

# Health Effects of Nanoparticles in Susceptible Persons

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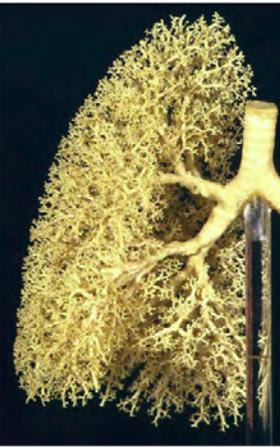
**SPITAL NETZ BERN**

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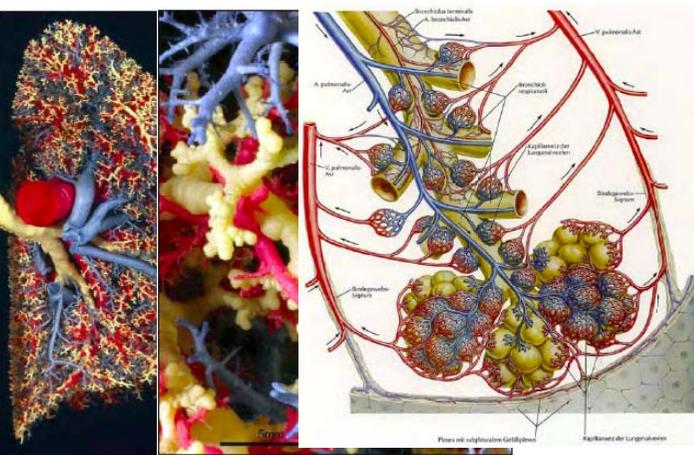
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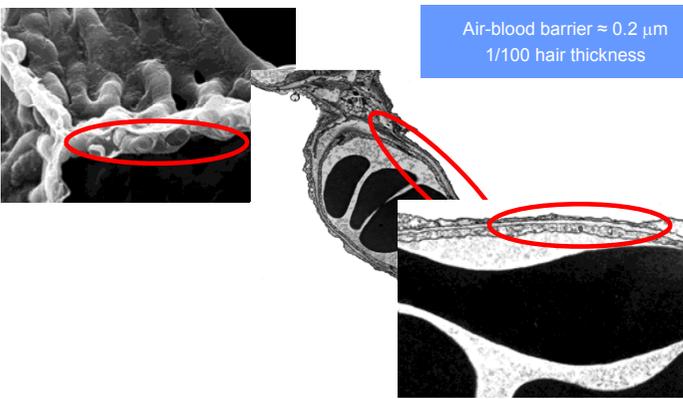
		Z	
Conducting airways	Trachea	0	
	Bronchi	1	
		2	
		3	
	Bronchioles	4	
5			
Acinar airways	Terminal bronchioles	14	Z'
	Transitional bronchioles	15	0
	Respiratory bronchioles	16	1
		17	2
		18	3
	Alveolar ducts	19	4
		20	5
		21	6
Alveolar sacs	22	7	
	23	8	

Courtesy Institute of Anatomy, Bern University



Courtesy Institute of Anatomy, Bern University

## Air-Blood Barrier



Air-blood barrier  $\approx 0.2 \mu\text{m}$   
 1/100 hair thickness

Courtesy Institute of Anatomy, Bern University

### The lung in numbers...

at rest, we breathe....

.... 12 times per minute 0.5 litres of air

.... 360 litres per hour

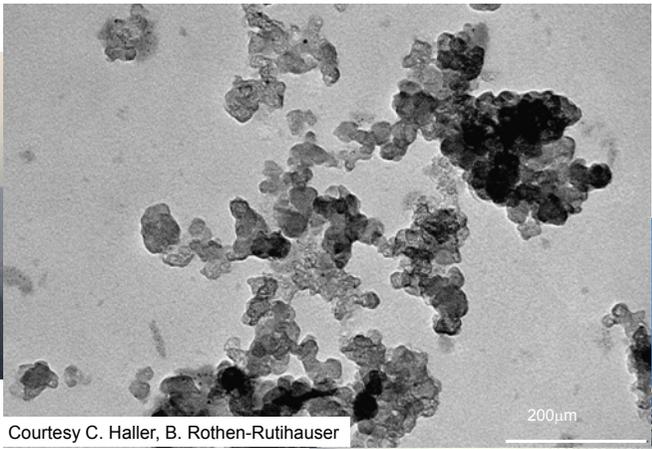
.... 10'000 litres per day (.... $10^{12}$  particles)

.... 3 000 000 litres per year

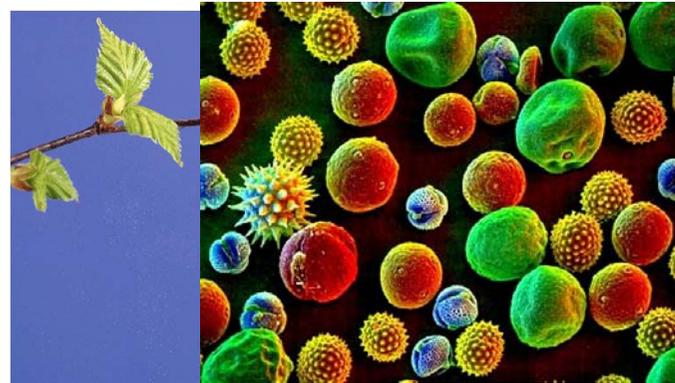
.... **x40 with exercise**



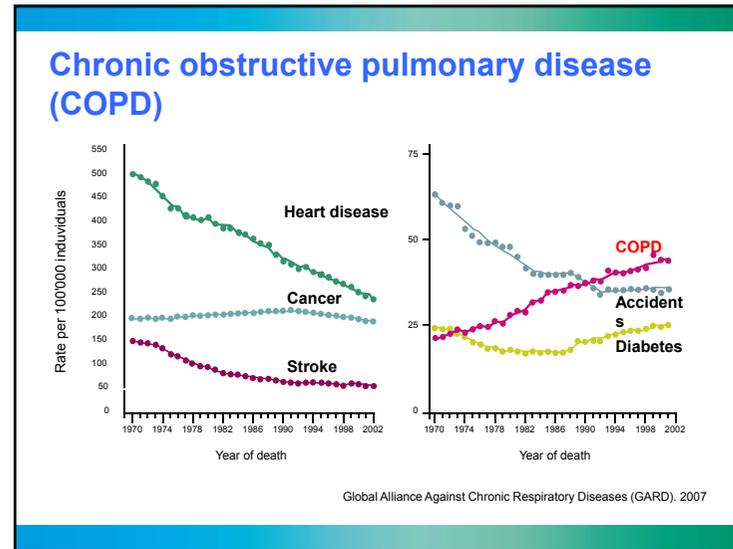
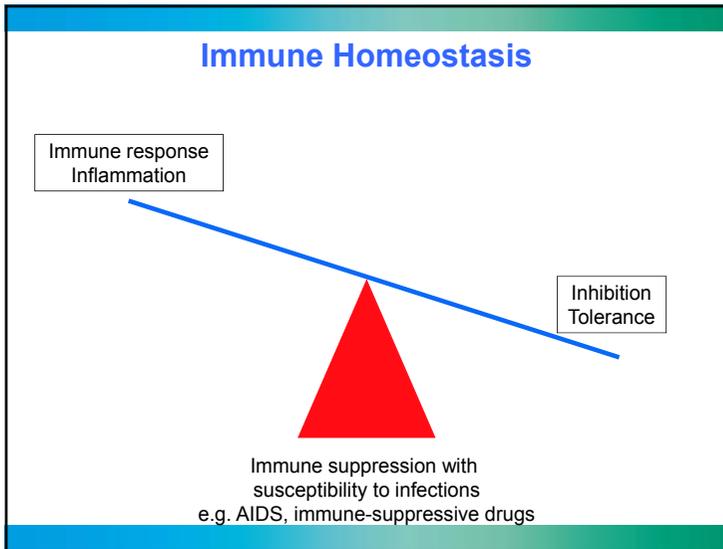
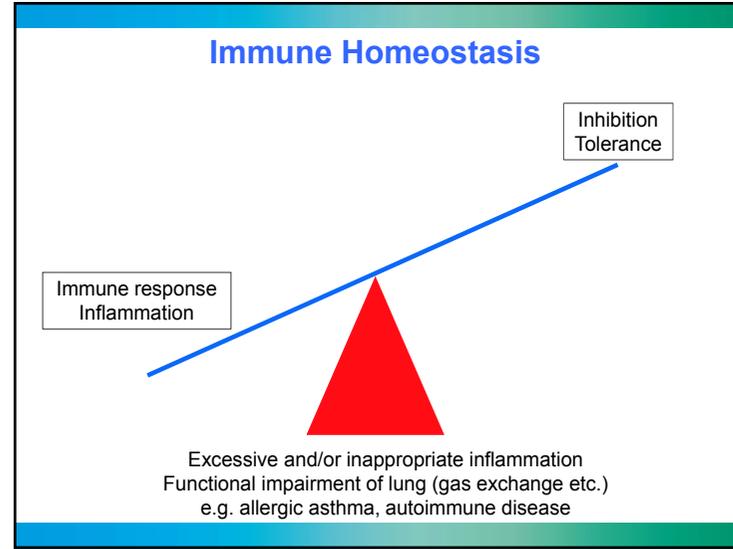
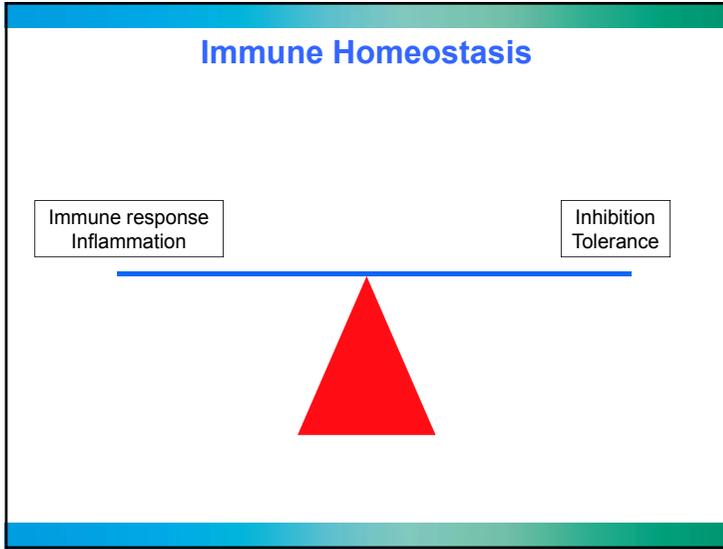
SCIENCEphotoLIBRARY

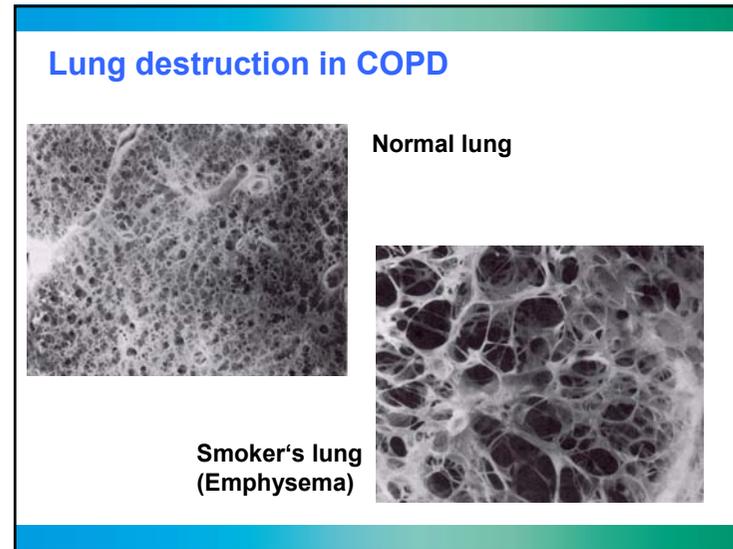
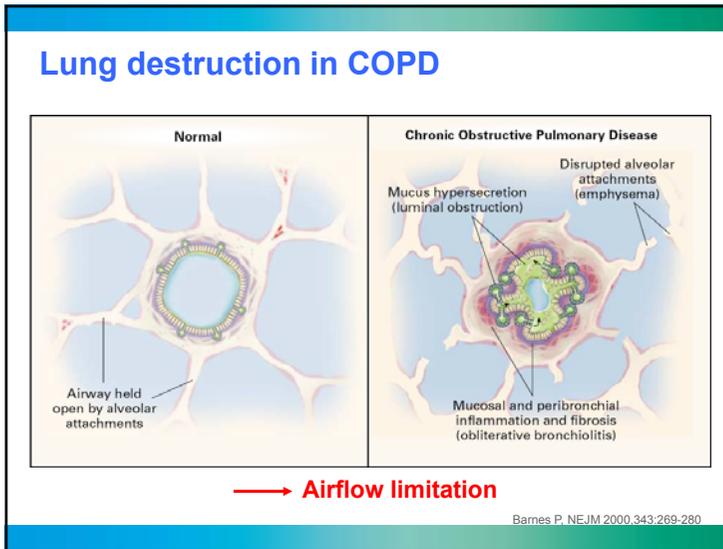
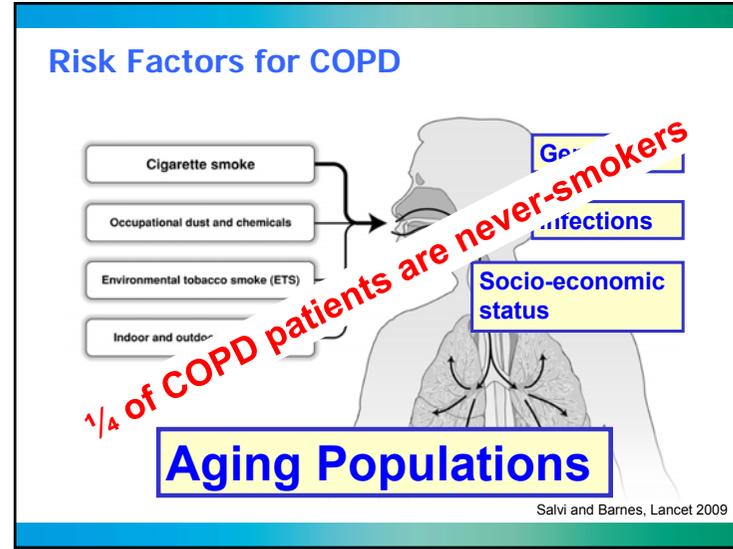
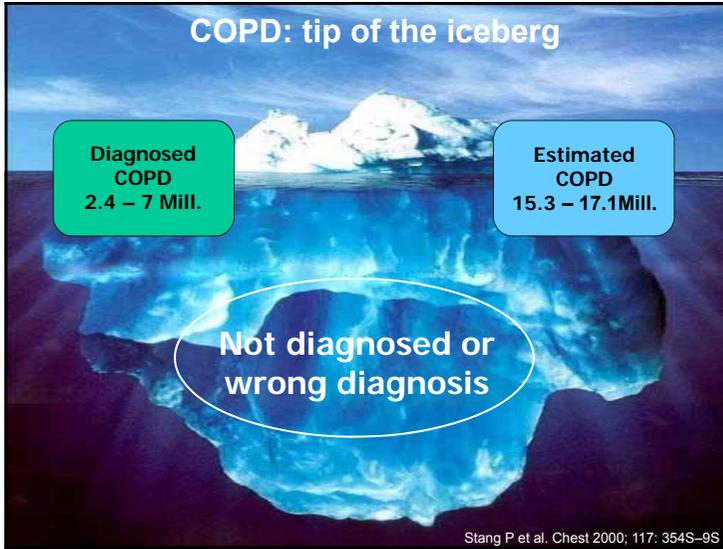


Courtesy C. Haller, B. Rothen-Rutishauser



cncntrc.tumblr.com





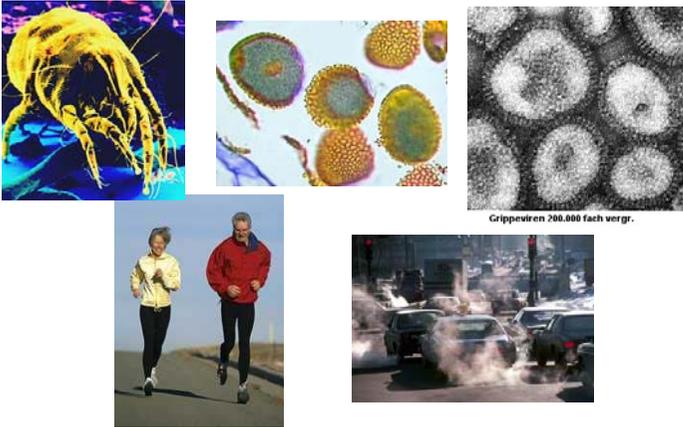
### Asthma

235 million persons suffer from **asthma**, most common chronic disease in children

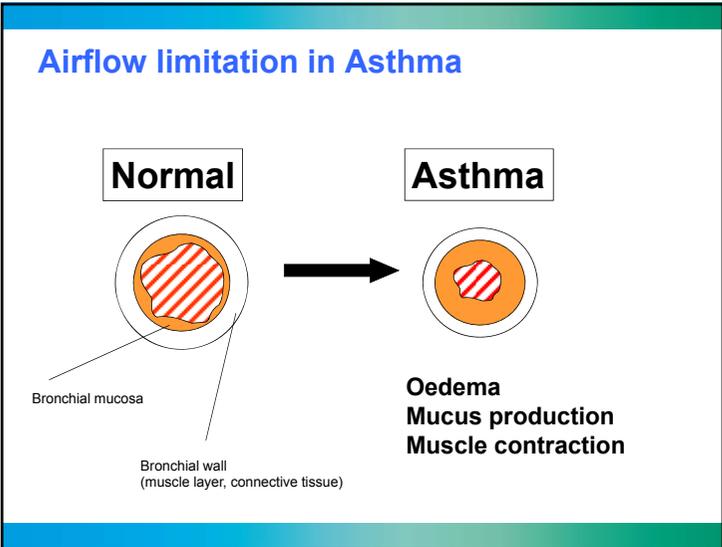
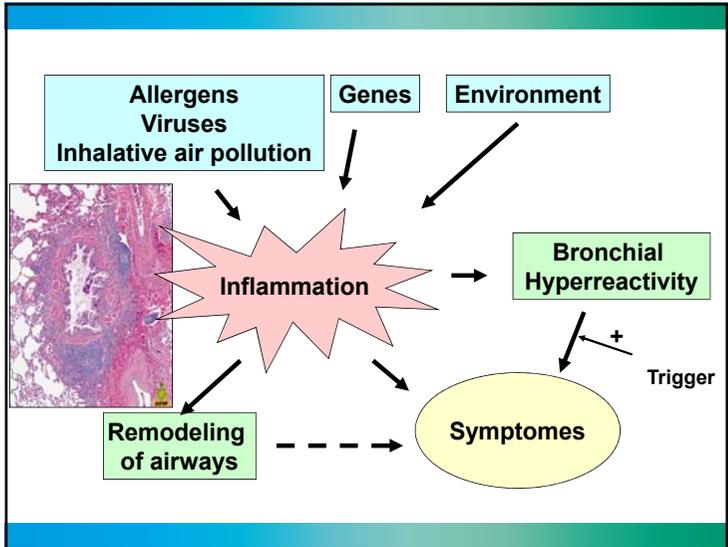


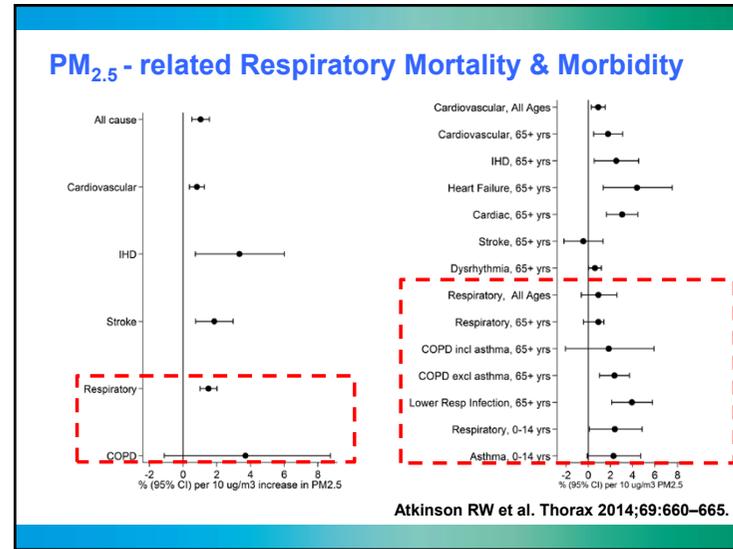
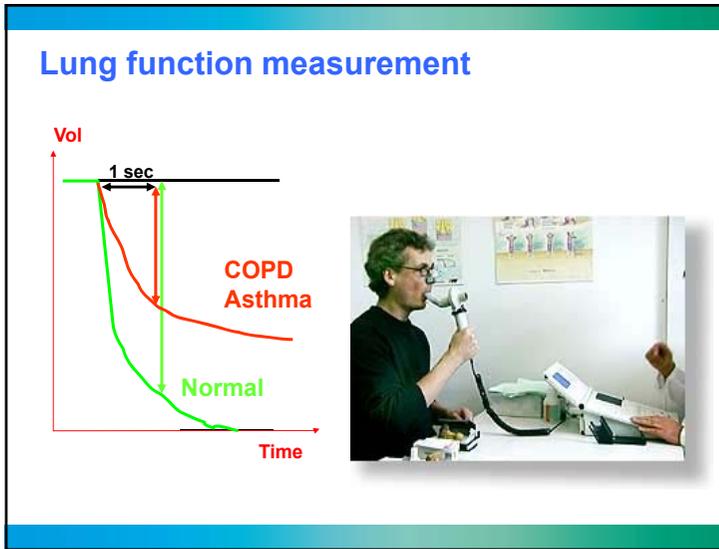
- **dyspnea (difficulty breathing)**
  - acute or chronic
  - at rest or with physical exercise
  - possibly trigger identifiable
  - reversible
- cough
- sometimes sputum production
- possibly related to allergies

### Asthma triggers...quite a few around



Gruppenfoto 200.000 fach vergr.





### PM<sub>2.5</sub> - related Respiratory Mortality & Morbidity

- Consistent evidence: Adverse health effects of short-term exposure to PM<sub>2.5</sub>: 10 µg/m<sup>3</sup> increment associated with 1.04% (95% CI 0.52% to 1.56%) increase in the risk of death
- Associations for respiratory causes of death larger than for cardiovascular causes, 1.51% (1.01% to 2.01%) vs 0.84% (0.41% to 1.28%)
- Caveats: Small study bias for single-city mortality studies and multicity studies of cardiovascular disease; heterogeneity for effect estimates in different regions of the world
- Data supports policy measures to control PM<sub>2.5</sub> concentrations

Atkinson RW et al. Thorax 2014;69:660-665.

### Acute exposure in a street tunnel: The Stockholm Tunnel Study

16 healthy individuals exposed during 2 hours in street tunnel with intense traffic

Examination (including bronchoscopy) before and after exposure

**RESULTS**

- transiently increased respiratory symptoms
- Increases inflammatory cells in broncho-alveolar lavage fluid
- Expression of transcription factors in bronchial mucosa (c-jun)
- BUT: no changes in lung function (FEV1)

Larsson et al, Eur Resp J 2007

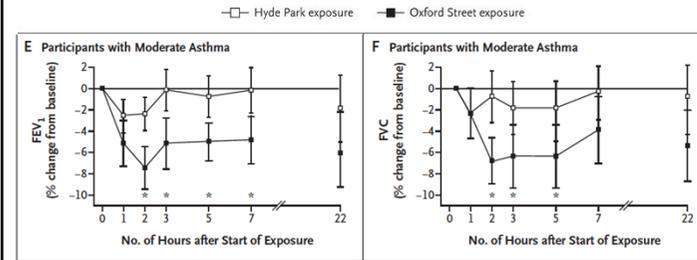
### „Oxford Street vs Hyde Park“ in asthmatics – The LONDON Experience !



	Oxford Str	Hyde Park	Sign.
PM <sub>2.5</sub>	28.3	11.9	
	p<0.01		
Ultrafine part.	63.7	18.3	p<0.01
Carbon	7.5	1.3	p<0.01

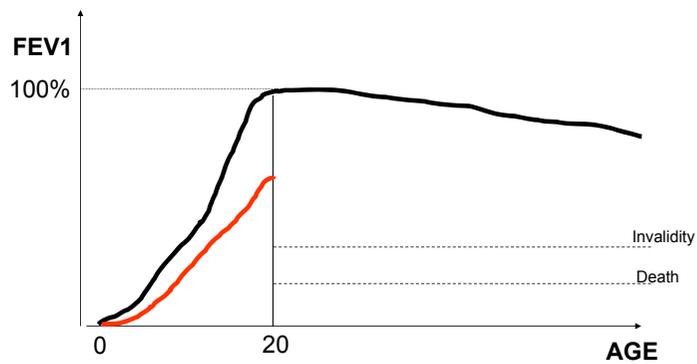
McCreanor J et al, NEJM 2007

### Effects on lung function

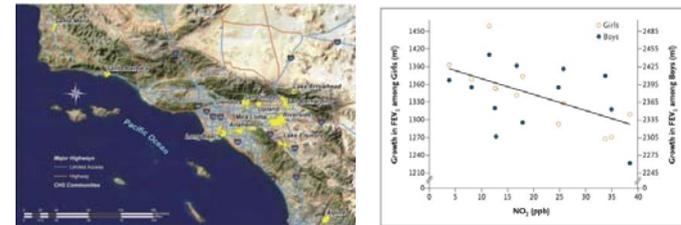


- increased inflammatory markers in airways after air pollution exposure
- decreased lung function in mild / moderate asthmatics

### Development of lung function from cradle to coffin...

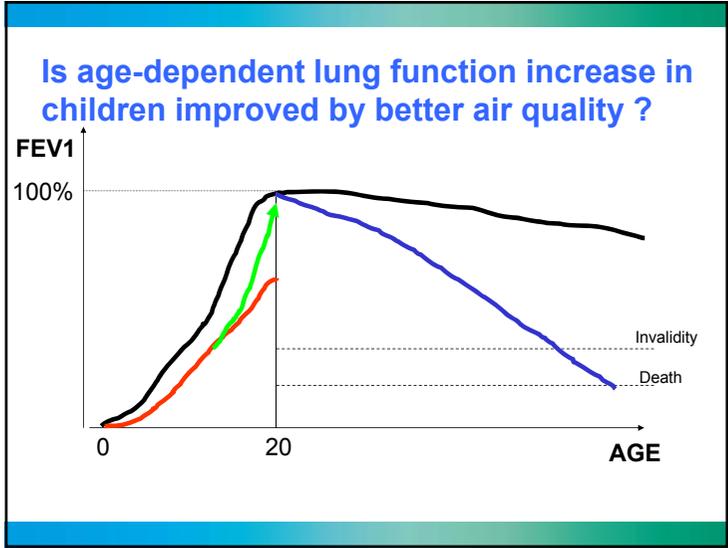


### Reduced age-dependent lung function increase in children due to air pollution?



areas with poor air quality  
 ↓  
 more children with FEV<sub>1</sub> < 80%

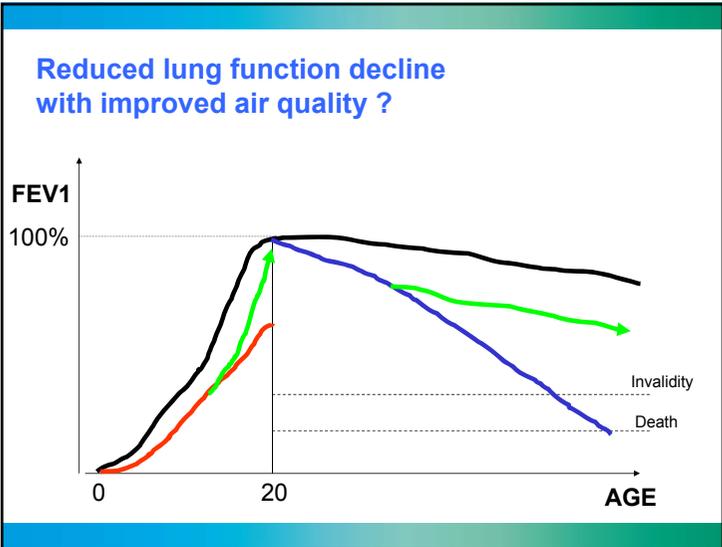
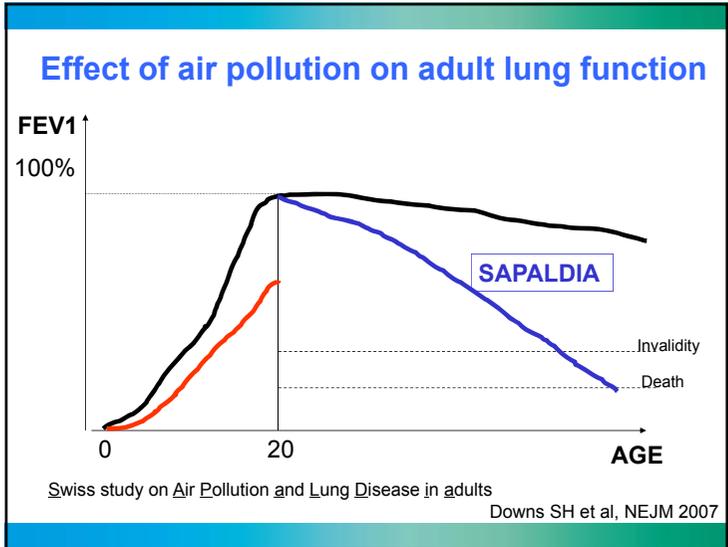
Children's Health Study, Gauderman et al, NEJM 2004



### Children's Health Study

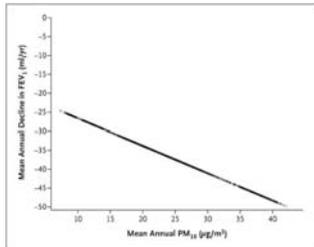
- **Improved** age-dependent lung function increase after migration to areas with **less air pollution**
- **Reduced** age-dependent lung function increase after migration to areas with **more air pollution**

Avol E et al, Am J Resp Crit Care Med 2001



### PM10-related effect on lung function

Swiss study on Air Pollution and Lung Disease in adults

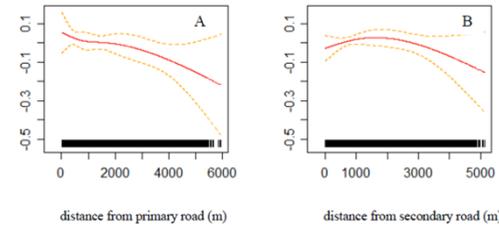


Improved air quality reduced physiological decline in lung function  
 → +3 ml FEV1 per 10 µg/m<sup>3</sup> decrease PM<sub>10</sub>

[NOTE: Effect of smoking cessation greater!  
 → +12 ml FEV1 per 1 pack/year]

Downs SH et al, NEJM 2007

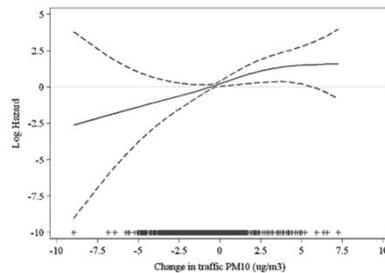
### Childhood asthma & traffic-related air pollution?



Asthma events associated with proximity to primary roads with odds ratio of 0.97 (95% CI: 0.94,0.99) for a 1 km increase in distance  
 → asthma events are less likely as the distance between the residence and a primary road increases

Li S et al. Environmental Health 2011, 10:34

### Traffic-related PM<sub>10</sub> & adult onset asthma?



Asthma incidence associated with change in TPM<sub>10</sub>

Independent of education, workplace exposure, passive smoking, parental asthma or allergies, random area effects, lung function or co-pollutants

Künzli N et al. Thorax. 2009 Aug;64(8):664-70.

### Conclusions

- Susceptible individuals to adverse effects of ambient particles: Children, COPD, Asthma
- Acute exposure to ambient particles:
  - trigger acute, inflammatory effect on respiratory tract
  - worsen lung function in asthmatics
- Chronic air pollution:
  - slows age-related lung function increase (children)
  - accelerates lung function decline (adults)
- Risk for asthma and exacerbation increased by air pollution (children & adults)