

Considerations About Exposure and Health Effects of Traffic Pollution

Northern Transportation and Air Quality Summit 2010

August 24, 2010

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What Is HEI

HEI is a nonprofit organization jointly funded by the US EPA, other government agencies, and motor vehicle industry to evaluate the effects of air pollution on health



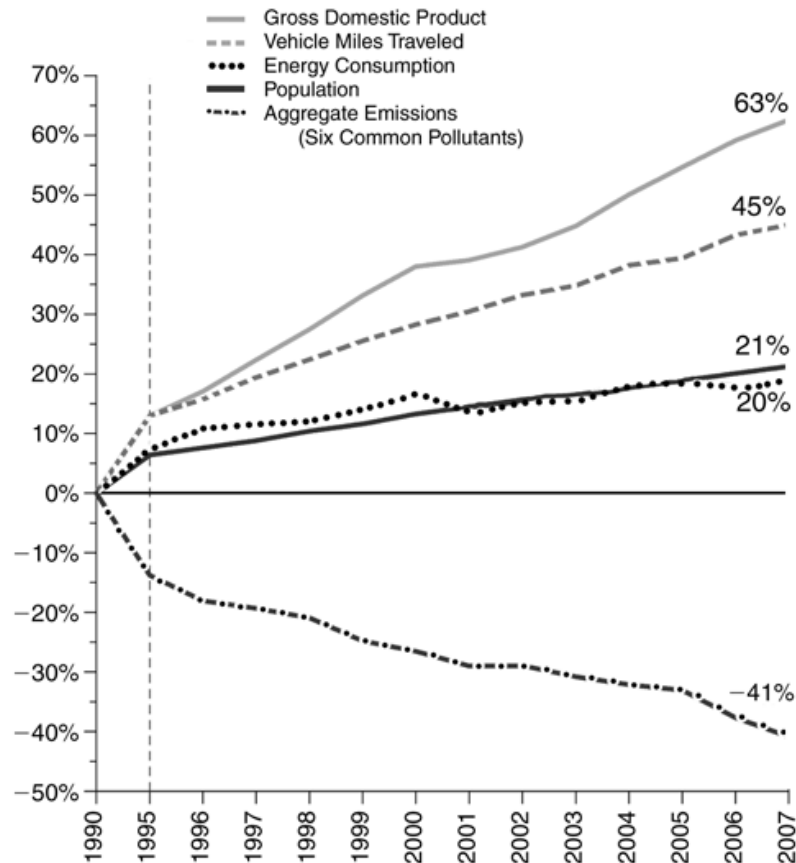
Topics Covered in Presentation

(taken in part from HEI Special Report #17)

- Context
- Considerations about exposure:
 - Area of impact
 - Exposure assessment
- Considerations about health effects
- Conclusions



Changes In Growth Measures and Aggregate Emissions From All Sources



Reductions in emissions from transportation show similar trends

1990–2007. (Adapted from U.S. Environmental Protection Agency 2008.)



Emissions from Motor Vehicles

The Current Context

Significant progress has been made in reducing pollutant emissions from motor vehicles despite increases in number of vehicles and vehicle miles traveled

Increased urbanization and urban populations and changes in land use have:

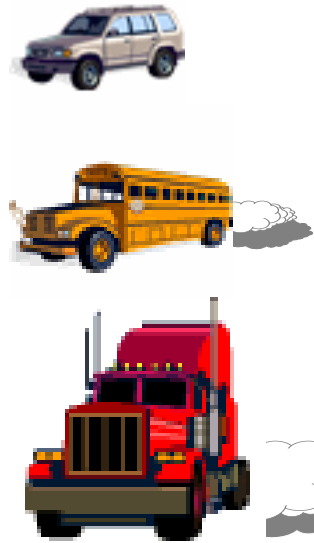
- Increased dependence on motor vehicles and traffic congestion

more people are near traffic sources of pollution

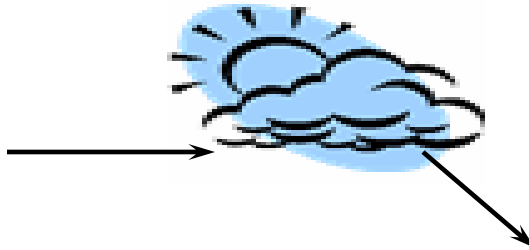


Integrating Disciplines

•Emissions



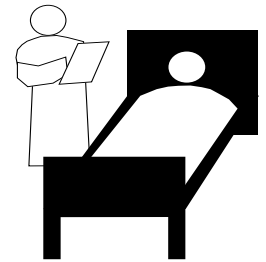
•Physico-chemical changes



•Human exposure



•Health Effects



Other sources

Where is the subject relative to the source (traffic)?



Considerations About Exposure



Pollutants From Motor Vehicles

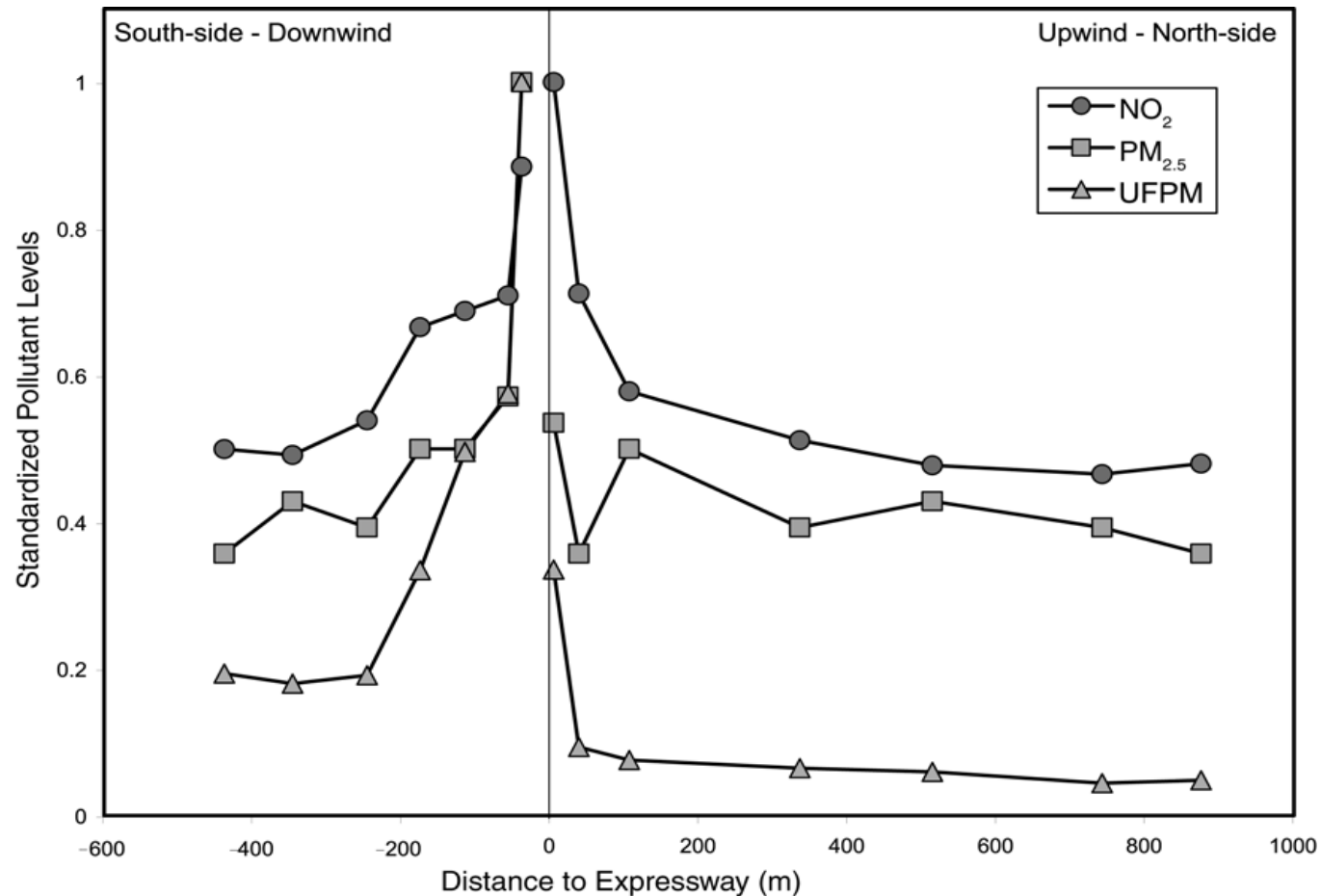
- Traffic pollution is a complex mixture of pollutants derived also from other sources and with different spatial distribution
- The major pollutants associated with pollution from motor vehicles are:

- NO₂
- CO
- Elemental Carbon
- Ultrafine particles

← Surrogates of traffic pollution



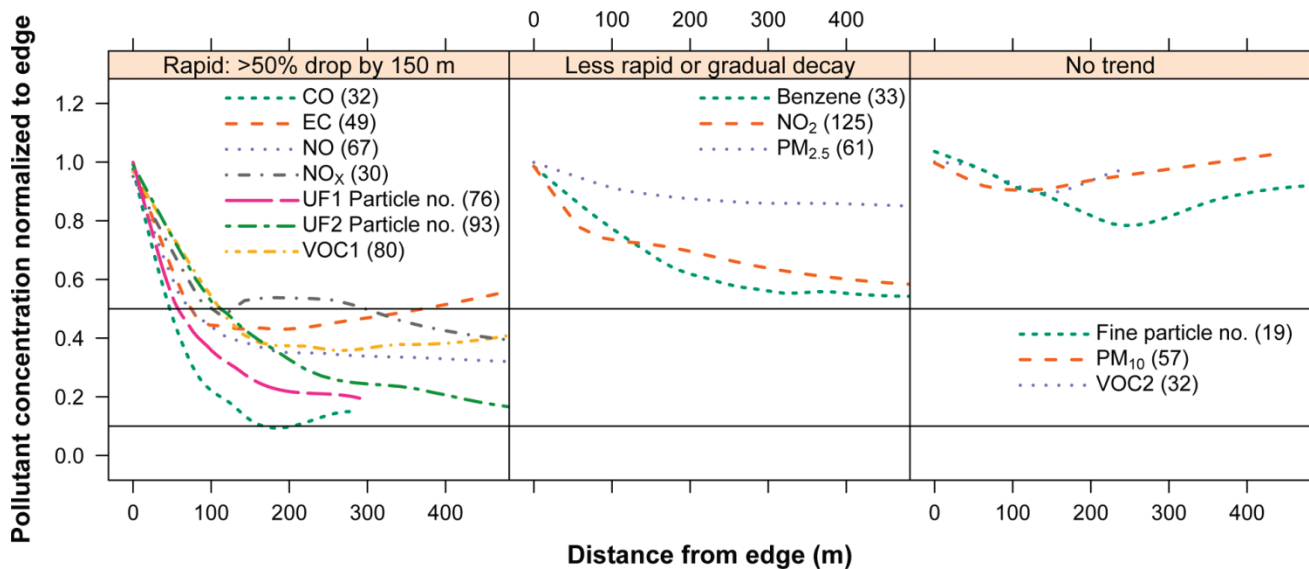
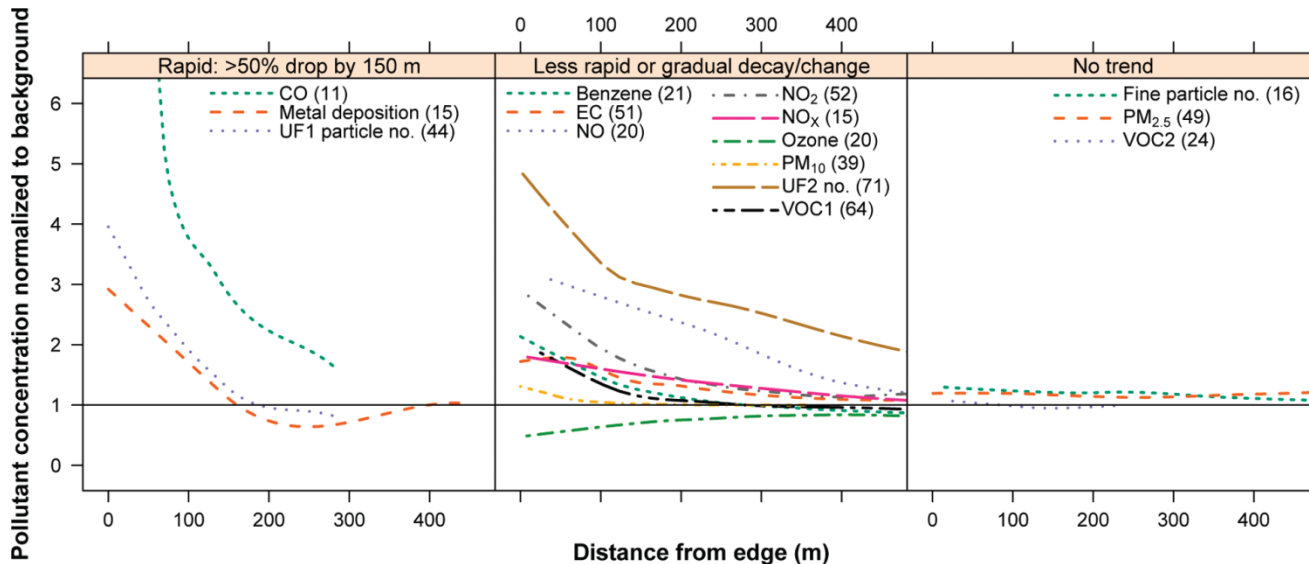
Gradients of NO₂ and PM from Road (Toronto)



From Beckerman et al. *Atm Environ* 2008



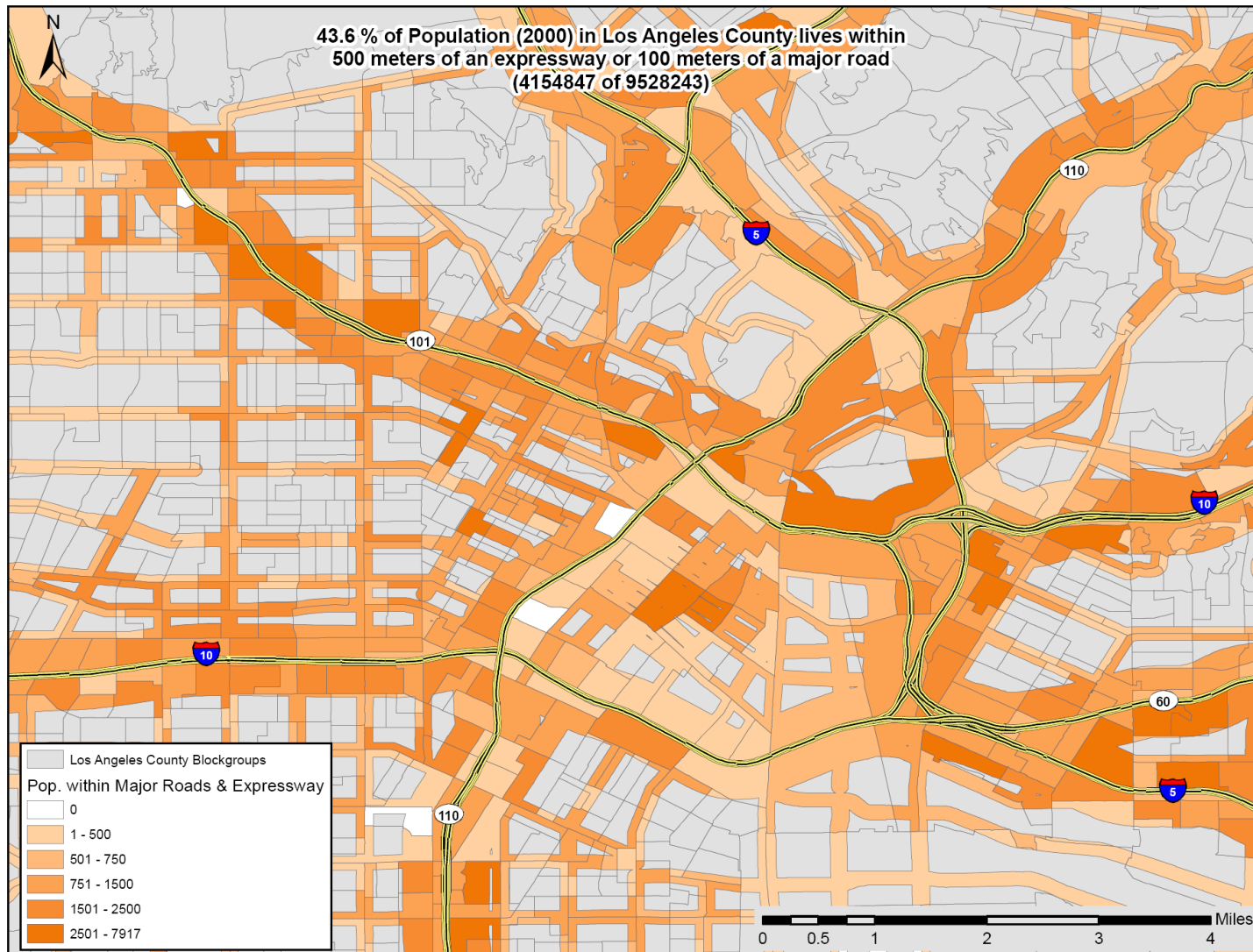
Near-Road Pollutant Gradients



Most pollutants decay to background between 115 and 570 m



Near Roadway Exposure Can Include Large Populations -- Los Angeles: ~44% (within 500 meters of an expressway; 100 meters of a major road)



Traffic Pollution Surrogates and Spatial Gradient Estimates

Most commonly used	CO, EC	Road to 100-400 m
	NO ₂	Road to 200-500 m
	UFPM	Road to 100-300 m
	PM _{2.5}	Spatial gradient less pronounced or non existent

How Do We Assess or Predict Exposure to Traffic Pollutants

- Measurements or modeling of traffic exposure surrogates
- Direct measures of traffic
 - Estimate of traffic density or intensity
 - Distance from and/or length of roadways



Characteristics of a Good Surrogate of Traffic Exposure

- Has traffic as the principal source of emissions
- Varies with other constituents of vehicle exhaust
- Can be measured at low concentrations



Conclusions on Traffic Exposure Surrogates

- None of the pollutant surrogates are ideal surrogates
 - CO, EC, and NO_x [NO₂] found in on-road vehicle emissions are components of emissions from all sources and are also contributed by indoor sources and have substantial variability across locations. Can be useful if measured with fine spatial resolution.
 - PM_{2.5} as a surrogate of traffic pollution is of limited value because it is emitted by many sources and is well mixed within a region
 - UFPM have not been used in epidemiologic studies so far because the characterization of their spatial concentration gradients pose a significant challenge
- Traditional approaches based on measurements at a central monitoring sites are not adequate for estimating exposure to traffic-related pollution



Traffic Pollution Exposure Models

- Estimate of traffic density or intensity
 - Distance from and/or length of roadways
- Direct measures of traffic
- Models that provide surrogate concentrations
 - geostatistical interpolation
 - dispersion
 - land-use
 - hybrid model



Conclusions on Exposure Models

- Direct measures of traffic are prone to errors; the distance measure can be confounded by socioeconomic status
- Progress has been made in exposure modeling, mainly to due to GIS techniques, but there are still problems with data input:
 - Geocoding of residences is not accurate
 - Data needed for land-use regression are often incomplete and of varying quality
 - Traffic counts and emission data are also prone to errors



Considerations About Health Effects



Are There Susceptible Populations?

Among those exposed to air pollution from traffic (such as those living near busy roads):

- Young children may be at higher risk of developing asthma;
- Asthmatic children may have more asthma symptoms;
- Asthmatic individuals may be more susceptible to some adverse health effects (such as decrements in lung function);
- Individuals with underlying cardiovascular disease may be at higher risk of progression of the disease;
- Groups of lower socioeconomic status may have more serious effects.

Assessment of the characteristics of persons with increased susceptibility has not been extensively carried out.



Prevalence of Asthma with Distance from Major Road

McConnell et al 2006

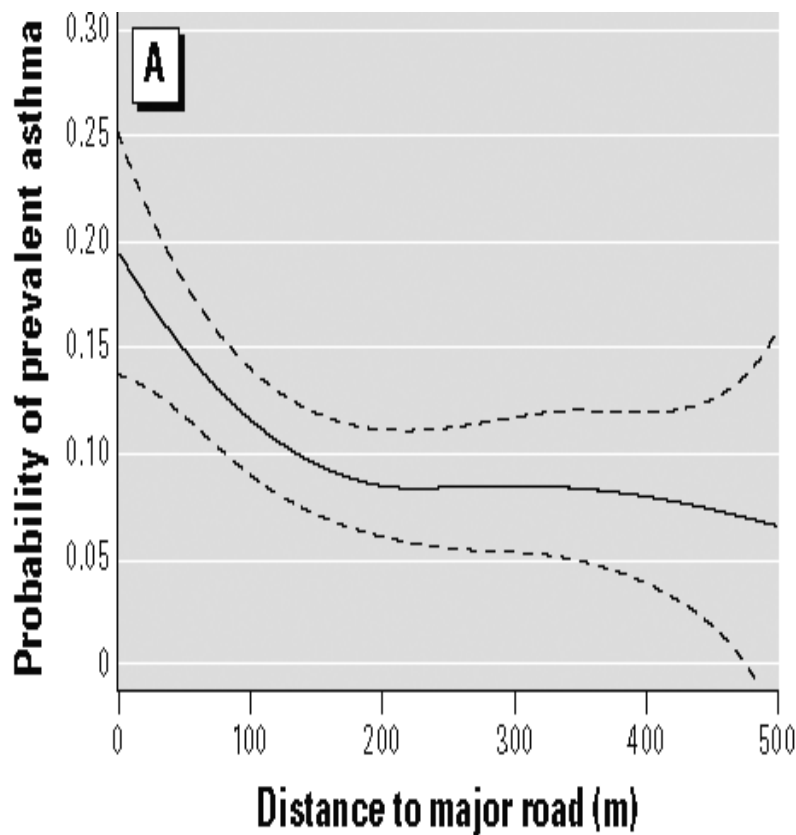
- Children (5-7 years of age) living in 13 communities in Southern California
- Parents were asked to respond to the question: “has your child ever been diagnosed of asthma?”
- Parents were asked about their asthma status
- Residential exposure was assessed by proximity to a major road using GIS



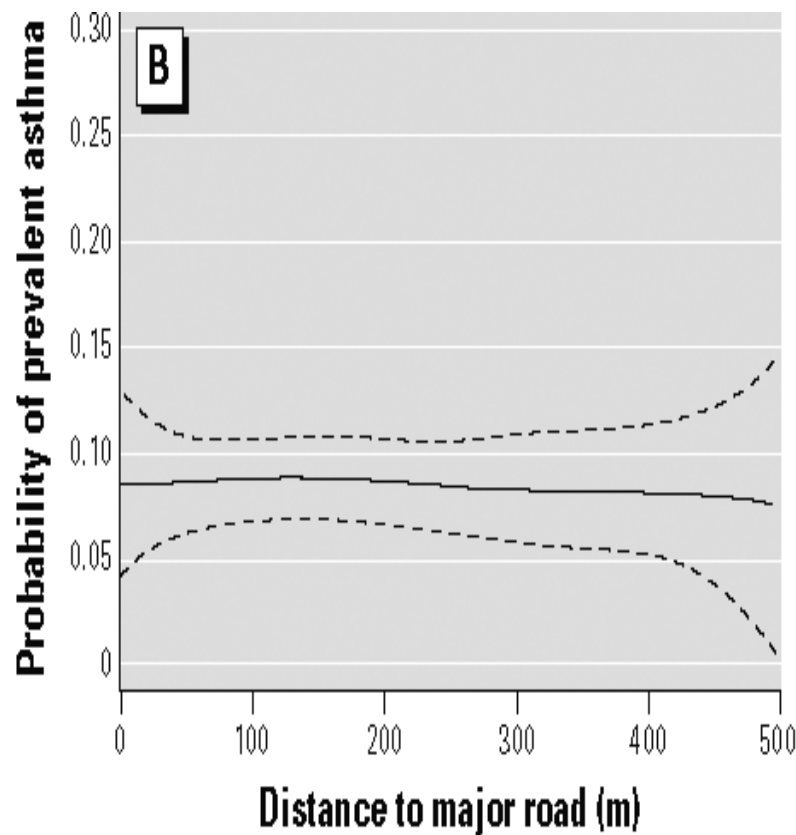
Asthma Prevalence by Distance to Road

McConnell *et al*, 2006

Children (5-7 year old) with no family history of asthma



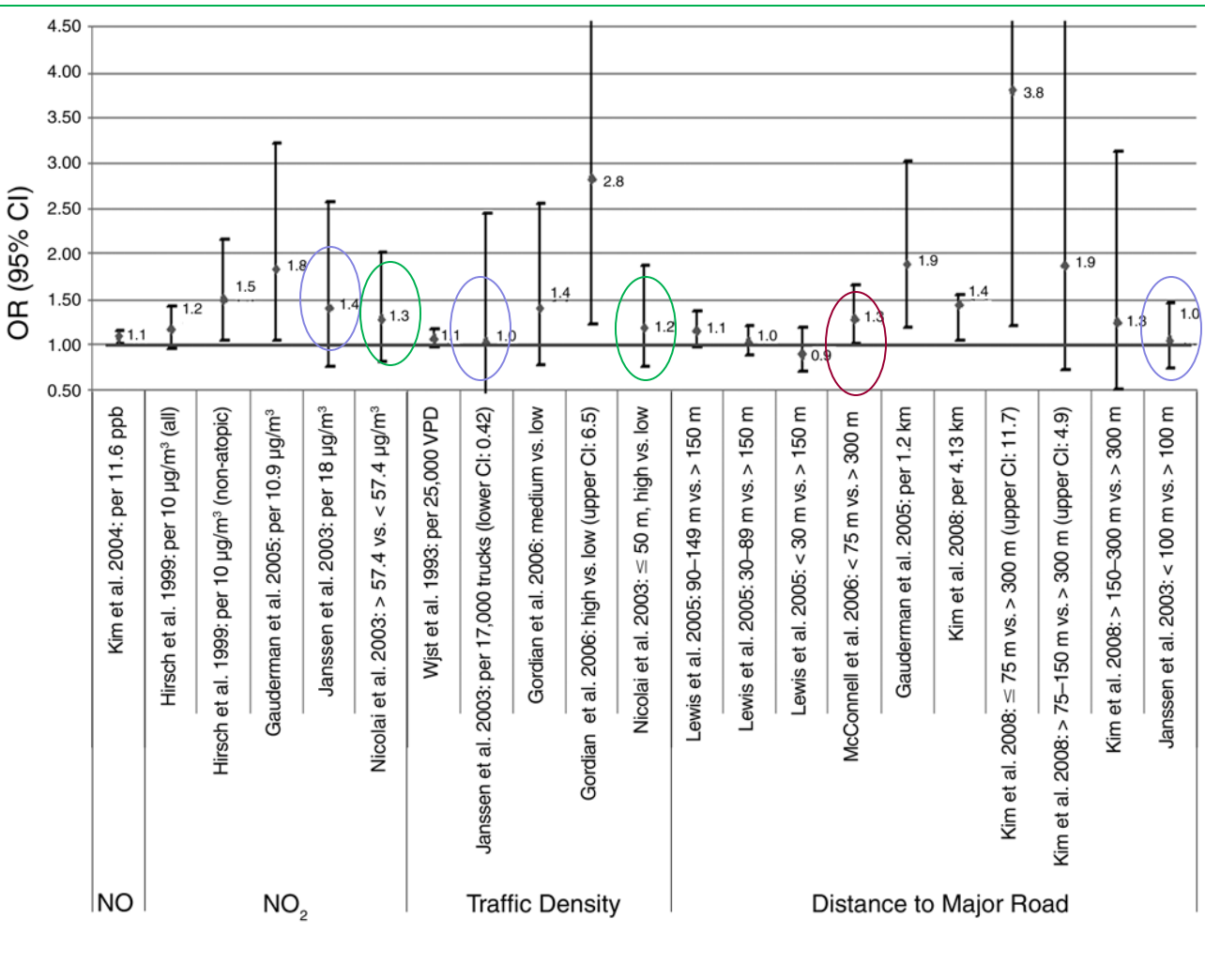
- A. Long-term residents
• (before age 2)



- B. Short-term residents
• (after age 2)



Traffic Exposure and Asthma Prevalence (in Children)



Synthesis of Evidence

“Sufficient” OR

“suggestive but insufficient”

to infer causal association

Reasons

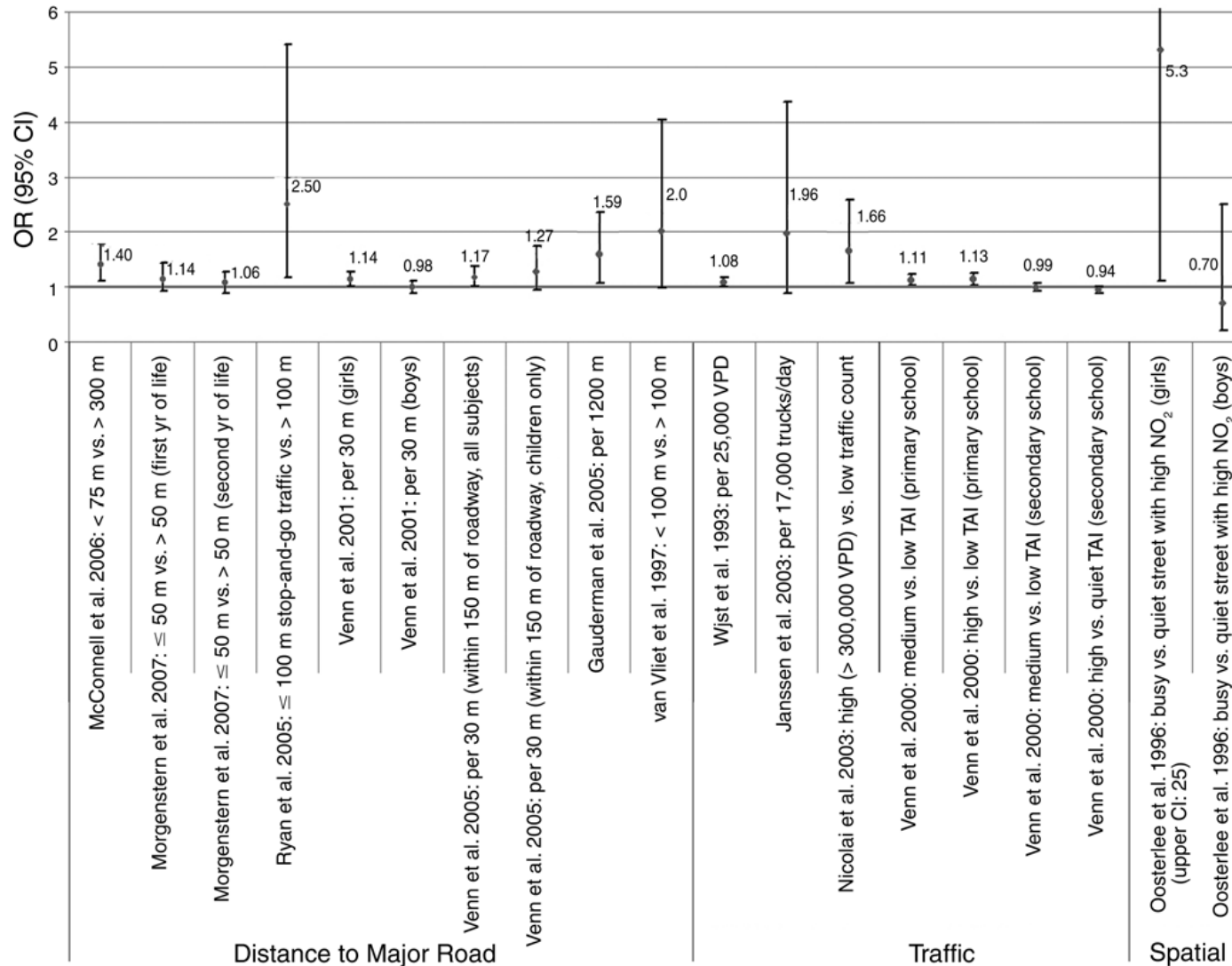
Studies including both traffic-specific pollutants and density measures most consistent

Studies on prevalence were consistent with studies of incidence



Exacerbation of Asthma Symptoms

Increase in Wheeze in Children



Conclusions



Exposure – Area of Impact

- Traffic-related pollutants impact ambient air quality on a broad spatial scale ranging from roadside, to urban, to regional background
- Based on synthesis of evidence, 300-500 meters from a major road was identified as the near-source area most impacted by traffic; variations exist depending on meteorology, background pollution, and local factors



Overall Conclusions

- In light of the large number of people residing within 500 m of major roads, the HEI Panel concluded that the sufficient and suggestive evidence for several health outcomes indicates that exposure to traffic related air pollution are likely to be of public health concerns and deserve public attention.



Thanks!

For the HEI Traffic Report visit
www.healtheffects.org

