

Challenges of Highway Epidemiology

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Highway Epidemiology....

- Studies of subjects living close to busy roads
- Exposure contrasts on small spatial scale (10s – 100s of meters)
- Various indirect exposure metrics: distance, traffic density, traffic flow composition
- **Relationship with measured concentrations?**
- **Relationship with personal exposure?**

Dutch studies

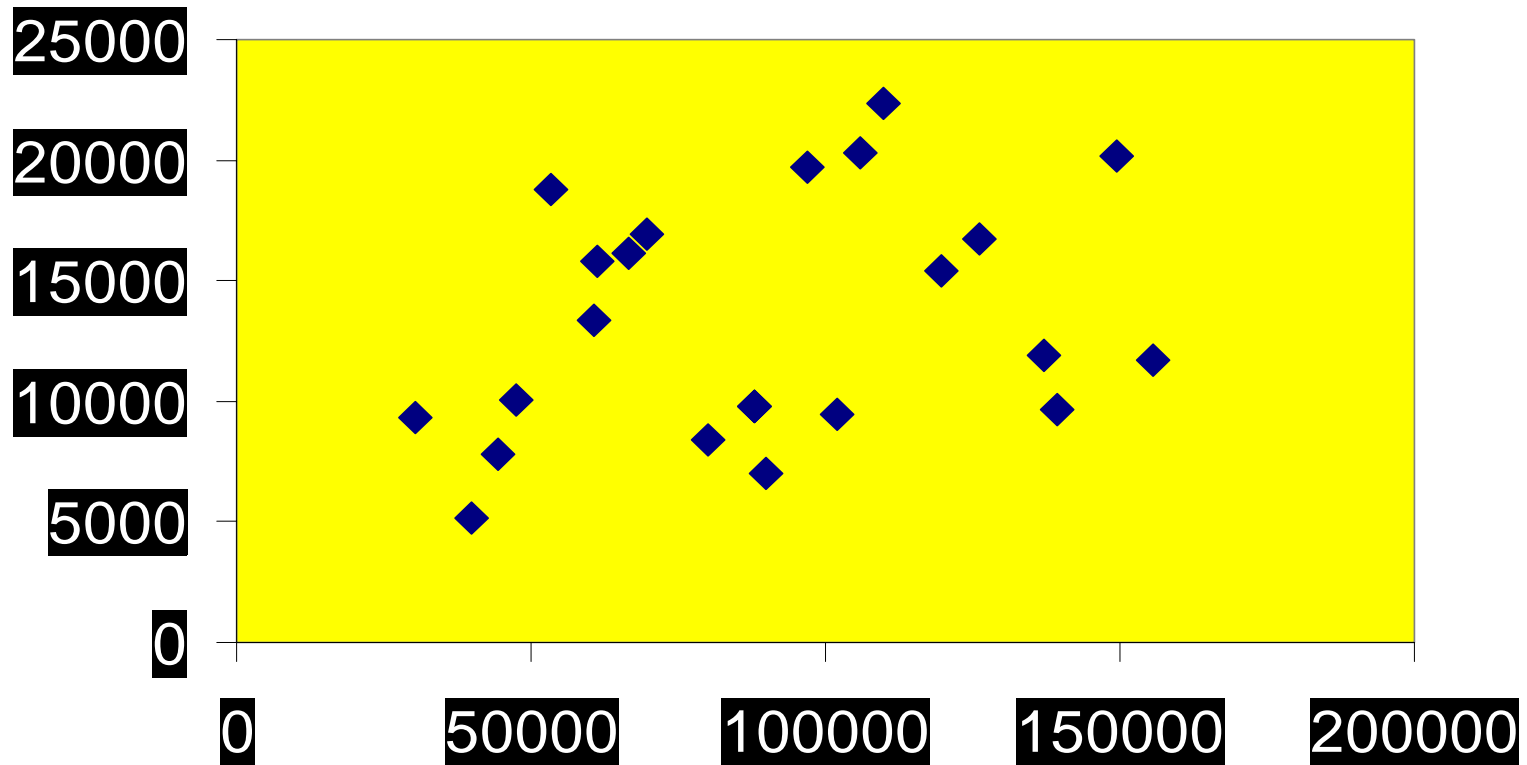
- **School kids living near highways** (van Vliet ER 1997; Brunekreef Epidemiology 1997; Roorda Atmosf Environ 1998; Janssen Atmosf Environ 2001; Rijnders EHP 2001; Janssen EHP 2003)
- **Elderly adults** (Hoek JEAAE 2001; Hoek Lancet 2002)
- **Birth cohorts** (Gehring ERJ 2002; Brauer AJRCCM 2002; Brauer Epidemiology 2003; Hoek Atmosf Environ 2002; Lewny STOTEN 2004; Cyrus JEAAE 2003)

School studies

- Traffic counts for short & long vehicles (~ gasoline vs. diesel)
- Distance
- Measurement of soot, PM_{2.5} and NO₂ at school

Truck (Y) and car (X) traffic density of freeways near participating schools

Janssen Atmosf Environ 2001



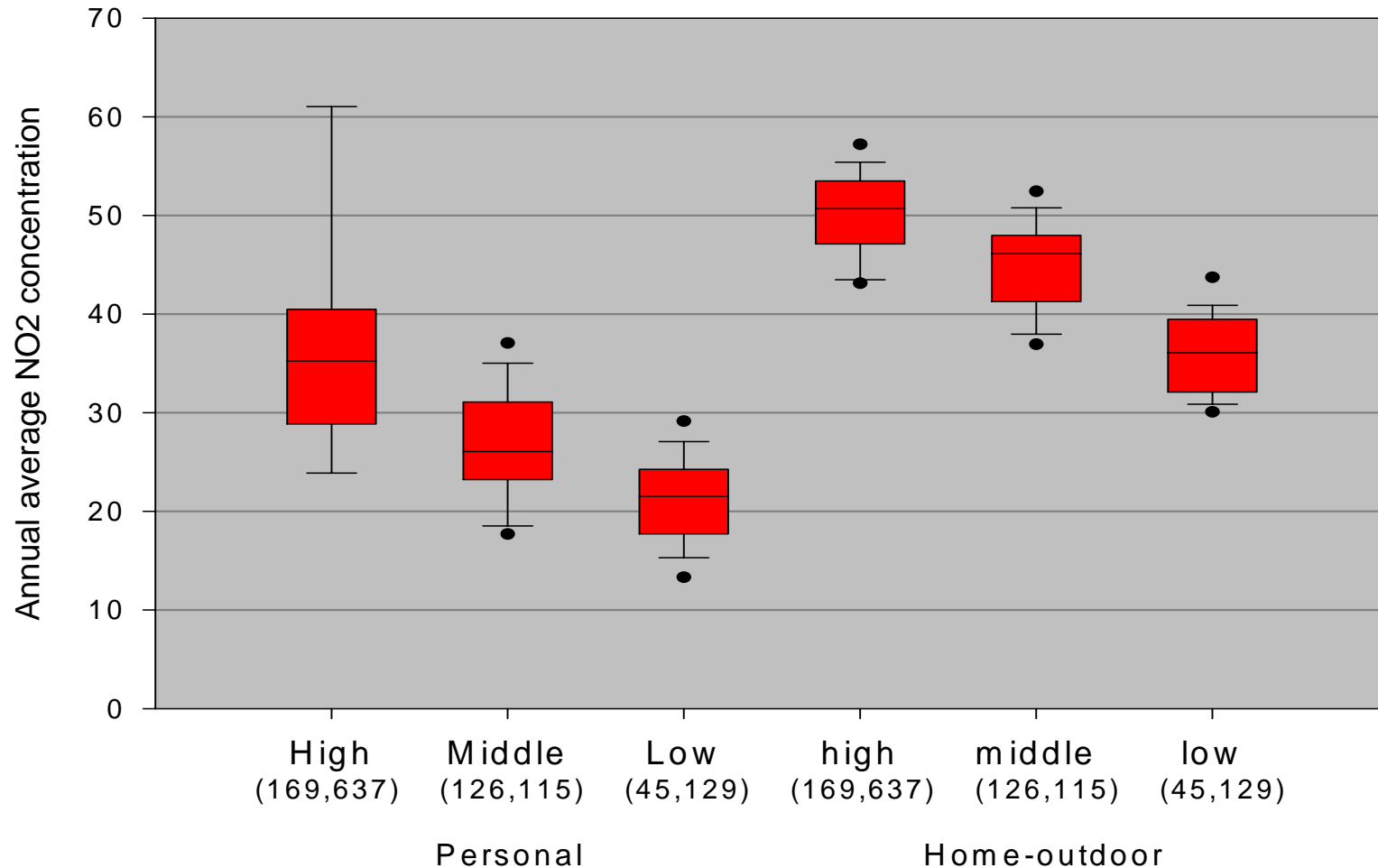
Association between air pollution outdoors and traffic (β , s.e.)

Janssen Atmosf Environ 2001

	<u>Light</u> <u>traffic</u>	<u>Heavy</u> <u>traffic</u>	<u>Log</u> <u>distance</u>
PM2.5	-1.06 (0.51)	4.01 (0.82)	-1.89 (0.53)
Soot	-0.06 (0.40)	2.23 (0.63)	-2.24 (0.42)
NO ₂	2.46 (1.49)	2.41 (2.33)	-2.40 (1.47)

Personal and home outdoor NO₂

Rijnders EHP 2001



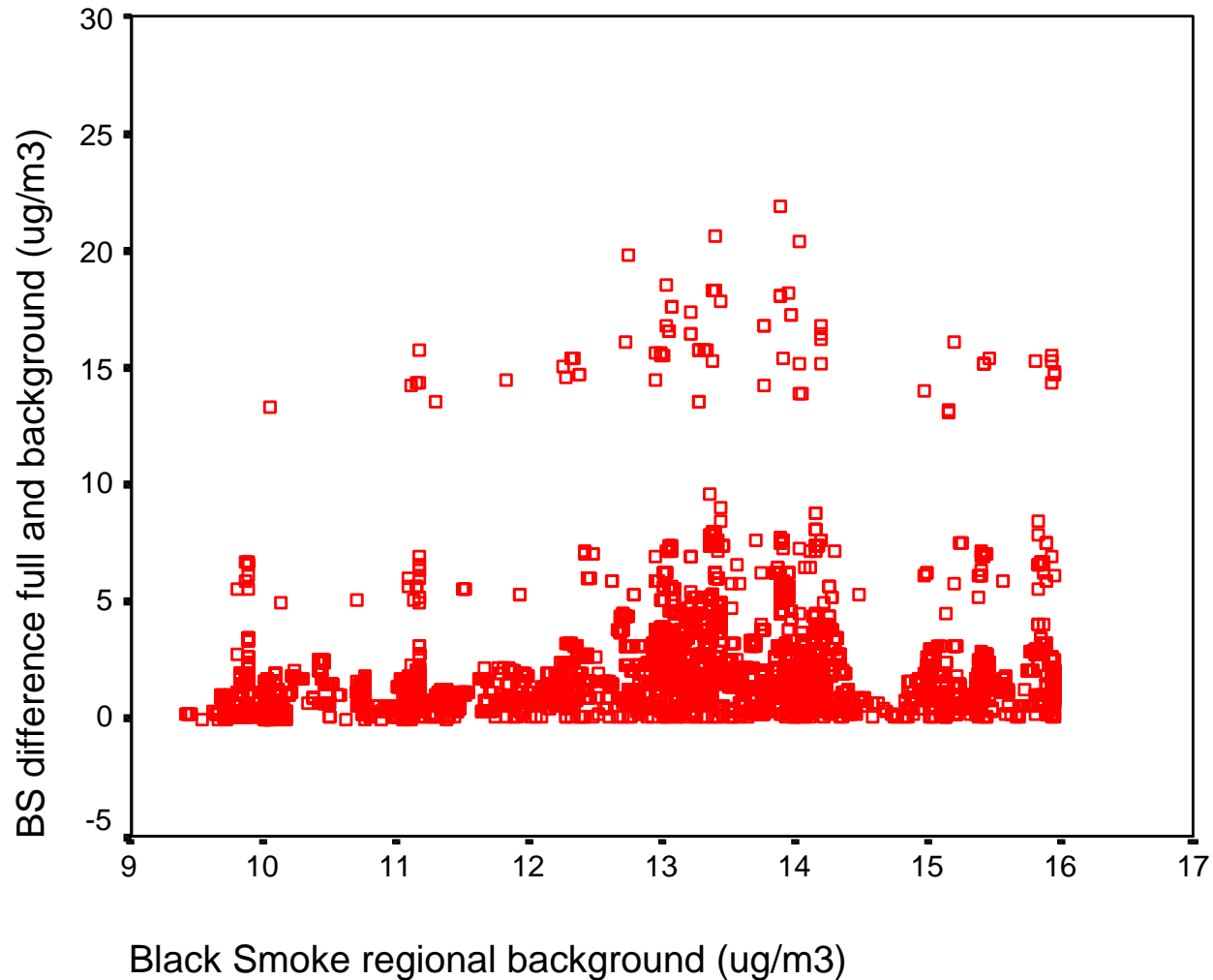
Elderly adults: NLCS study

- Existing cohort study: The Netherlands Cohort study on Diet and Cancer (NLCS); started in 1986
- Included about 120,000 55-69 yr old adults
- Spread over the Netherlands, in small towns and large cities
- **Beelen Poster**

Exposure estimation

- $E = C_{\text{regional}} + C_{\text{urban}} + C_{\text{road}}$
- E = estimated individual 'exposure'
- C_{region} = regional background
- C_{urban} = city contribution
- C_{road} = contribution from major street

Ignoring contribution of urban & local component



TRAPCA

Traffic Related Air Pollution and Childhood Asthma

- Pollution concentrations at 40 sites linked to regional background, GIS traffic-related variables
- Stochastic models developed to describe relationships





Soot Model (GIS variables only)

- $R^2 = 0.81$ (Netherlands)
- $R^2 = 0.67$ (Munich)
- $R^2 = 0.66$ (Stockholm)
 - traffic intensity indicators
 - population density indicators
 - region (NL only)

Soot Model (GIS variables plus locally collected information)

- $R^2 = 0.81 \rightarrow 0.90 \rightarrow 0.94$ (Netherlands)
- $R^2 = 0.67 \rightarrow 0.83$ (Munich)
- $R^2 = 0.66 \rightarrow 0.76$ (Stockholm)
 - street canyon
 - traffic site
 - traffic counts (NL)

Validation of GIS models

- Indoor & personal exposures
- Use of existing databases & new studies
- Ongoing studies among school children & elderly adults (PhD study Sofie van Roosbroeck)



Wichmann (submitted)

Soot from Janssen AJE 1998

	Personal		Indoor	
	β	s.e.	β	s.e.
Traffic home	0.43	0.11	0.51	0.12
Outdoor soot	0.87	0.16	1.00	0.19
Time in transport	0.14	0.06		
Time outdoors	0.06	0.03		

Challenges....

- Further refinement of GIS modeling
- Validation of spatial models for long-term exposure assessment against indoor & personal exposure measurements