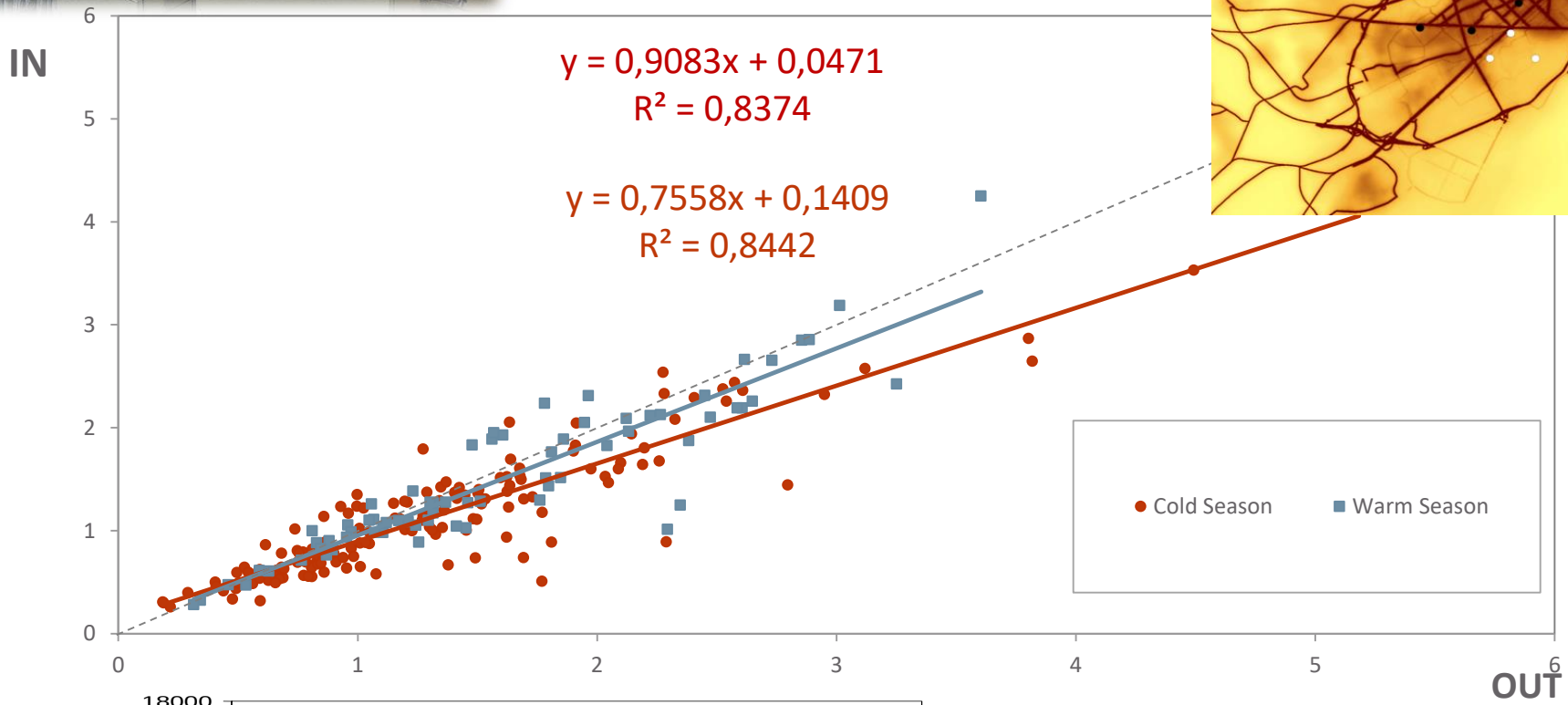
Joint ERS / ATS statement (ERJ 2017)

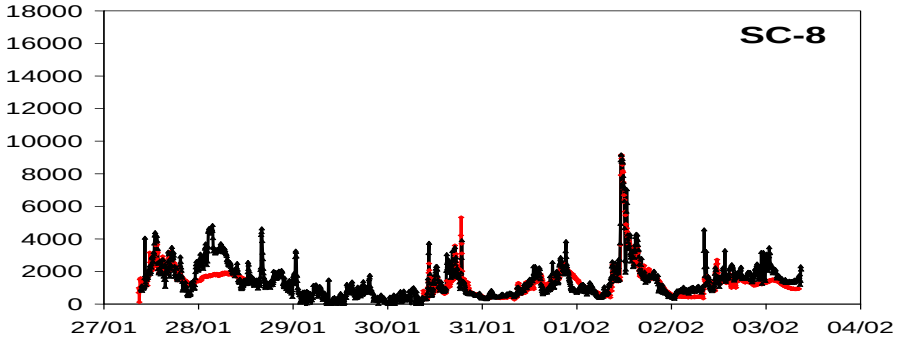
- **High blood pressure**
- Endothelial dysfunction
- Increased blood coagulation
- Systemic inflammation
- **Deep Venous Thrombosis**

- **Premature Birth**
- **Decreased Birth Weight**
- Decreased foetal growth
- In uterine growth retardation
- Decreased sperm quality
- Preclampsia

# ELEMENTAL CARBON INDOOR-OUTDOOR BREATHE PROJECT

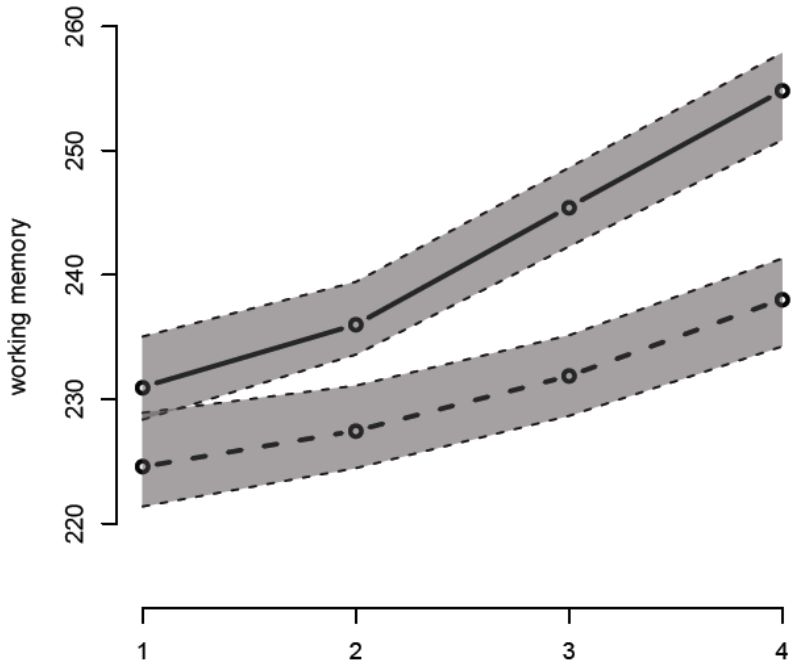


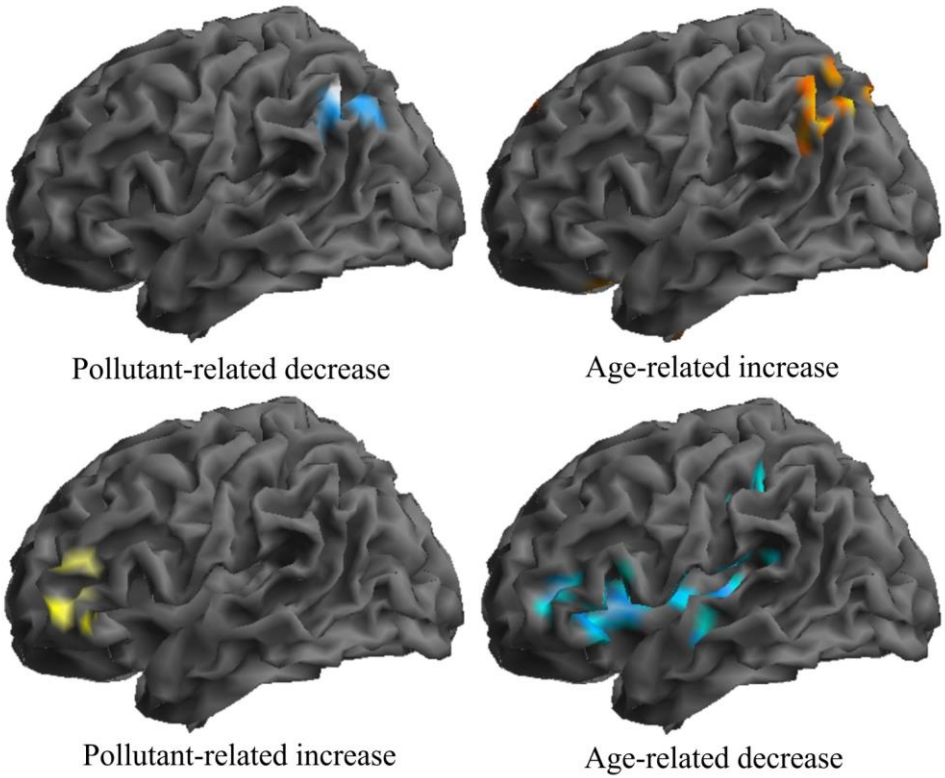




*Rivas I, 2014*

# Brain function development and imaging in 2750 school children by low (—) and high (- -) traffic pollution



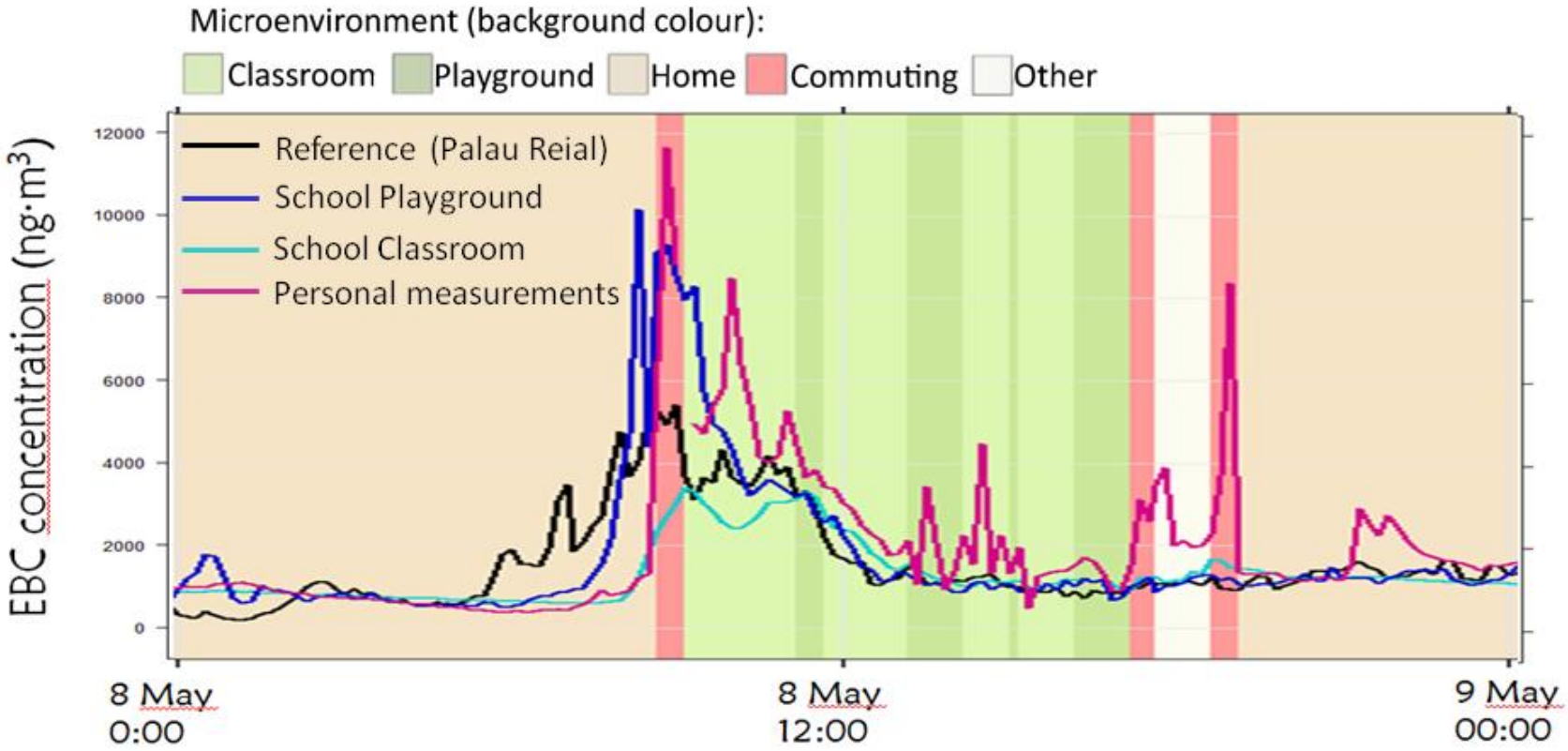

Sunyer et al. Plos Medicine 2015



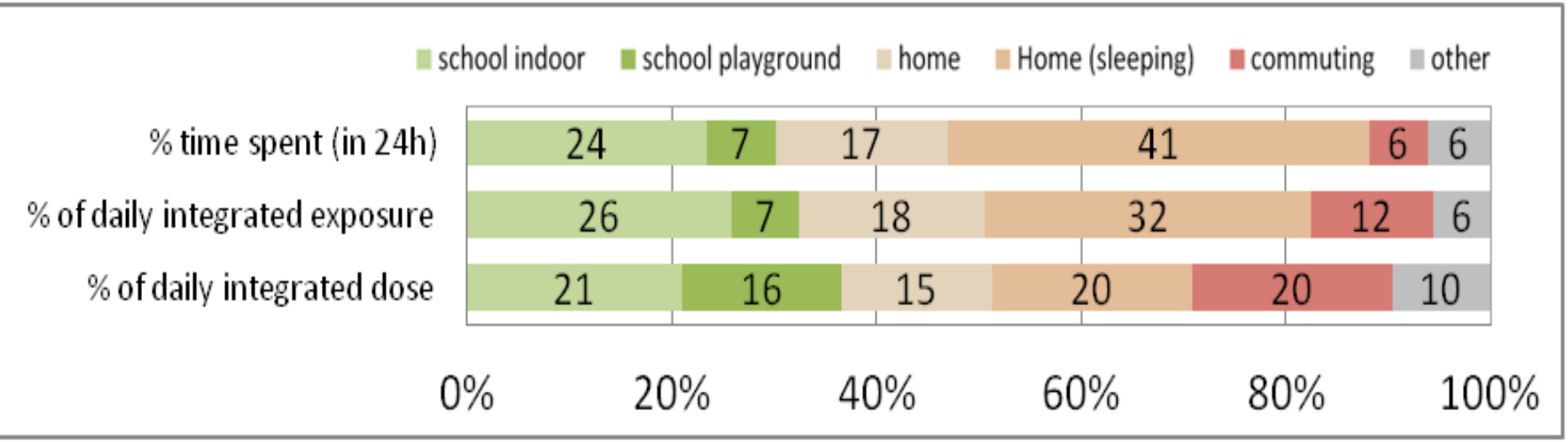

Pujol et al. Neuroimage 2016

Adjusted for sex, maternal education, residential neighbourhood socio-economic status and school pair; school and subject as nested random effects.

# a time series from 24h of personal measurements of BC from a child participant



# personal measurements in a small subsample (N=51)



# Què fem?

Tenim la diagnosi ben feta: ciutats amb l'aire contaminat

Originat sobretot pel tràfic

Un problema de salut prioritari

Ara toca trobar solucions:

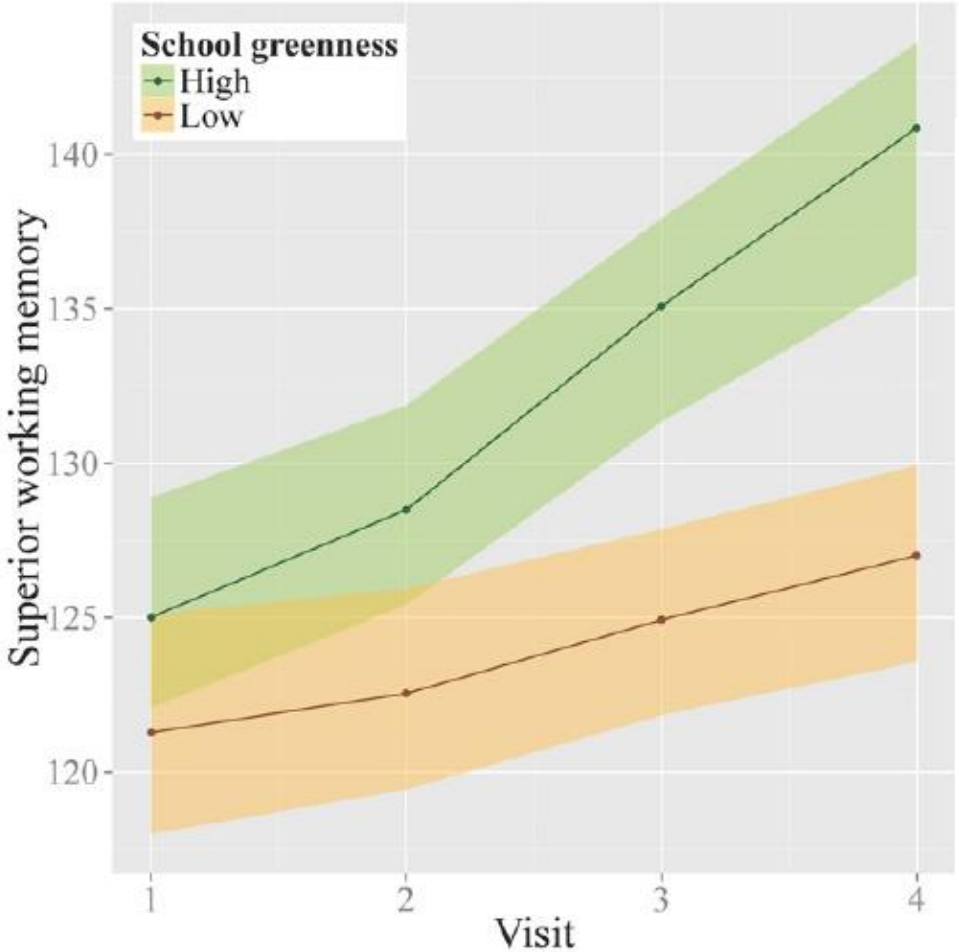
-. La **bicicleta** (elèctrica) és el vehicle urbà

-. **Compartir**

-. Vehicle a motor (mercaderies, ...) elèctric

-. Reduir espai tràfic: corredors verds, carrils bici

# GREEN SPACE AND BRAIN DEVELOPMENT AND IMAGING



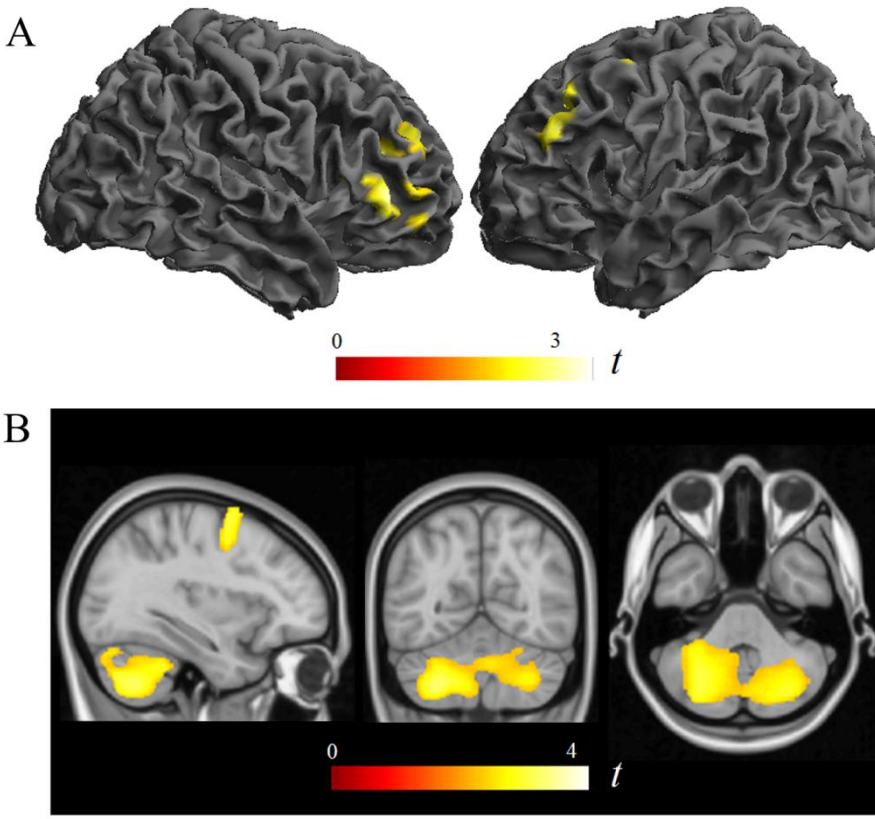




**Fig. 1.** Twelve-month progress (with 95% confidence bands) in superior working memory for participants with the first (low greenness) and third (hi greenness) tertiles of greenness within the school boundaries.

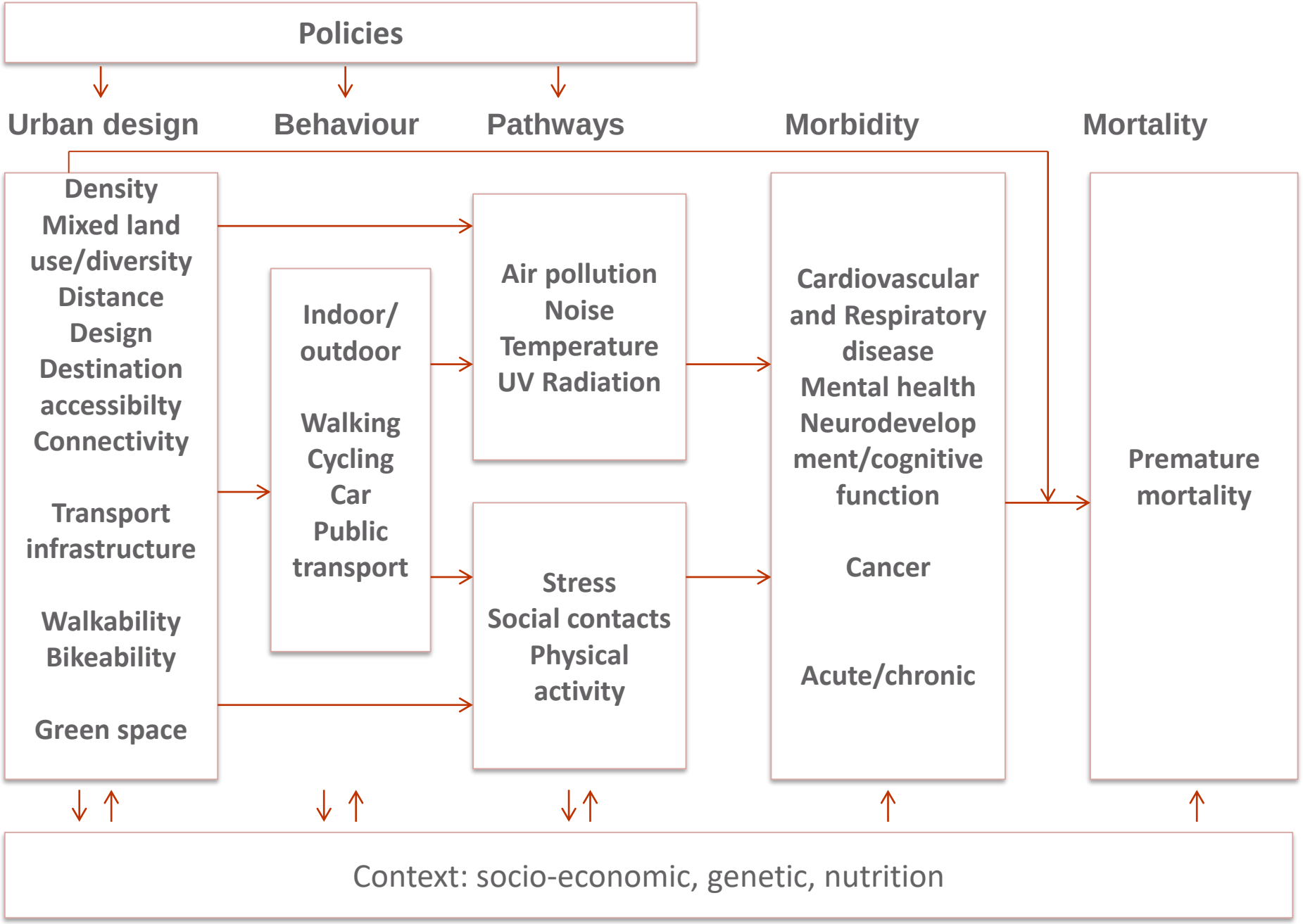
Dadvand et al 2015
PNAS

N=2,593 children, 7-10 yrs

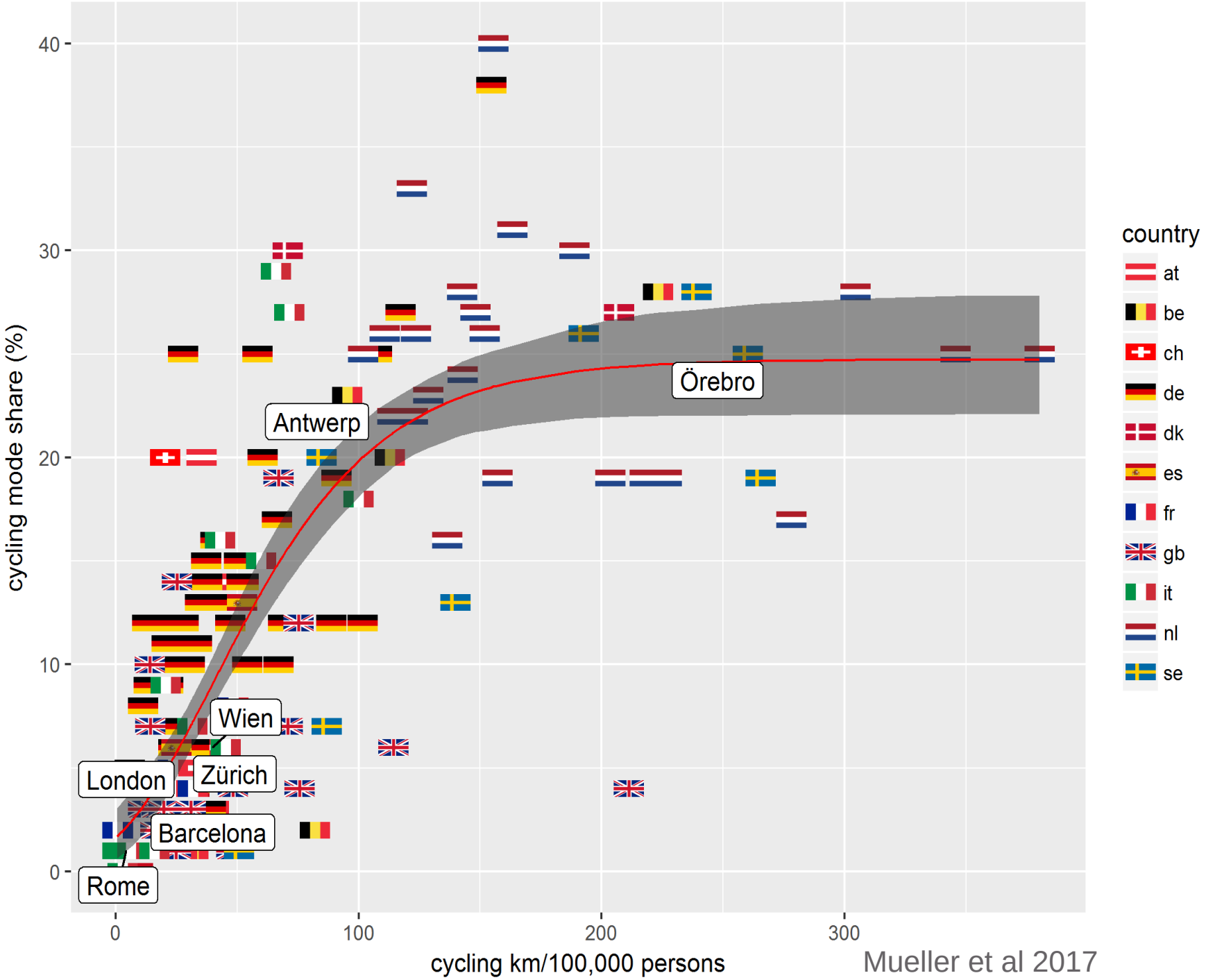
# Efectes secundaris del vehicle a motor URBÀ

- Contaminació aire
- Soroll
- Manca exercici físic
- Ocupació de l’espai (verd)
- Dificulta la interacció social


Carrer d'Aribau
Carrer de Còrsega
Carrer del Rosselló
Carrer d'Enric Granados
Carrer de Còrsega
Carrer del Rosselló
Carrer d'Aribau
Carrer del Rosselló
Carrer de Provença
Carrer d'Enric Gra
Carrer de Muntaner
Carrer d'Aribau
Carrer de Provença
Carrer de Mallorca




Nieuwenhuijsen 2016



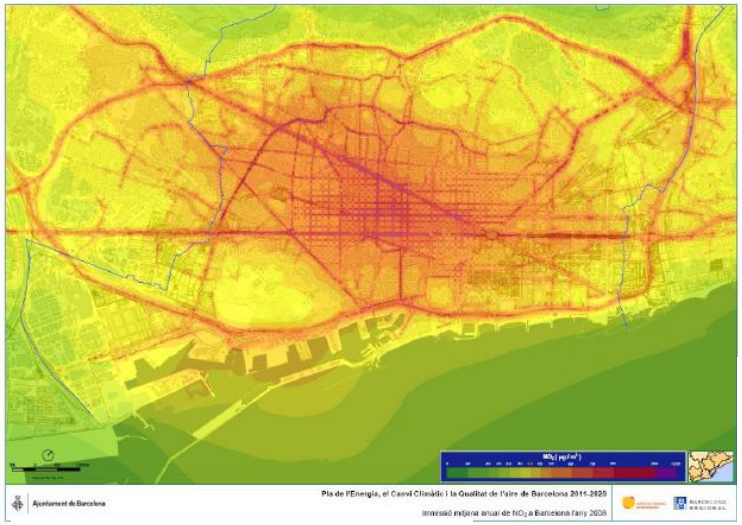

Mueller et al 2017

# PREMATURE DEATHS PREVENTED

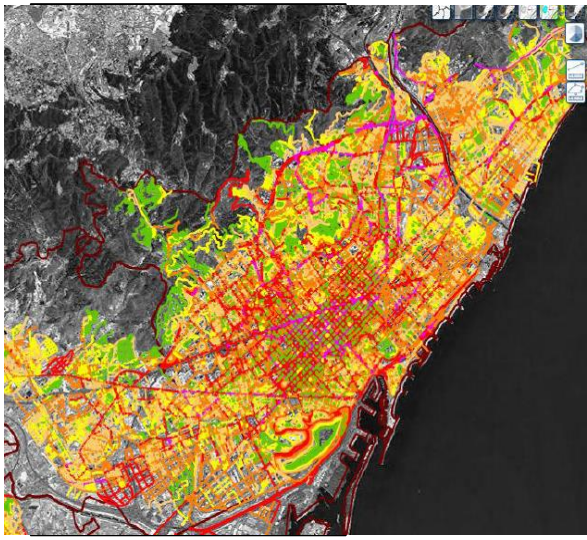
- 15,801 premature deaths prevented annually in 167 European cities if the mode share of cycling went up to 24.7%

Mueller et al 2017

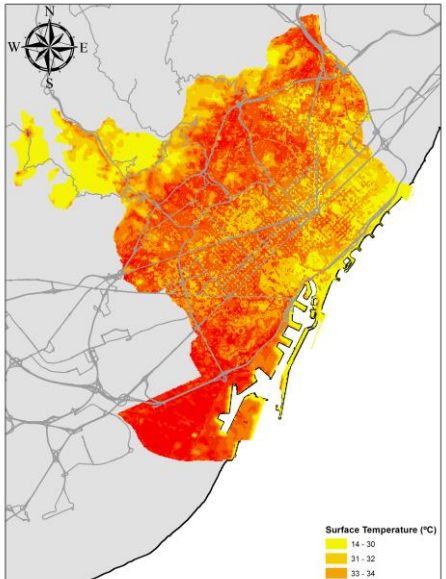
# EXPOSURE PATTERNS IN CITIES



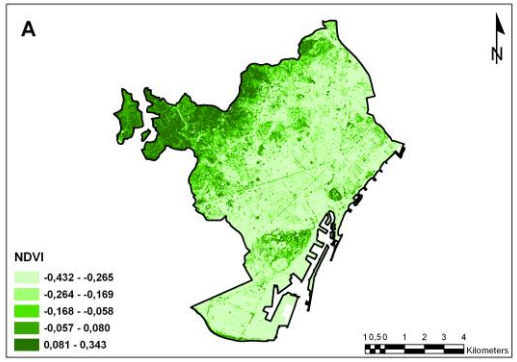

Air pollution

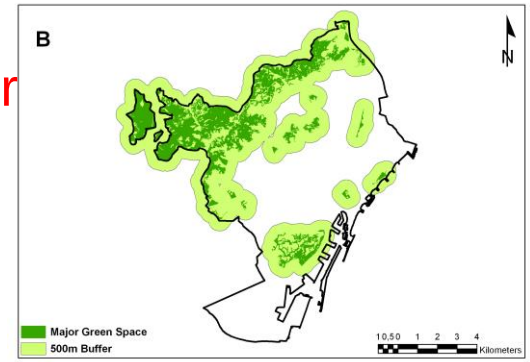


Noise



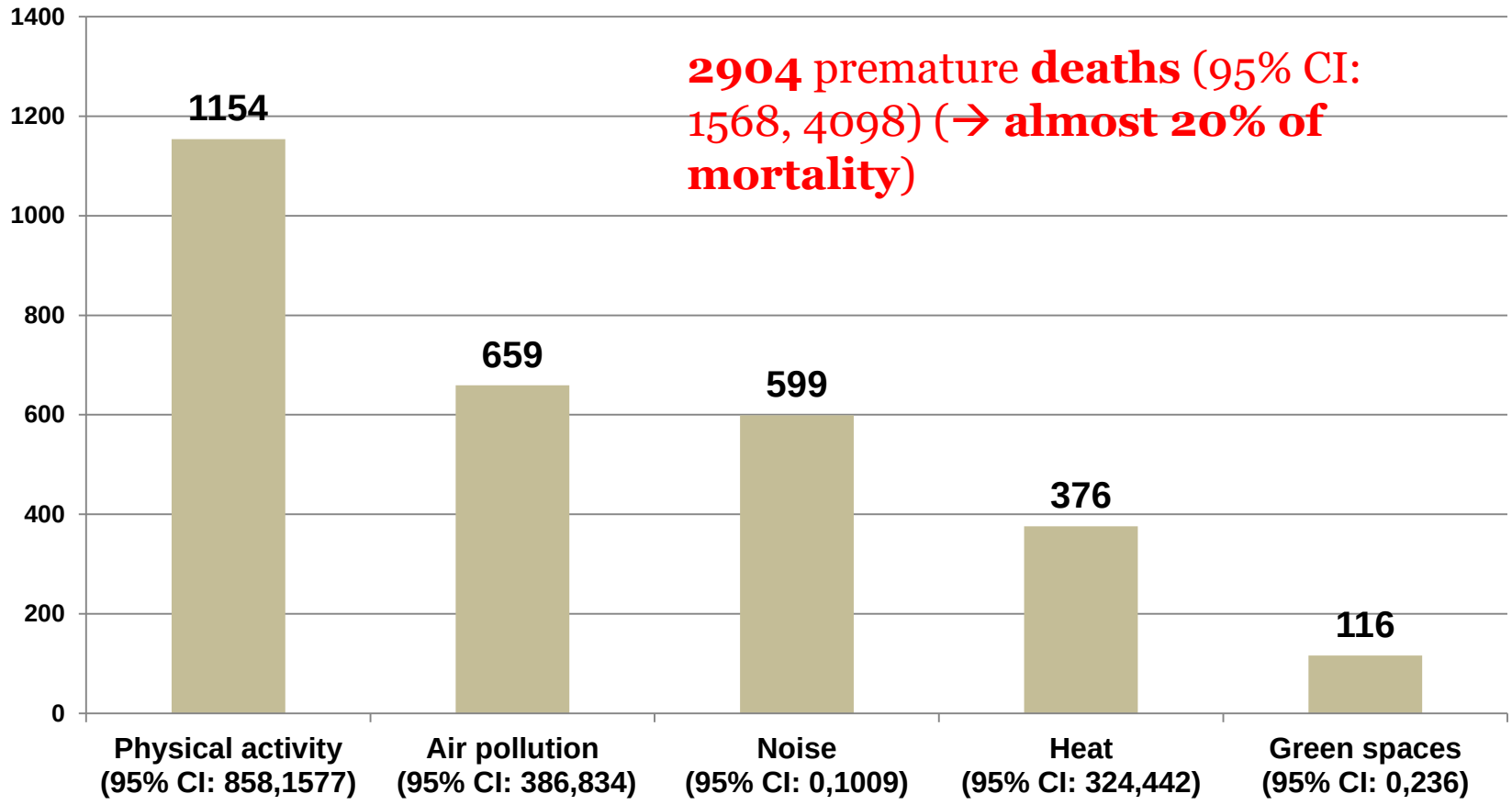

Temperature



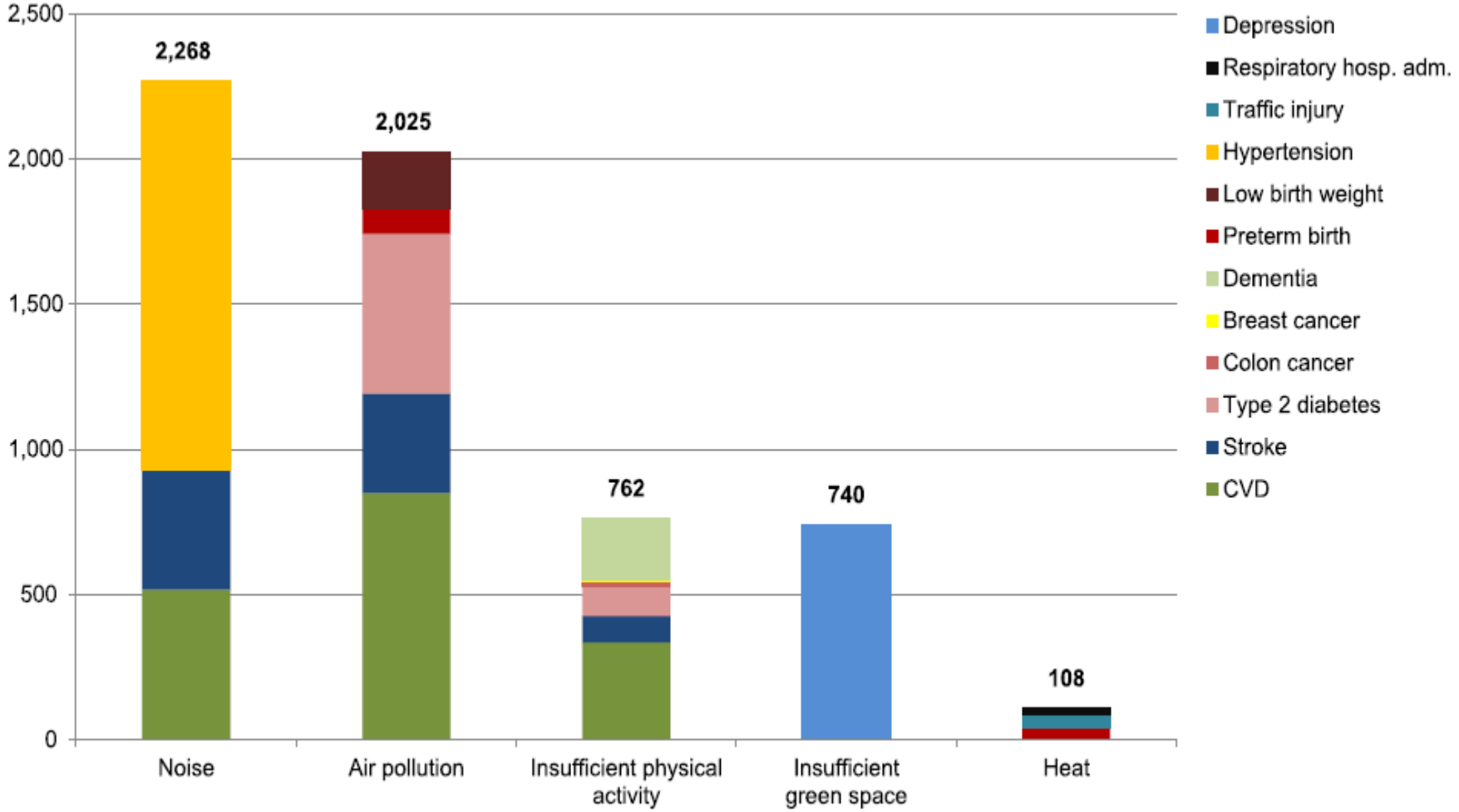

Green space

# DEATHS DUE TO POOR URBAN AND TRANSPORT PLANNING




Traffic injury deaths 30

Mueller et al 2017




CVD=cardiovascular disease; hosp.adm=hospital admissions
Noise-related annoyance and sleep disturbance (i.e. 178,773 persons and 99,603 persons, respectively) are not considered.

**52,001 DALYs (95% CI: 42,866–61,136)**

Mueller et al 2017

# Què fem?

La mobilitat no es pot deslligar de la planificació urbana:

- Substituir el cotxe com a vehicle de mobilitat a la ciutat té importants beneficis sobre la salut: reducció soroll, contaminació, calor.
- Augmentar el transport actiu té un gran impacte en salut per l'augment de l'exercici físic.
- Crear un espai urbà verd i amigable afavoreix el transport actiu.

# Intervenció

- **Model de ciutat: Cars free cities??**
- Vehicle urbà:
  - Bicicleta (elèctrica)
  - Transport interurbà actiu
- Transport mercaderies ‘net’
- Compartir el transport
  - Més i millor transport públic
  - ‘net’
- Reduir vehicles privats
  - Corredors verds
  - Carrils bici
  - Zones peatonals
  - Aparcament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