

Health Effects of Nanoparticles in Susceptible Persons

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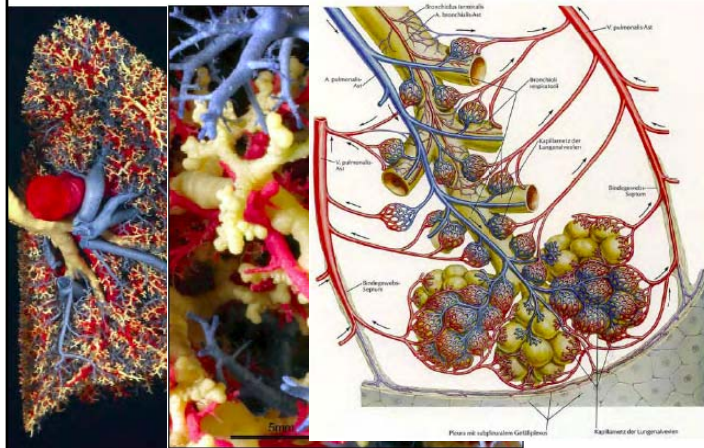
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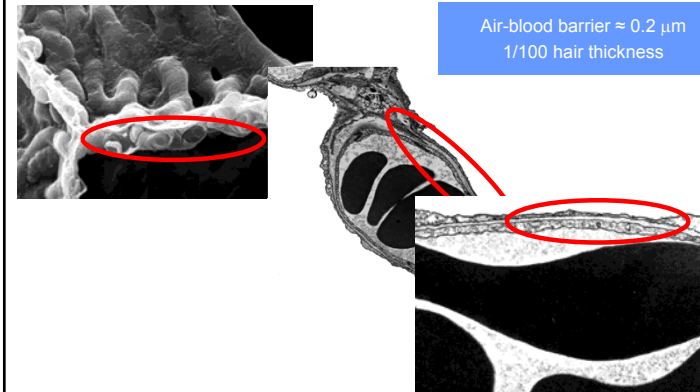
		Z
Conducting airways	Trachea	0
	Bronchi	1
		2
		3
	Bronchioles	4
Acinar airways	Terminal bronchioles	5
	Transitional bronchioles	14
	Respiratory bronchioles	14 Z'
		15 0
		16 1
	Alveolar ducts	17 2
		18 3
		19 4
	Alveolar sacs	20 5
		21 6
		22 7
		23 8

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....

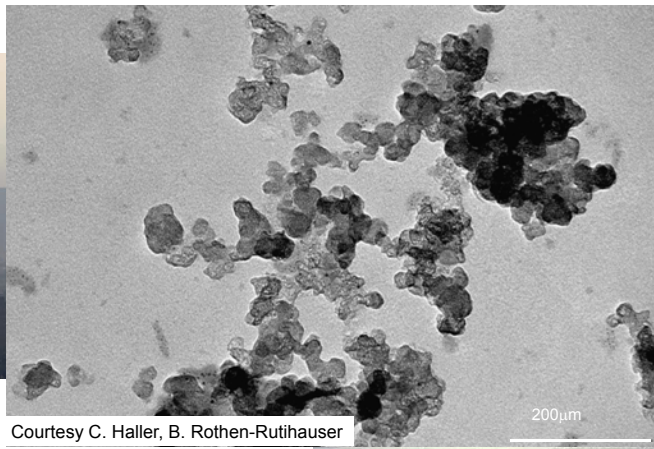
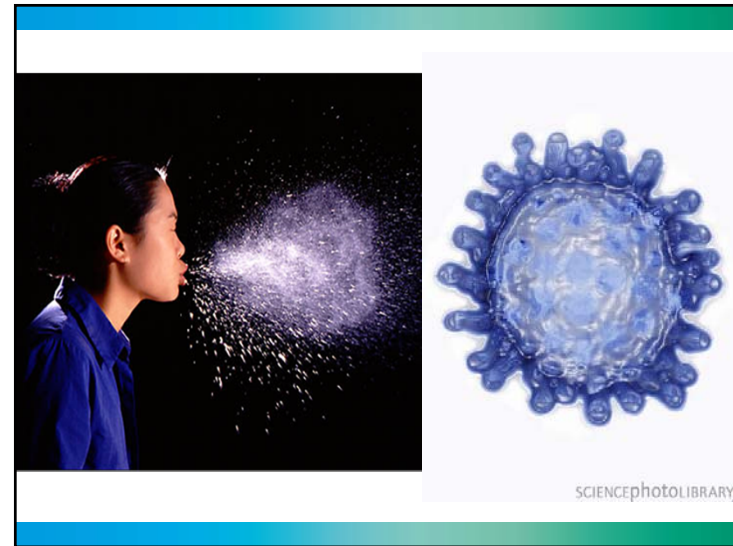
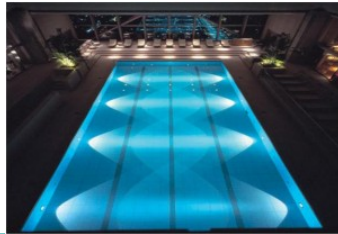
.... 12 times per minute 0.5 litres of air

.... 360 litres per hour

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

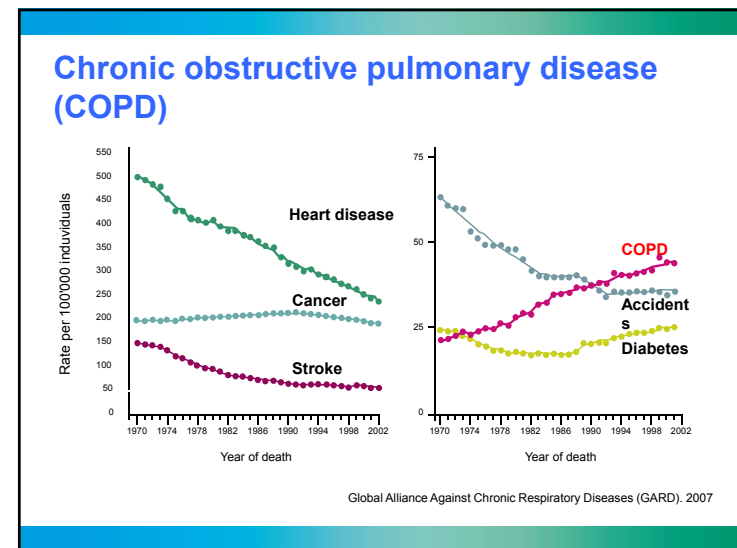
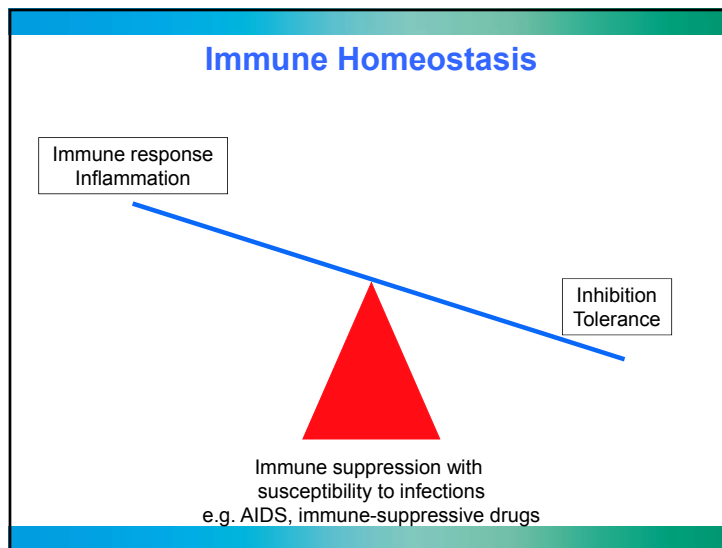
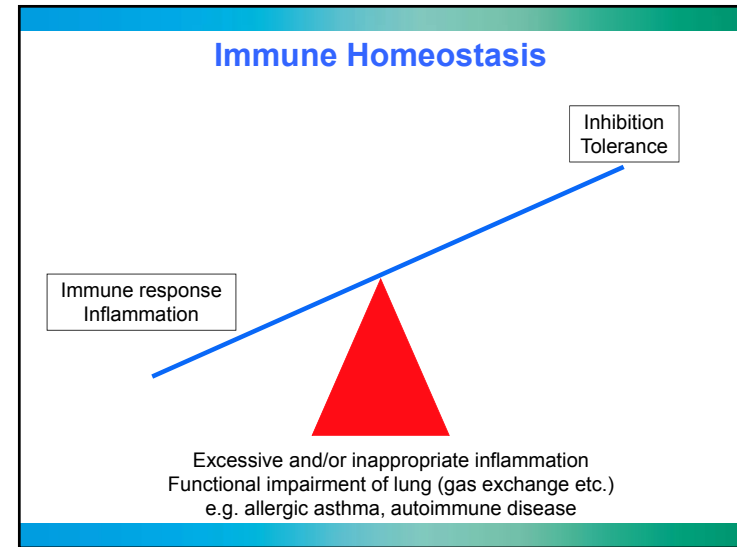
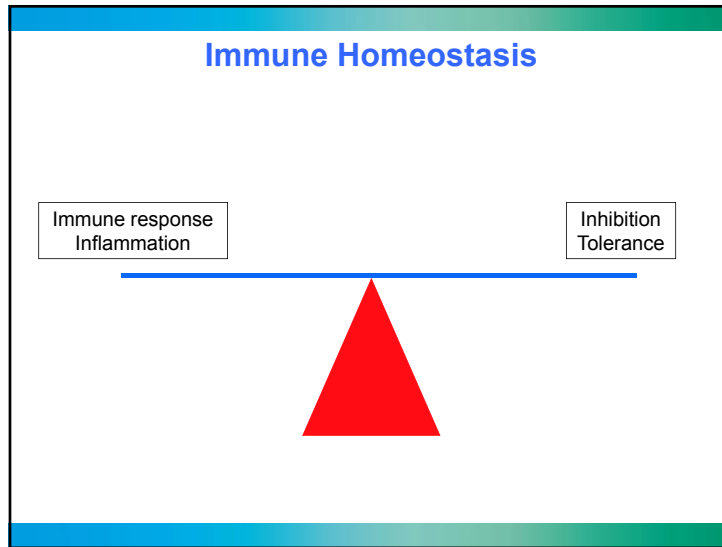
.... 3 000 000 litres per year

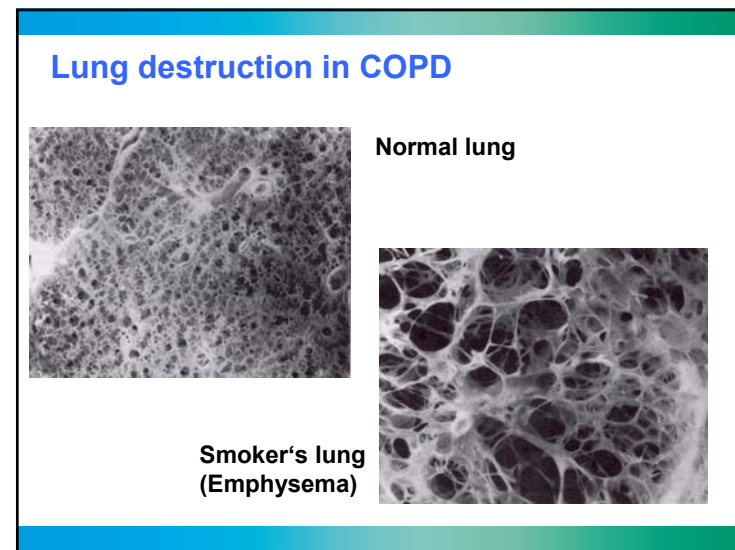
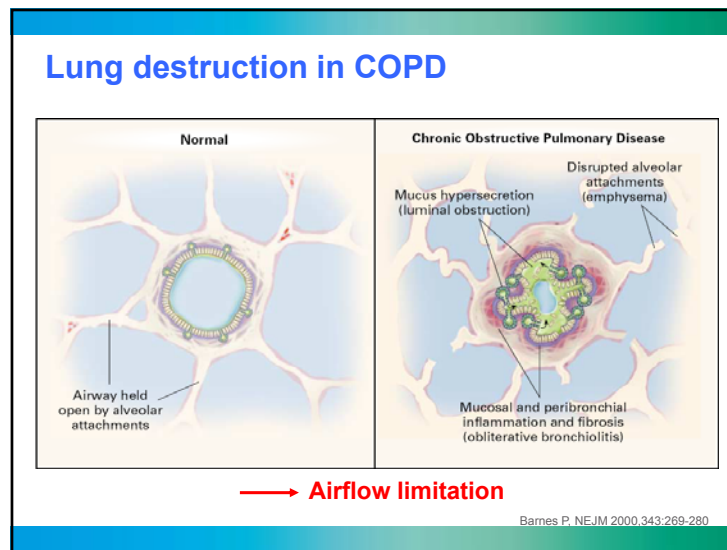
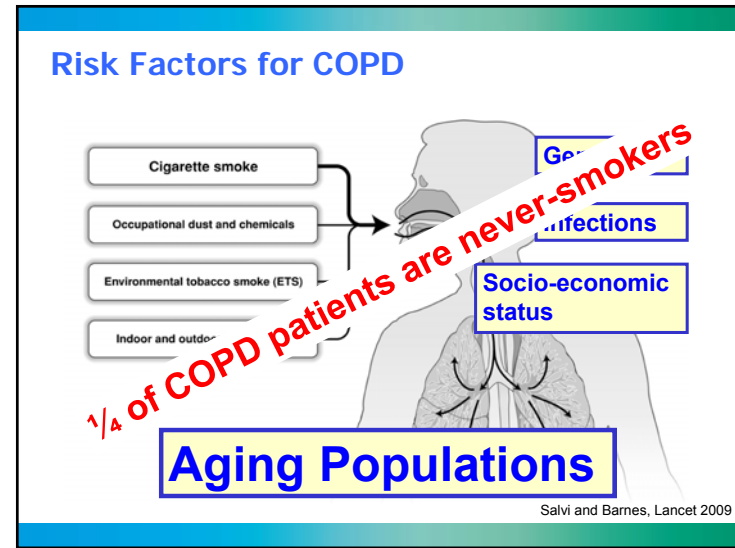
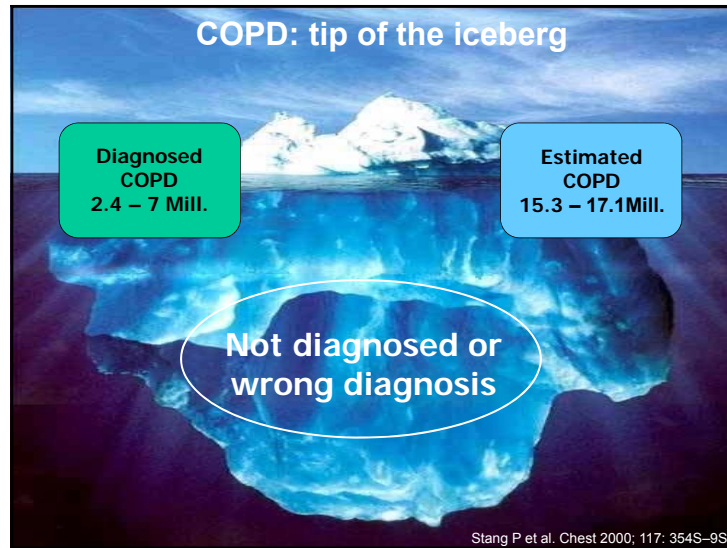
.... **x40 with exercise**



Courtesy C. Haller, B. Rothen-Rutishauser







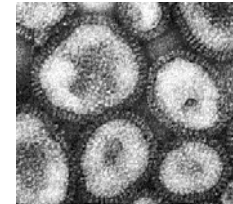
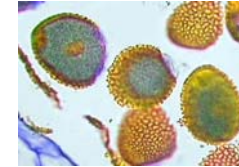
Asthma

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

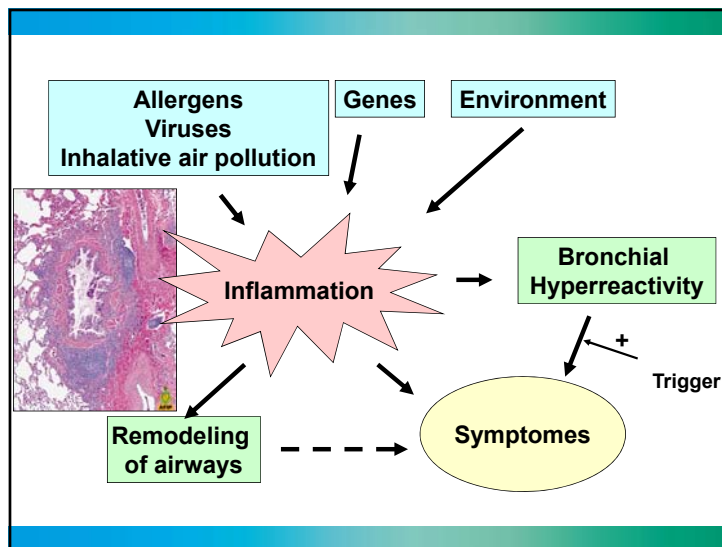


- **dyspnea (difficulty breathing)**
 - acute or chronic
 - at rest or with physical exercise
 - possibly trigger identifiable
 - reversible
- cough
- sometimes sputum production
- possibly related to allergies

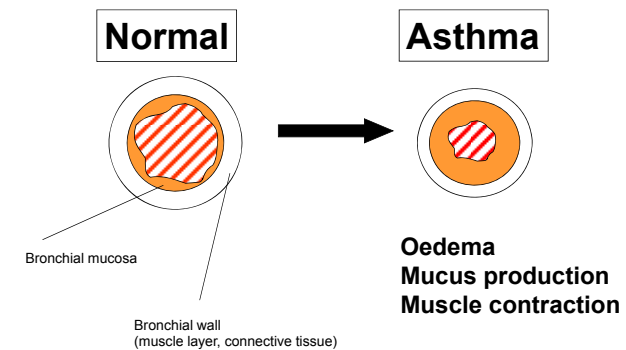
Asthma triggers...quite a few around



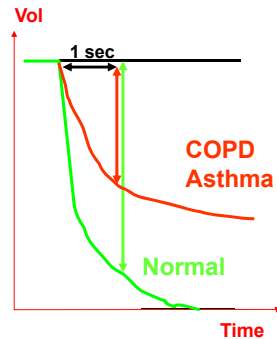
Grippeviren 200.000 fach vergr.



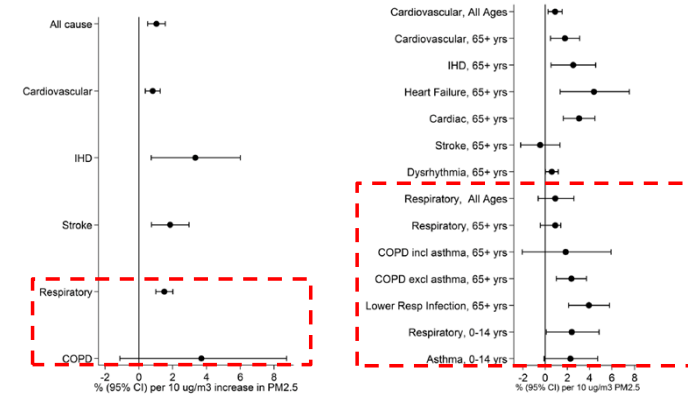
Airflow limitation in Asthma



Lung function measurement



PM_{2.5} - related Respiratory Mortality & Morbidity



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

PM_{2.5} - related Respiratory Mortality & Morbidity

- Consistent evidence: Adverse health effects of short-term exposure to PM_{2.5}: 10 µg/m³ 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_{2.5} 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

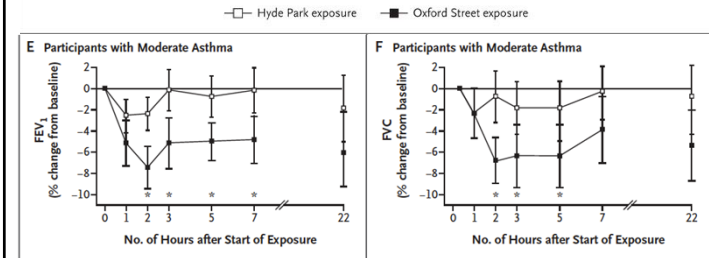
„Oxford Street vs Hyde Park“ in asthmatics – The LONDON Experience !



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

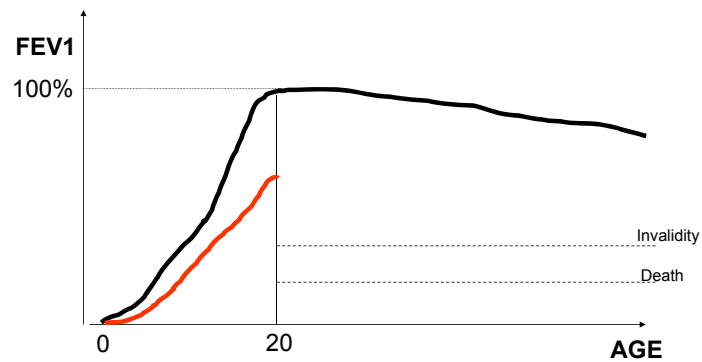
McCreanor J et al, NEJM 2007

Effects on lung function

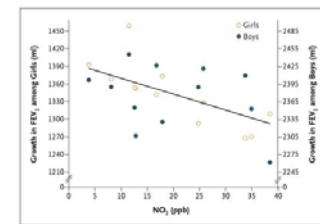


- increased inflammatory markers in airways after air pollution exposure
- decreased lung function in mild / moderate asthmatics

Development of lung function from cradle to coffin...



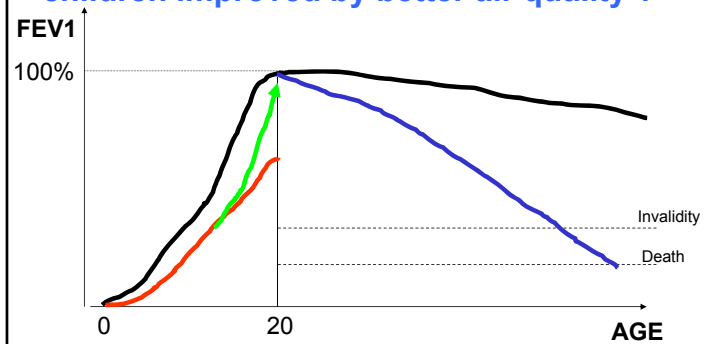
Reduced age-dependent lung function increase in children due to air pollution?



areas with poor air quality
↓
more children with FEV1 < 80%

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

Is age-dependent lung function increase in children improved by better air quality ?



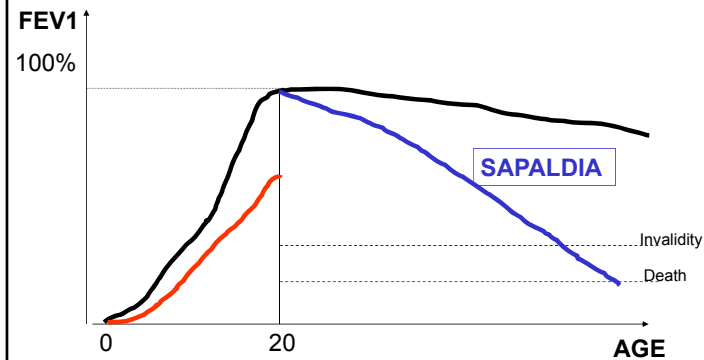
Children's Health Study



- **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

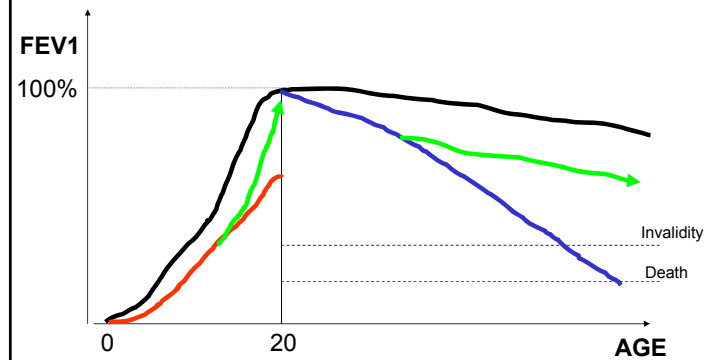
Effect of air pollution on adult lung function



Swiss study on Air Pollution and Lung Disease in adults

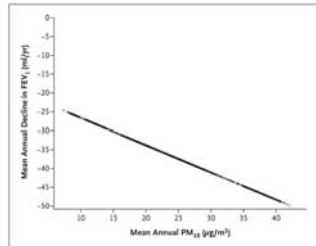
Downs SH et al, NEJM 2007

Reduced lung function decline with improved air quality ?



PM₁₀-related effect on lung function

Swiss study on Air Pollution and Lung Disease in adults



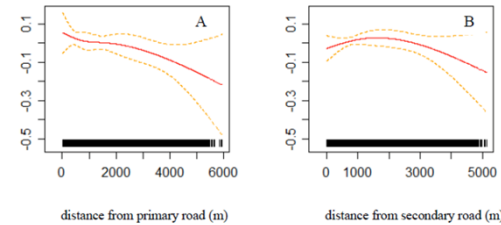
Improved air quality reduced physiological decline in lung function

→ +3 ml FEV1 per 10 µg/m³ decrease PM₁₀

[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?

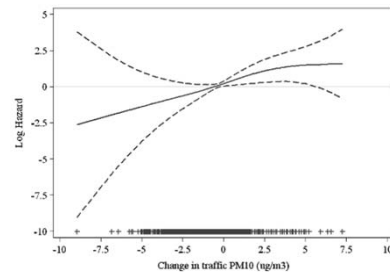


Asthma events associated with proximity to primary roads with odds ratio of 0.97 (95% CI: 0.94,0.99) for a 1 km increase in distance

→ 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 PM₁₀ & adult onset asthma?



Asthma incidence associated with change in TPM₁₀

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)

