U.S. Department of Transportation
Federal Highway Administration

Federal Highway Administration
RESOURCE CENTER

Health Effects Institute Traffic-Related Research Studies

Midwest Transportation Air Quality Summit
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FHWA Resource Center

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Health Effects Institute (HEI)

The Health Effects Institute (www.healtheffects.org) is an independent, non-profit organization funded by EPA, FHWA, and industry

Completed research studies include:

1. Diesel Emissions and Lung Cancer
2. Mobile Source Air Toxics
3. Traffic-Related Air Pollution

Diesel Emissions and Lung Cancer

Special Report – *Diesel Emissions and Lung Cancer: Epidemiology and Quantitative Risk Assessment*, June 1999, http://pubs.healtheffects.org/getfile.php?u=282

Examine published epidemiologic studies of diesel exhaust emissions and lung cancer for possible use in support of quantitative risk assessments

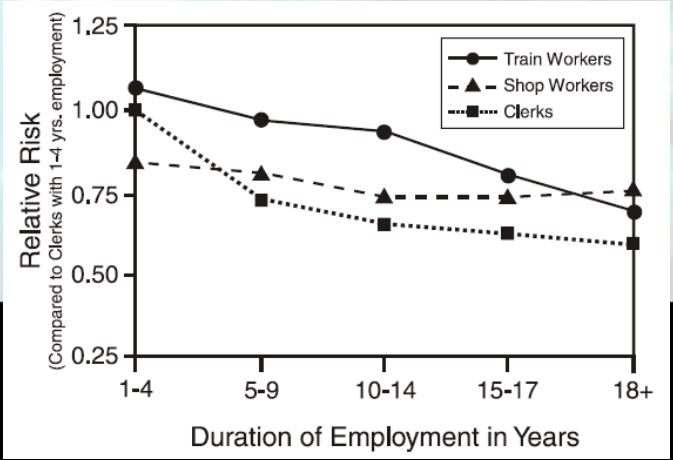
Only two such studies were identified:

1. Railroad workers studies
2. Teamsters studies

Diesel Emissions and Lung Cancer

Findings

- Enhanced exposure and epidemiologic data and analysis are needed for the purposes of quantitative risk assessments
- Using the current railroad worker data as the basis for quantitative risk assessments in ambient settings is not recommended
  - The relation of lung cancer risk to duration of employment is negative within all job categories



Diesel Emissions and Lung Cancer

Findings

- Further scrutiny of the teamster data is recommended in order to improve the use of these data in quantitative risk assessments
  - More similar to ambient exposures of the public
  - The source of the diesel exhaust is likely to be more relevant to regulatory issues

Mobile-Source Air Toxics

Special Report 16 – *Mobile-Source Air Toxics: A Critical Review of the Literature on Exposure and Health Effects*, November 2007
http://pubs.healtheffects.org/getfile.php?u=384

Seven priority MSATs were selected for detailed review (electing not to focus on a critical review of diesel exhaust):

1. acetaldehyde;
2. acrolein;
3. benzene;
4. 1,3-butadiene;
5. formaldehyde;
6. naphthalene; and
7. polycyclic organic matter

Mobile Source Air Toxics

For each MSAT, the HEI report answers three questions:

- To what extent are motor vehicles a significant source of exposure?
- Does it affect human health?
- Does it affect human health at environmental concentrations?

Mobile Source Air Toxics

Compound	To what extent are motor vehicles a significant source of exposure?	Does the MSAT affect human health?	Does the MSAT affect human health at environmental concentrations?
Acetaldehyde	• A significant, but not the principal source of exposure • Concentrations tend to be lowest outdoors; 2 to 10 times higher indoors and in vehicles • Present in many foods	• An irritant • Carcinogen in rodents, inadequate data on human carcinogenicity • Data on respiratory effects limited to mainly small clinical studies	• Only one small epidemiological study, which was unable to distinguish its effect from other pollutants • Ambient concentrations appear to be far below those producing irritation • Future emissions likely to in-crease with increased ethanol use
Acrolein	• Limited urban roadside and in-vehicle data do not suggest elevated exposures • Exposure contributions from mobile sources might result from formation from 1,3-butadiene • Environmental tobacco smoke is a major indoor source	• Very irritating to the respiratory tract • Several animal bioassays have not provided substantive evidence of carcinogenicity	• Insufficient data for an assessment of ambient exposures on human health • Measured environmental concentrations and personal exposures only slightly lower than concentrations shown to cause irritation
Benzene	• Mobile sources are an important component of overall exposure • Highest concentrations were found at urban roadside and urban in-vehicle locations • Personal exposure levels appeared to be in the same range as ambient levels	• Exposures linked to increased risks of acute myeloid leukemia • Data from several new cohorts demonstrated increased risks at lower estimated exposures than previously observed	• Studies have yielded mixed results regarding association between traffic and childhood leukemia • There remains considerable uncertainty as to the lowest concentration associated with adverse hematological effects

Mobile Source Air Toxics

Compound	To what extent are motor vehicles a significant source of exposure?	Does the MSAT affect human health?	Does the MSAT affect human health at environmental concentrations?
1,3-Butadiene	• Mobile sources are the most important contributors to ambient exposures in most locales • Concentrations are highest near sources; indoor concentrations might be higher than outdoor concentrations • Its high reactivity results in the production of formaldehyde, acetaldehyde, and acrolein	• Possibly causes lymphohemato-poietic cancers in humans in high-exposure occupational settings • Clear evidence of effects in animal studies	• No direct evidence of health effects at ambient concentrations, but community studies have limitations due to low exposure concentrations and presence of other pollutants
Formaldehyde	• Indoor sources appear to be the principal source of exposure, 3 to 5 times higher than outdoor concentrations • Mobile sources are an important source of ambient concentrations with highest levels found at urban roadside sites • Photochemical activity contributes more to ambient levels than direct vehicle emissions	• Irritant to eyes, skin, and respiratory tract • Evidence of nasopharyngeal cancer at concentrations historically encountered in industrial settings	• Limited and inconclusive evidence that indoor exposure increases the occurrence of asthma in children • No evidence about health effects at ambient concentrations

Mobile Source Air Toxics

Compound	To what extent are motor vehicles a significant source of exposure?	Does the MSAT affect human health?	Does the MSAT affect human health at environmental concentrations?
Naphthalene	• Mobile sources are an important, but not the primary source of exposure • Concentrations are higher at roadside sites and in vehicles • Indoor concentrations are typically 5 to 10 times higher than ambient concentrations	• There are no data on carcinogenicity in humans; there is evidence in rodents that exposure leads tumors of the nasal and olfactory epithelium • Case reports that exposures can cause effects in blood cells	• No studies that assess the health effects at ambient concentrations
Polycyclic Organic Matter (POM)	• No standard exposure or health based definition of POM • Food-derived sources are likely to be the principal source of exposure in many settings • Mobile sources might be significant contributors to ambient concentrations in urban settings • Diesel vehicles emit more polycyclic aromatic hydrocarbons (PAHs) than gas vehicles	• A few PAH components are potent animal carcinogens; some of these are classified as human carcinogens • At high occupational exposures, there is sufficient evidence for increased risk of lung cancer in coke-oven workers and possibly in asphalt-industry workers	• No direct evidence from community studies that ambient exposure concentrations causes health effects, but these studies have limited ability to address the effects

Mobile Source Air Toxics

Among the gaps and recommendations offered in the HEI report are:

- It is evident that exposure to many MSATs comes from sources other than vehicles
- Mobile sources are the primary sources of exposure for only a few of the 21 MSATs listed by the EPA in its 2001 rule
- Cancer-potency estimates have been derived largely from occupational exposures to high concentrations. These data might be of limited utility in the evaluation of health effects at ambient concentrations
- Some cancer-potency estimates for MSATs have been derived from animal models. Extrapolating these results to humans remains troublesome

Mobile Source Air Toxics

Among the gaps and recommendations offered in the HEI report are:

- Clear need for better attribution of the sources, e.g., measuring concentrations at roadsides and in vehicles
- Need for better characterization of concentrations in homes and workplaces and the factors that affect these concentrations
- Improved modeling and better characterization of spatial and temporal trends are vital to the assessment of the effect of regulatory changes on the emissions of MSATs

Traffic-Related Air Pollution

Special Report 17 – *Traffic-Related Air Pollution: A Critical Review of the Literature on Emissions, Exposure, and Health Effects*, May 2009 preprint
http://pubs.healtheffects.org/getfile.php?u=453

The primary goal of the research is to summarize and synthesize relevant information on air pollution from traffic and its health effects

Traffic-Related Air Pollution

Researchers looked at linkages between:

1. Traffic emissions (at the tailpipe) with ambient air pollution in general;
2. Concentrations of ambient pollutants with human exposure to pollutants from traffic;
3. Exposure to pollutants from traffic with human-health effects and toxicological data; and
4. Toxicological data with epidemiological associations

Traffic-Related Air Pollution

Overall Conclusions

- Evidence was "sufficient" to infer a causal relationship between exposure to traffic-related air pollution and the exacerbation of asthma
- Evidence was "suggestive but not sufficient" to infer a casual relationship with onset of childhood asthma, non-asthma respiratory symptoms, impaired lung function, and total and cardiovascular mortality
- Since the epidemiologic studies are based on past estimates of exposure, they may not provide an accurate guide to estimating health associations in the future