

10070- Abstract

Title

Assessment of risk factors in exposure to ultra-fine particles and respiratory health in school students

Authors

Lynne Johnson, Shilu Tong, Lidia Morawska, Charles Mitchell.

Respiratory symptoms and allergic status in asthmatics and those with pre-existing respiratory conditions are likely to be influenced by a number of factors. These will include medical history, socio-economic background, diet, household environment, smoking, health status and exposure to allergens. One area that has also generated interest is the likely impact of air pollutants.

Studies of ultra fine particle air pollution and respiratory health have been limited to-date. One of the major reasons for this is the lack of a standardised questionnaire to assess confounding factors. Existing questionnaires include the ATS survey and a recently developed survey as part of the ISAAC project. However, most researchers find it necessary to modify these surveys for use in air pollution-respiratory health studies.

A modified questionnaire on confounding factors and respiratory health has been developed at QUT as part of a study of exposure to ultra-fine particles from vehicles and respiratory health in schoolchildren. The study is investigating the respiratory health status of children attending a school located on a major freeway compared with students attending a school located away from the influence of high volumes of traffic. The symptoms to be investigated include: wheeze, cough; increased medication use; bronchial irritation symptoms, asthma, allergic rhinitis, hay fever, allergic status and lung function. Confounding factors considered in the survey include: ethnicity, residential history, overcrowding, indoor air quality, exposure to pets, carpets, child and parent's medical history; breastfeeding, diet, physical fitness, immunisation status, paracetamol usage and smoking history of parents. This paper will detail the development of the questionnaire and present the results of a pilot study to trial the instrument.

**10086- Carbon Monoxide Exposure and Cardiac Markers in Commercial Vehicle Drivers:
A Nigerian Urban Experience**

S. O. Banjoko and M. K. C. Sridhar

Division of Environmental Health,

Department of Epidemiology, Medical Statistics and Environmental Health,
Faculty of Public Health, College of Medicine, University of Ibadan, Ibadan, Nigeria

Carbon monoxide (CO) exposure is known to affect hemoglobin (Hb) in humans and certain cardiac markers such as creatine kinase MB (CK-MB) and C-reactive protein (CRP) in plasma reflect the degree of exposure. A study was carried out in Ibadan, capital of Oyo State in Nigeria, on the exposure of 150 professional drivers to CO in vehicular emissions inside the automobiles used for commercial purposes. These drivers were grouped into three categories: those driving minibuses and taxicabs using gasoline, and those who use diesel-powered buses. A control group of 100 residents who never drove any automobile were drawn from the University of Ibadan for comparison. The sample populations were selected randomly from each group after stratifying them into various categories. The CO, COHb, CK-MB and CRP were measured using standard methods.

The results showed that the ambient CO levels in Ibadan ranged between 3 and 5 ppm with a mean value of 4 ppm (International permissible limit is 10 ppm). The mean CO exposure levels in minibuses, taxicabs, and diesel-powered vehicles were, (ppm, respectively): 22.0 ± 3.3 , 25.0 ± 6.0 , and 17.0 ± 3.0 thus indicating the higher levels in taxicabs ($p < 0.001$). The COHb levels among the drivers of minibuses, taxicabs and diesel-powered vehicles were, respectively: 4.78 ± 1.50 , 4.33 ± 1.6 , and 4.09 ± 1.16 ($P < 0.001$). The controls showed COHb levels of 2.7 ± 0.92 . A dose effect relationship was observed between CO exposure and COHb levels with a correlation coefficient of 0.173. The control populations with smoking habits showed significantly higher COHb levels 5.33 ± 0.88 , and 3.75 ± 0.988 , respectively, ($P < 0.001$). Exposed groups with smoking habits showed slightly increased COHb levels but not significant ($P > 0.05$): minibus drivers, 5.08 ± 1.78 and 4.21 ± 1.58 ; taxicab drivers, 4.32 ± 1.99 and 4.21 ± 1.58 ; and diesel-powered vehicle drivers, 5.10 ± 1.60 and 4.10 ± 1.08 . The cardiac markers did not show any variation among the exposed and the controls. The results suggest that CO exposure have significant health effect on the drivers and smoking aggravates the effects, which may lead to myocardial ischaemia.

10418- Exposure assessment of motor transport to the health of population in Sumgayit

Air pollution is a major environmental health problem affecting developed and developing countries around the world. Increasing amounts of potentially harmful gases and particles are being emitted into the atmosphere on a global scale, resulting in damage to human health and the environment.

Sumgayit was one of the industrial city of the former Soviet Union. In the last 10 years, in spite of most of Sumgayit industrial enterprises working only at 10-15% of their capacity the air quality is not improved.

At present the sources of air pollution in Sumgayit are motor transport.

The aim of the study was identification of negative affect of active factors to the health of Sumgayit population

Methods. It was studied motor transport fleet; density and type of motor transport in roads; different aspect of harmful effect of motor transport to the population health of Sumgayit; the state of population health for the last ten years.

Result: It has been evaluated the affect of motor transport to the population health of Sumgayit.

10463- Traffic density and fine particulate matter concentrations in highway toll station workers in Taipei

Lai, Ching-Huang^{1,6}; Liou, Saou-Hsing¹; Tsai, Perng-Jy.²; Shih, Tung-Sheng³; Chen, Hsiao-Lung²; Chang, Yue-Cune⁴; Strickland, Paul⁵; Buckley, Timothy J.⁵; Jaakkola, Jouni.J.K.^{6,7,8}

¹ Department of Public Health, National Defense Medical Center, Taiwan, ROC

² Department of Environmental and Occupational Health, National Cheng Kung University, Tainan, Taiwan, ROC

³ Institute of Occupational Safety and Health, Council of Labor affairs, Executive Yuan, Taipei, Taiwan, ROC

⁴ Department of Mathematics, Tamkang University, Taipei, Taiwan, ROC

⁵ Department of Environment Health Sciences, Johns Hopkins Bloomberg School of Public Health, Baltimore, USA

⁶ Department of Epidemiology, Johns Hopkins Bloomberg School of Public Health, Baltimore, USA

⁷ The Nordic School of Public Health, Göteborg, SWEDEN,

⁸ Department of Public Health, University of Helsinki, Helsinki, FINLAND

Objectives: We assessed the relation between passing traffic density and personal exposure to PM_{2.5} among toll station workers in Taipei.

Methods: We used personal monitors to assess the integrated 8-hour PM_{2.5} concentration in breathing zones of toll station workers. We compared the exposure levels between truck and bus lanes, car lanes using cash payment, and car lanes using ticket payment. Generalized estimating equations (GEE) were applied to account for correlated successive measurements of PM_{2.5} concentrations.

Results: The mean PM_{2.5} concentrations were significantly substantially higher in truck and bus lanes ($308.22 \pm 115.48 \mu\text{g}/\text{m}^3$, n=59) compared with car lanes with cash payment (115.56 ± 41.77 , n=54) and car lanes with ticket payment (109.50 ± 48.65 , n=108). The traffic densities were 274 per hour for trucks and buses and 390 per hour for cars in the cash payment and 661 per hour for cars in the ticket payment lanes. The intensity of PM_{2.5} concentration per unit of vehicle in truck & and bus lane was 6.4 and 3.7 times stronger than that of pay by ticket lane and pay by change lane. The intensity of traffic pollution per unit of vehicle on pay by change lane was 1.7 times greater than that of pay by ticket lane.

Conclusions: Toll station workers are continuously exposed to very high concentrations of fine particles. Buses and trucks constitute a stronger source of exposure compared with cars.

10568- THE USE OF THE P-TRAK IN MEASURING EXPOSURE TO ULTRAFINE PARTICLES UNDER DIFFERENT DRIVING CONDITIONS

Heff, A¹, Laden, F^{1,2}, Garshick, E^{2,3}, Natkin, J¹, Hart, JE², Smith, TJ¹. ¹Dept. of Environmental Health, Harvard School of Public Health, ²Channing Lab, Brigham & Women's Hosp, Harvard Medical School, ³VA Boston Healthcare System, Boston, MA, USA.

OBJECTIVES: Vehicle emissions, including gasoline and diesel exhaust, contain ultrafine particulate matter (less than 1 micron in diameter). Studies have found that the majority of particulate matter of this size range is produced by diesel engines. In the US, diesel engines are predominantly found in midsize and heavy-duty trucks; automobile traffic is overwhelmingly gasoline engines. Driving conditions, such as traffic density, type of surrounding vehicles and ambient exposures, affect the exposure experienced by a driver. We used the P-Trak (TSI, Inc), an inexpensive real-time particle counter to measure concentrations of ultrafine particles in the passenger compartment of motor vehicles. This instrument was originally developed for indoor air quality measurements. It is most sensitive to particles of less than 0.1 micron diameter.

METHODS: As part of the Trucking Industry Particle Study, an extensive nationwide study of exposure to diesel exhaust in the U.S. trucking industry, we are testing the use of this instrument for recording real-time exposure to ultrafine particles. Data were collected in vehicles driving in the Boston-metro area, including urban and suburban roads, major highways with truck traffic, and major highways without truck traffic. Driving and traffic conditions were recorded while driving for later interpretation of P-Trak data. **RESULTS:** There are two modes of traffic exposure to ultrafine particles, one due to immediate exposure to a nearby truck with noticeable emissions, the other is the background left by trucks that had previously driven in the area. The immediate mode produced very large peaks in particulate concentration, e.g., 300,000 particles per cm³, and occurred in proximity to either visibly older trucks or to certain smaller trucks. Particulate exposure in the background mode, e.g., 50,000 to 100,000 particles per cm³, was largely a function of average vehicle speed, as opposed to vehicle density. It was also a function of the presence of trucks on the road. On a highway that banned trucks, particulate concentrations were similar to nearby local roads. **CONCLUSIONS:** Ultrafine particulate concentrations experienced inside vehicles, as measured by the P-Trak, are higher on highways frequented by trucks, even in lighter traffic, than on city streets or highways without truck traffic. These observations suggest that the P-Trak is a useful inexpensive device for qualitative real-time measurements of both rapid and long-term variations in particulate concentrations experience inside vehicles.

10572- THE ACCELEROMETER AS A TOOL TO DISTINGUISH BETWEEN DRIVING ON OPEN HIGHWAYS AND ON LOCAL ROADS

Heff, A¹, Laden, F^{1,2}, Garshick, E^{2,3}, Natkin, J¹, Hart, JE², Smith, TJ¹. ¹Dept of Environmental Health, Harvard School of Public Health, ²Channing Lab, Brigham & Women's Hosp., Harvard Medical School, ³VA Boston Healthcare System, Boston, MA, USA

OBJECTIVES: Exposure to diesel exhaust and particulate matter vary by type of road and driving conditions. Distance between and type of vehicles differ on the open highway and in stop-and-go traffic on city streets affecting the exposure experienced by a driver, both the intensity and the composition. It is therefore important in an exposure assessment study of professional truck drivers to be able to distinguish between these driving scenarios for the interpretation of real-time particulate measurements. For logistical and safety reasons it is not practical for a driver to constantly record the driving conditions. Further, the use of a video camera is also not feasible due to legal issues. Therefore we propose the use of an accelerometer for this purpose. **METHODS:** The instrument used in this study, an Endevco capacitive accelerometer, is a real-time instrument that records changes in velocity by detecting changes in the separation between two parallel plates caused by inertial or gravitational forces acting on the device. The output is digitized and data-logged. Relevant frequencies are frequencies less than 1 Hz. Relevant accelerations are up to 0.05 g's, which corresponds to an acceleration of about zero to sixty miles per hour in one minute. As part of the Trucking Industry Particle Study, an extensive nation-wide study of the US trucking industry, accelerometers are being placed in vehicle cabs to record driving conditions. **RESULTS:** Two distinct modes of accelerometer data were observed, one associated with highway driving and one with local roads, i.e., for stop-and-go traffic. The highway mode is characterized by long periods of steady driving broken by occasional changes, i.e. a time-independent distribution of accelerations, whereas the stop-and-go mode shows an alternating pattern of quiescent (stops) and highly variable signals. These two modes can be distinguished algorithmically by time-series and correlation methods. **CONCLUSION:** The accelerometer is an unobtrusive method that can be combined with real-time vehicular particulate exposure monitoring in order to differentiate between highway and local driving, which will have qualitatively different emissions.

10883- Trends in Carbon Monoxide Exposures Inside a Vehicle Based on Three Field Studies of a Standardized Route between 1980 and 2002

Peter Flachsbart, University of Hawaii

Wayne Ott, and Paul Switzer, Stanford University

The purpose of this paper is to determine the existence of a long-term trend in CO exposures to assess the effectiveness of the California motor vehicle emission control program since 1980. To that end, carbon monoxide (CO) exposures were measured inside a motor vehicle during three field studies of a standardized route (El Camino Real) in Palo Alto, California. In each study, between 60 and 132 trips were taken in both directions of a 5.9-mile segment of the highway, which presently has over 20 intersections with traffic lights. Each study spanned a 14-month period that began in January of one year and ended in March of the next year. For each study, trips typically lasted from 30 to 60 minutes due to variation in traffic conditions. To facilitate comparisons of exposure over two decades, trips from each study were screened using two criteria. First, trips had to occur on the same day of the week and within three days of the survey's serial day of the calendar year. Second, the trip's starting time had to occur at the same time of day (within ± 15 min.) to achieve an "exact" match. Although the test vehicles and exposure monitors differed for the three studies, the driver remained the same and window positions and driving patterns were standardized. At the start of the third study, 60 trips from the first two studies satisfied these matching criteria. Although data collection and analysis are still in progress for the third study, preliminary results can be reported, based on 29 cases for which "exact" matches occurred.

Survey Period	Mean CO Exposure (ppm)	Standard Deviation (ppm)	Range in the Mean CO Exposure (ppm)
1980 - 1981	9.6	3.4	4.2 - 19.1
1991 - 1992	4.4	1.6	1.2 - 8.1
2001 - 2002	2.2	0.9	1.3 - 5.9

Background CO concentrations near but off the highway were also measured for each study, but were found to be very low. The results show that current in-vehicle mean CO exposures are about 50% of mean CO exposures measured 10 years ago and about 23% of mean CO exposures measured 21 years ago. During this period, the standard deviation has fallen and the range in mean CO exposures has narrowed suggesting a reduction in the number of "gross emitters" on the highway over two decades. These results indicate that the California motor vehicle emission control program has been very effective in reducing CO exposure inside vehicles in traffic. Measuring low CO concentrations during the third study required a pair of very sensitive CO monitors made by Langan Products Inc. with careful calibration using NIST traceable gases. The measured CO concentrations for the third study were very similar to predicted CO concentrations based on a published CO emission model (known as the STREET model) developed specifically for the highway about 10 years ago.

10921- Traffic-Related Air Pollution and Respiratory Health: The East Bay Children's Respiratory Health Study.

Janice J. Kim¹, Svetlana Smorodinsky¹, Bart Ostro¹, Michael Lipsett¹, Brett C. Singer², and Alfred T. Hogdson²

¹Office of Environmental Health Hazard Assessment, California EPA

²Environmental Energy Technologies Division, Lawrence Berkeley National Laboratory

Traffic-related emissions are a major source of air pollution in most urban areas. Recent studies, primarily in Europe and Japan, have reported an association between respiratory symptoms and residential proximity to busy roadways. School location near a busy road may be an important surrogate of traffic-related exposures as well. To investigate whether these findings might apply in California, which has stringent motor vehicle emissions regulations, we conducted the East Bay Children's Respiratory Health Study (EBCRHS), a cross-sectional epidemiological study of the respiratory health of children (8-11 years old, n = 1100) attending one of ten schools located at varying distances from major roadways in the San Francisco Bay Area. Ten demographically similar schools were selected based on proximity to major roadways and traffic density of roads. "Near" schools (n=6) had a major road (average annual daily traffic >90,000 cars/day) within 350 m. "Far" schools (n= 4) were located >750 m from all major freeways and had no road with traffic >20,000 cars/day within 300 m. Information on the child's respiratory health, family history, and home environment were obtained by a self-administered parental questionnaire. Outdoor concentrations of traffic-related air pollutants (nitrogen oxides (NO_x, NO₂) and particulate matter (PM₁₀, PM_{2.5}, and Black Carbon)) at the schools were measured simultaneously over 1-2 week intervals in two seasons. Study average pollutant concentrations at individual schools ranged as follows: NO_x, 33-66 ppb; NO₂, 18-31 ppb; PM₁₀ mass, 27-32 µg/m³; PM_{2.5} mass, 12-15 µg/m³; and BC associated with PM₁₀, 1.7-2.8 µg/m³. School location (upwind-near, downwind-near, upwind-far, and downwind-far) and annual estimates of traffic-related air pollutants at the neighborhood school were used as surrogate measures of children's overall exposure to traffic-related pollution. Preliminary results show that parental history of asthma, history of water damage to the house, presence of mold within the previous 12 months and presence of pests within the previous 12 months are associated with bronchitis symptoms. Controlling for several demographic and environmental variables, preliminary results show that the prevalence of bronchitis symptoms is increased in children attending schools near and downwind a major road compared to children attending schools far and upwind from a major road. Similarly, school location was associated with current physician-diagnosed asthma. Of the measured air pollutants, only NO_x was weakly associated with an increased prevalence of bronchitis symptoms. Further analyses using other traffic metrics will be explored. Preliminary findings of the EBCRHS support the hypothesis that there is an increase in respiratory symptoms among children living and attending schools near busy roads.

11022- An Epidemiological Study on Road Traffic Injury in China, 1951-1999

WANG, SY¹, CHI, GB¹, JING, CX¹, DONG, XM¹

¹Dept.of Epidemiology,Medical College of Jinan University

OBJECTIVE:

To Explore the secular trend and the influencing factors of road traffic injury so as to provide basis for prevention and control.

METHODS:

Evaluation indexes:

1. Motorizes Extent of City (MEC): The rate per 1000 person possess the number of vehicles;
2. Level of Traffic Safety (LTS): The rate of 10 000 registered vehicle of mortality;
3. Level of Personal Safety (LPS): The rate per 100 000 person of mortality.

4. Mortal coefficient (MC) =
$$\frac{N. \text{Death of road injury}}{\sqrt{N. \text{Population} \times N. \text{Vehicle}}} \times 10000/10000$$

RESULTS:

The traffic injury victim had doubled every decade since 1951. The mortal coefficient (MC) of Zhejiang Province always ranked the top three positions and Ningxia had risen to the first from eleventh in lately 10 years. It ascribed over 90% road injury to driver's overspeed and negligence. It showed that a positive correlation between level of personal safety (LPS) and the numbers of vehicle, volume of road haulage, volume of passenger transport, mileage of rigid highway (correlation coefficients were 0.8714, 0.9691, 0.9510, P = 0.0005). The numbers of vehicle, volume of road haulage, volume of passenger transport and mileage of rigid highway were increasing when LPs decreased. Principal component regression analysis overcame multi collinearity of independent variables and obtained a regression equation $y = -3.7197 + 1.49E-03X1 + 5.2E-06X3 + 6.19E-02X4$.

CONCLUSION:

In the past 50 years, LTS will be improved with the progresses of MEC, and better LPS was based on the well being of LTS in China. The primary determinants of LPS were numbers of vehicle, volume of road haulage, volume of passenger and mileage of rigid highway. Road injury thus could be reduced through improving the traffic environment, strengthening the traffic administration as well as promoting traffic safety.

Key words: Road injury Risk factor China