1st Session

Traffic-related air pollution

(Chairs: Shiro Sakurai and Weimin Song)

Traffic-related air pollution and asthma in children living along trunk roads in Japan

Masayuki Shima
Department of Public Health, Hyogo College of Medicine, Japan

In Japan, the concentration of sulfur oxide had been decreased by the regulatory efforts to control air pollution during the past several decades. However, the increasing automobile traffic has caused considerable increases in levels of air pollutants, such as nitrogen dioxide and suspended particulate matter. In areas adjacent to trunk roads in large cities, the concentrations of these air pollutants are higher than in the general environment. The potential effect of these concentrations on the health of residents who live near trunk roads is a matter of concern.

To investigate the effects of traffic-related air pollution on respiratory symptoms among children who lived near trunk roads, we conducted a cohort study on 2,506 schoolchildren in eight different communities in Chiba Prefecture, Japan. The prevalence of asthma was higher among girls who lived less than 50 m from trunk roads (roadside areas) than among girls in the other areas studied. Among boys, the prevalence of asthma did not differ in relation to the distance from roads, although the rate was higher in urban areas than in rural areas. The incidence of asthma during the follow-up period significantly increased among boys living in roadside areas relative to rural areas (odds ratio [OR] = 3.77 [95% confidence interval: 1.00-14.16]), even after adjustment for potential confounding factors such as a history of allergic diseases and indoor environment. Among girls, the incidence of asthma also increased (OR = 4.03 [0.90-17.96]), although the risk was not significant.

Recently, many epidemiologic studies have reported that traffic-related air pollution affects respiratory diseases and symptoms. However few studies examine the relationship between asthma incidence and traffic-related air pollution. Well-designed large-scale studies are needed to assess the question of whether exposure to traffic-related air pollutants is risk factors for the onset of asthma and other respiratory diseases in children and adults. In view of this situation, we are conducting the SORA (Study On Respiratory disease and Automobile exhaust) administered by the Japanese Ministry of Environment, Japan.

Keywords: air pollution; traffic; automobile exhaust; cohort study; asthma

Recent research progress in traffic pollution related health effects in China

Xinbiao Guo and Furong Deng

Peking University School of Public Health, Beijing 100191, China

With the rapid economic growth and the development of transportation in China in the recent two decades, the number of motor vehicles in China continues to increase at an annual rate of approximately 13%. Air pollution related to traffic has become the focus of attention, and it contributes a significant proportion of ambient air pollutants in large cities in China. It was estimated that more than 80% of ambient air CO and VOCs were from vehicle emission. Furthermore, the proportion of ambient air NOx from traffic in Beijing , Shanghai and Guangzhou were 54.8%, 56% and 86.3%, respectively. This indicates that the air pollution pattern in some large cities in China has been shifting from the coal-burning pollution to that mainly from the traffic..

Traffic pollution has been related to an increased risk of respiratory and cardiovascular disease in population. The studies on professional drivers and traffic police in some cities in China have showed that the traffic pollution may decrease peak expiratory flow and increase the incidence of respiratory symptoms and the level of blood HbCO, leucocytes and platelets. Long term exposure to traffic pollution was found to cause hypertension and abnormal ECG in traffic police. It was also reported that the increases in the prevalence of respiratory disease and symptom among school-age children were closely associated with the traffic pollution in some big cities in China. Traffic pollution may also impede children's vital volume and the circumference of chest, and damage children's neurobehavioral functions.

Effort during the past decades has contributed greatly our understanding of traffic pollution related health effects in China. Nevertheless, further studies are needed to identify the adverse impacts of traffic pollution on elder and other susceptible population and to characterize the personal exposure to traffic pollution. Based on the obtained scientific evidence, comprehensive measures could be taken to protect people's health in China from traffic pollution.

Note: This study was supported by Grant 30571534 from the National Natural Science Foundation of China, and Grant 2006BAI19B06 from The Ministry of Science and Technology of the People's Republic of China.

Key words: Traffic pollution; Health effect; Motor vehicle

Personal exposure to $PM_{2.5}$ of children living near traffic road in Beijing and the possible influencing factors

Furong Deng, Xin Wang, Huijuan Su, Shaowei Wu, Haibo Lv and Xinbiao Guo

Peking University School of Public Health, Beijing 100191, China

Growing number of epidemiological studies have reported a positive association between ambient concentrations of particulate matter and the incidence of cardiovascular and respiratory morbidity and mortality. Due to the rapid economic growth and development of transportation in China in recent two decades, the number of motor vehicles in China increase at an annual rate of approximately 13%. Air pollution related to traffic has become the focus of attention, and it contributes a significant proportion of ambient air pollutants in large cities in China. The air pollution pattern in some large cities in China has been shifting from the coal-burning pollution to that mainly from the traffic. Children are one of the most susceptible population to air pollution. Previous studies have showed the association between traffic pollution and children's health, however, the level of children's personal expose to traffic related pollutants such as PM2.5 and its influencing factors remains unclear. We choosed a primary school located near traffic road in Beijing, monitored the level of PM10,PM2.5 and PM1.0 in campus, classroom and living rooms of pupils, calculated the personal exposure of pupils to PM2.5 and investigate the possible influencing factors. Our results indicated that the PM2.5 exposure levels of children were comparatively high in some areas of Beijing, and the indoor PM2.5 level might be one of the major factors which affected the children's personal exposure levels.

Note: This study was supported by Grant 30571534 from the National Natural Science Foundation of China, and Grant 2006BAI19B06 from The Ministry of Science and Technology of the People's Republic of China。

Key words: fine particulate matter, Children; exposure; traffic pollution

The children's personal exposure levels of nitrogen oxides and its impact on pulmonary function, Beijing

Hong Liu, Furong Deng, Xin Wang, Shaowei Wu, Haibo Lv and Xinbiao Guo*
Peking University School of Public Health, Beijing 100191, China

With the development of economy and urbanization, the number of the motor vehicles increases greatly all over the world in recent decades, especially in the developing countries. And the health problems caused by traffic emission are very serious. A number of epidemiological studies indicated the negative relationship between traffic air pollution and children's health. Outdoor concentrations of nitrogen oxide (NO, NO2 and NOx) outside of schools have been associated with children's respiratory symptoms. There are also plenty of studies on the association between children's pulmonary function and nitrogen oxides, and all of them got the similar conclusion that the levels of nitrogen oxides have significantly negative correlation with children's pulmonary function in China and other countries. But so far there are few studies on personal exposure in China. Therefore, the effect of personal exposure levels on children's respiratory system is not clear yet. In our study, we assessed the personal exposure of pupils to NOx, NO and NO2 in Beijing, and studied the effect of personal exposure to NOx, NO and NO2 on the pulmonary function. Our results indicated that children living near traffic road had relatively high personal exposure levels of nitrogen oxides, and the personal exposure levels of NO2 and NOx could cause a significant decline on children's pulmonary function.

Note: This study was supported by Grant 30571534 from the National Natural Science Foundation of China, and Grant 2006BAI19B06 from The Ministry of Science and Technology of the People's Republic of China.

Key words: children; nitrogen oxides; exposure assessment; pulmonary function

Pedestrian exposure to particulate matter along trunk road in Tokyo

Kenji Tamura[1], Yoshinori Kondo[1], Shuichi Hasegawa[1], Hiroshi Nitta[1] and Shiro Sakurai[2]

[1] National Institute for Environmental Studies, Japan, [2] Dept of Environmental Science, School of Social Information Studies, Otsuma Women's University, Japan

There are occasions when people may be exposed to high concentrations of auto exhaust gas, even if only for short periods of time. Research on the actual conditions of exposure to nanoparticles, which has become a question of particular concern in recent years, has only just begun.

We examined short-term changes in exposure concentration while walking and seasonal variations of airborne particulate matter (PM) and fine particles (number concentration), including nanoparticles. Measurements were taken while walking along streets and in backland areas.

The subject area of the study was set as a zone between main roads in Setagaya City (Ringed Route 7 and Japan National Route 246). Four walking courses were set: two along roads (both sides), one through a backland area and along roads, and one just through a backland area. The study was conducted over two five-day periods in August 2007 and February 2008. Each day, measurements were taken while walking for three-hour stretches from about 9 a.m. and again at 1 p.m. SPM concentrations were obtained from the nearest air quality monitoring stations and compared with the time average concentration.

The results of the study are as follows:

1) Environmental concentration (auto exhaust station SPM) was lower in the winter (0.020 mg/m^3) than the summer (0.041 mg/m^3). The PM2.5 exposure concentration while walking was lower than this SPM concentration in the summer and slightly higher in the winter.

2) Short-term variation was greater in number concentration than weight concentration in both seasons.

3) The PM2.5 exposure concentration while walking along roads was lower than the monitoring station SPM concentrations in the summer, when the PM concentration was higher, and higher than the SPM concentration in winter, when the PM concentration was lower.

4) The situations for high concentration exposure were extracted through combination of GPS and digital video data.

Recent change in contributors to atmospheric polycyclic aromatic hydrocarbons and nitropolycyclic aromatic hydrocarbons in Shenyang, China

Ning Tang[1], Kenji Tamura[2], Takayuki Kameda[1], Akira Toriba[1] and Kazuichi Hayakawa[1]

[1] Graduate School of Natural Science and Technology/ Institute of Medical, Pharmaceutical and Health Sciences, Kanazawa University, Kakuma-machi, Kanazawa, 920-1192, Japan

[2] National Institute for Environmental Studies, 16-2 Onogawa, Tsukuba 305-8506, Japan

*Presenting Author: Telephone: 81.76.234.4458, Fax: 81.76.234.4456, tou@p.kanazawa-u.ac.jp

Several polycyclic aromatic hydrocarbons (PAHs) and nitropolycyclic aromatic hydrocarbons (NPAHs) are carcinogenic and/or mutagenic. PAHs and NPAHs in the atmosphere mainly originate from imperfect combustion of organic matters such as petroleum and coal. On the other hand, heterogeneous or homogeneous reactions of parent PAHs with nitrogen oxides and hydroxyl radicals were reported as another formation mechanism of NPAHs in the atmosphere. During the past three decades, the consumption of petroleum and coal in China has grown significantly due to economic and industrial development. As a consequence, air pollution constituted one of the most significant environmental problems in China. Shenyang city is the political and economic center of northeast China. In addition to domestic heating exhaust, industrial and automobile exhausts have caused much air pollution in Shenyang. In our previous studies, we have reported the average concentrations of total PAHs (9 kinds of PAHs) and NPAHs (7 kinds of NPAHs) were 534 pmol/m3 and 473 fmol/m3, respectively, in Shenyang in 2001. These concentration levels were significantly higher than those in Kanazawa, Japan in the same period. However, the Shenyang government took the measures against air pollution positively. From 2001 to 2006, total 100 factories were transferred to outer city. And, from 2001 to 2007, total 5,000 chimneys used for coal heating were pulled down.

In this study, in order to clarify the effect of above counter measures carried by the Shenyang government, airborne particulates were collected at the same sites in Shenyang in both 2001 and 2007. PAHs and NPAHs in the extracts from the particulates were analysed by HPLC with fluorescence and chemiluminescence detections, respectively. In winter 2007, as compared with 2001, the concentrations of PAHs decreased to two fifths and the concentrations of NPAHs did not decrease. This suggested that the above counter measures were effective to decrease in the concentration of PAHs. However, in summer, the concentrations of PAHs and NPAHs rose by the factor of 4 and 5 times, respectively. As a possible cause, the increase in the number of cars was considered, because the numbers of registered vehicles (360 thousands in 2000) increased in this period (560 thousands in 2007).

Determination of gaseous organic compounds in Hyogo Prefecture, Japan

Ryoji Yamamoto and Masayuki Shima
Department of Public Health, Hyogo College of Medicine, Nishinomiya, Hyogo, Japan

Abstract. The aim of this study was to analyze Gaseous Organic Compounds (GOCs) of high traffic (Nishinomiya City: 979,987 vehicles/day) and low traffic areas (Miki City: 29,338 vehicles/day) by gas chromatography-mass spectrometry (GC/MS) and to evaluate general environment exposure by PAHs in GOCs. After air sampling using an OMNIPORE membrane filter (< 0.45μmm) and Porapak-QS, sorbents were extracted with solvent (dichloromethane: acetone (4:1 v/v), and analysis was carried out by GC/MS. Oxidative derivatives of diethylbenzene, such as diacethylbenzene and ethylacetophenone, were detected in GOCs. PAHs and phthalates in GOCs were measured. Pyrene, benz[a]anthracene, benzo[a]pyrene and benzo[ghi]perylene level were significantly higher in high traffic areas. The geometric mean of pyrene was 0.76 ng/m3 for low traffic areas and 1.96 ng/m3 for high traffic areas; benz[a]anthracene was found at 0.72 ng/m3 and 1.80 ng/m3 in low and high traffic areas, respectively; and benzo[a]pyrene was found at 0.87 ng/m3 and 3.60 ng/m3 in low and high traffic areas, benzo[ghi]perylene 0.57 ng/m3 and 3.04 ng/m3, respectively. The bis(2-ethylhexyl)phthalate (DEHP) level was the highest in the detected GOCs. The geometric mean of the DEHP levels in high traffic and low traffic areas were 484.85 and 387.26 ng/m3, respectively. Adult and child DEHP exposure levels were 145.32 and 300.33 ng/kg/day, respectively, in high traffic areas. In low traffic areas, adult and child DEHP exposure levels were 116.18 and 240.10 ng/kg/day, respectively.

Characterization of $PM_{10-2.5}$ and $PM_{2.5}$ collected in the roadside atmosphere

Kenji Tawara and Masayuki Shima
Dept of Public Health, Hyogo College of Medicine, Japan

The morphologies of airborne particulate matter (PM) have been found to differ in terms of particle size range, location of sampling, and collection method. However the chemical properties of PM related to the morphologies are still wrapped in much obscurity. Accordingly both a scanning electric microscope equipped with a energy-dispersive X-ray spectrometer (SEM/EDX) and a transmission electric microscope equipped with a energy-dispersive X-ray spectrometer (TEM/EDX) were introduced, to characterize the elemental compositions of PM in relation to the morphologies in the roadside atmosphere.

Two main roadside sites were selected for collecting PM; a crossroad of a trunk road, called *CR samples* for short after this, and the roof of a nearby five-story building, called *RF samples* for short as well. Size-classified samplings for PM10-2.5 and PM2.5 were performed at these two sites on the same days between November in 2008 and January in 2009, using a filter holder with a mode of mono-holed cascade impactor, which was connected to a mini pump with a flow rate of 1.5 L/min.

Low vacuum SEM observations of PM10-2.5 found out that, in either of both collecting sites, most were coarse carbonaceous particles (4-10 μm in size), which contained various fine metal particles (1-3 μm in size). However EDX analyses of such metal particles demonstrated that heavy metals like Fe, Cu, Pb, Zn, Ba, were not alike in distribution between *CR samples* and *RF samples*; heavy metals except for Fe were hardly detected from *RF samples*. As for PM2.5, two general species of PM were commonly delineated by TEM observations of both collecting sites; (1) branched clusters of carbonaceous spherules (individual spherule side: 0.01-0.05 μm), and (2) individual particulates in various configurations (0.1-2 μm in size). EDX analyses demonstrated that certain carbonaceous spherules only in *RF samples* contained heavy metals like Cr, Pb, Zn, Mn. On the other hand, such heavy metals tend to be commonly detected, including Sb and Ba, from individual particulates of < 1μm in size in both *CR samples* and *RF samples*.

These individual-particle observations and analyses of PM showed complex and heterogeneous chemical conditions of PM even in a regionally same airshed, that should be taken into account for further examinations of chemical properties and formation mechanisms of PM.