An overview of studies on health effects of traffic-related air pollution in China

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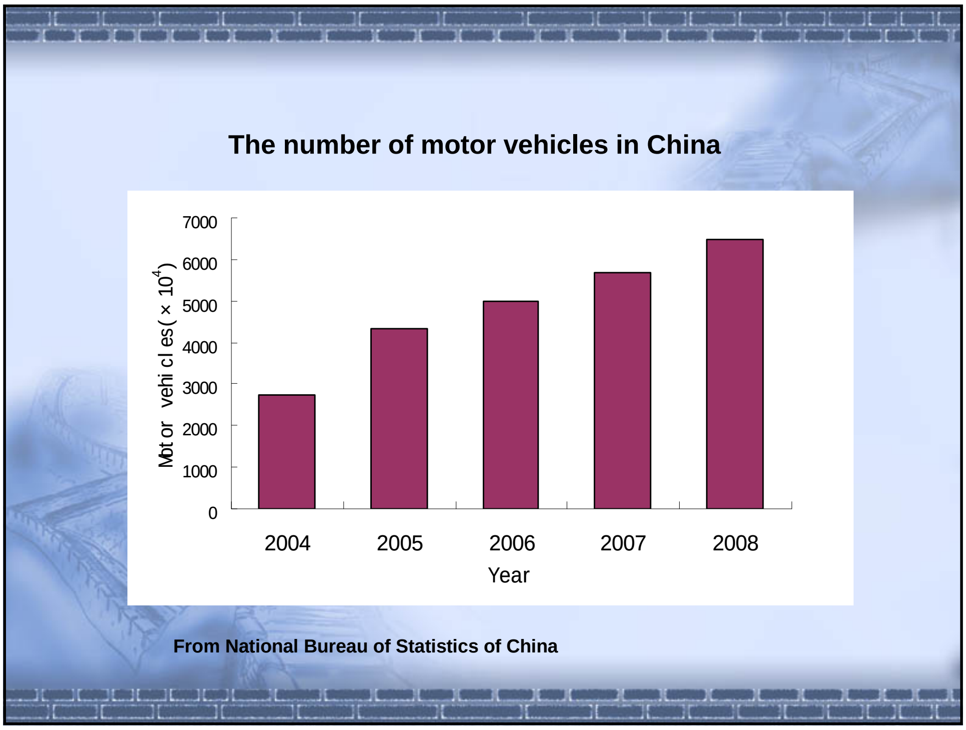
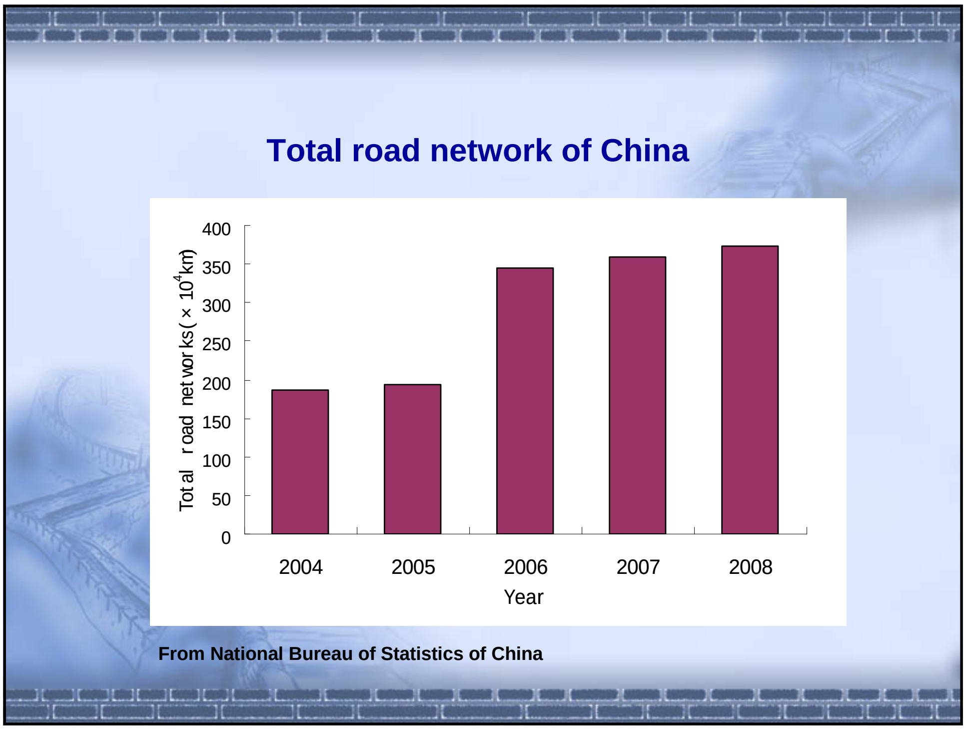
- With the rapid economic growth and the development of transportation in China in the recent two decades, the number of motor vehicles in China continues to increase at an annual rate of approximately 13%.


The number of motor vehicles in China
Motor vehicles(× 10^4)
7000
6000
5000
4000
3000
2000
1000
0
2004
2005
2006
2007
2008
Year
From National Bureau of Statistics of China


Total road network of China
Total road networks(× 10^4km)
400
350
300
250
200
150
100
50
0
2004
2005
2006
2007
2008
Year
From National Bureau of Statistics of China

- The traffic-related air pollution 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.

Annual average concentration of nitrogen dioxide in Beijing, Shanghai and Guangzhou from 2000 to 2005

City	Concentration (mg/m^3)					
	2000	2001	2002	2003	2004	2005
Beijing	0.071	0.071	0.076	0.072	0.071	0.066
Shanghai	0.090	0.063	0.058	0.057	0.062	0.061
Guangzhou	0.061	0.071	0.068	0.072	0.073	0.068

- **Traffic-related air pollution has been related to an increased risk of respiratory and cardiovascular disease in population.**
- **The studies on traffic police and professional drivers in some cities in China have showed that the traffic pollution may increase the prevalence of respiratory symptoms and illnesses.**
- **Long term exposure to traffic-related air pollution was found to be related with the high prevalence of hypertension and abnormal ECG in traffic police.**

- It was also reported that the increases in the prevalence of respiratory disease and symptom among children were closely associated with the traffic-related air pollution in some cities in China.

Prevalence rates and estimated risk of respiratory symptoms or illnesses in children whose houses are near the main road in Beijing

symptom or illness	prevalence rate (%)	OR
Cough	59.06	1.13*
With a cold	58.59	1.13
Without a cold	4.73	1.29
Persistent cough	4.50	0.99
Phlegm	39.24	1.16*
With a cold	38.80	1.15*
Without a cold	4.01	1.15
Persistent phlegm	2.96	1.18
Cough and phlegm	21.37	1.12
Persistent cough and phlegm	1.49	1.01
Wheeze	4.92	0.95
Tightness	3.38	1.04
Asthma	0.92	1.04
Bronchitis	21.19	1.16
Chronic bronchitis	0.58	0.81

* Significantly different from children whose houses are not near the main road.

S Wang, et al., 2004

Prevalence rates and estimated risk of respiratory symptoms or illnesses in children whose houses are near the main road in Anshan city, Liaoning province

symptom or illness	prevalence rate (%)	OR*	95% CI
Persistent cough	11.04	1.36	1.01-1.84
Persistent phlegm	4.96	1.06	0.69-1.60
Wheeze	7.57	1.43	1.00-2.06
Asthma	1.61	1.43	0.66-3.08

* Compared children whose houses are not near the main road

Prevalence rates and estimated risk of respiratory symptoms or illnesses in children whose houses are at different distance from main road in Anshan city, Liaoning province

symptom/illness	distance from main road(m)	prevalence rate (%)	OR*	95% CI
Persistent cough	20-100	9.27	1.10	0.77-1.58
	＜20	11.40	1.39	0.94-2.05
Persistent phlegm	20-100	4.44	0.91	0.56-1.47
	＜20	5.38	1.11	0.66-1.88
Wheeze	20-100	6.92	1.17	0.77-1.77
	＜20	5.81	0.97	0.60-1.59
Asthma	20-100	1.04	1.51	0.50-4.60
	＜20	2.79	4.11	1.57-10.74

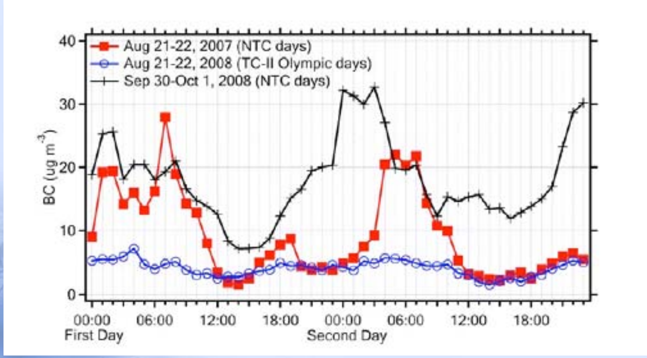
* Compared children whose houses are whose houses are over 100 m from main road

M Liu, et al., 2006

- The ambient particulate air pollution in Beijing during the 2008 Olympic Games (from August 8 to September 20) decreased markedly after a series of air quality control countermeasures implemented by the Beijing Municipal Government, including more than half of the motor vehicles in Beijing banned from the streets every day.
- Several field studies were performed during this period.

Traffic-related Air pollutant Measurement:

Diurnal patterns of BC in 2007 and 2008 in Beijing

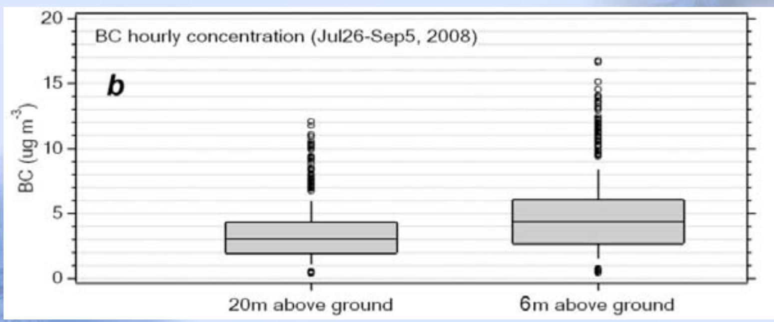


BC: black carbon; TC-II: Traffic control days period-II (from Jul 20 to Sep 20, 2008); NTC: Non traffic control days

Wang, et al., 2009

Traffic-related Air pollutant Measurement:

BC concentrations at 20 m and 6 m levels



Wang, et al., 2009

Taxi Driver Study

Daily averages of exposure variables inside the taxicab

Variable	Period[a]			Percentiles[b]				Interquartile range
	Before	During	After	25%	50%	75%	95%	
$PM_{2.5}$ real-time (μg/m³)	95.4±58.6	39.5±25.2	64.0±60.3	22.7	44.6	84.8	207.2	62.1
$PM_{2.5}$ mass (μg/m³)	105.5±44.1	45.2±27.0	80.4±72.5	34.6	56.6	104.1	182.5	69.5
CO (ppm)	3.6±1.4	2.8±1.0	2.7±0.7	2.2	2.6	3.7	5.0	1.5
NO_2 (ppb)	36.4±12.3	30.3±12.2	37.1±17.0	24.2	32.8	45.3	61.0	21.1
NO (ppb)	176.1±84.8	156.0±77.2	268.0±55.5	125.6	181.5	274.8	362.2	149.2
Temp (°C)	30.0±4.4	28.8±2.0	25.0±2.2	24.9	28.4	30.3	33.5	5.4
RH (%)	38.8±9.5	41.7±6.6	24.8±5.8	28.8	35.2	40.9	51.2	12.1

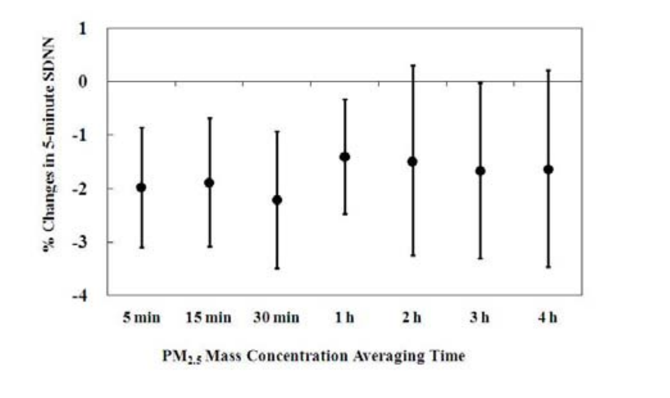
[a]Before, during and after the Beijing 2008 Olympic Games indicates the periods of May 26 to June 19, August 11 to September 5 and October 27 to November 14, respectively. Mean concentrations are presented as arithmetic mean (AM)±standard deviation (SD) for the three periods.

[b]Percentiles are calculated and presented after combining exposure data of all three time periods.

Wu, et al., 2009

Taxi Driver Study

Percent changes (95% CIs) in 5-minute SDNN for per IQR (69.5 $\mu g/m^3$) increase of the PM2.5 mass concentration moving averages (from 5 minutes to 4 hours)



SDNN: standard deviation of normal-to-normal intervals; IQR: interquartile range

Wu, et al., 2009

Pedestrian Study:

Exercise performed and physiological parameters during 2-hour walk

***Langrish, et al.,* 2009**

		Without Mask	With Mask
Activity	Energy expenditure, kcals	340 (314 – 367)	364 (304 – 426)
	Energy expenditure, METS	3.33 (3.09 – 3.57)	3.61 (3.12 – 4.10)
Ambulatory blood pressure	Systolic blood pressure, mmHg	121 (115 – 127)	114* (108 – 120)
	Diastolic blood pressure, mmHg	81 (75 – 87)	79 (74 – 83)
	Mean arterial pressure, mmHg	94 (89 – 99)	90 (86 – 94)
	Heart rate, bpm	88 (82 – 94)	91 (85 – 97)
Heart rate variability	Data validity, %	99.1	97.8
	Average NN interval, ms	594 (562 – 627)	613 (571 – 655)
	pNN50, %	3.3 (0.8 – 5.7)	2.1 (-0.1 – 4.4)
	RMSSD, ms	17.2 (13.4 – 21.0)	20.0 (15.5 – 24.6)
	SDNN, ms	45.8 (36.8 – 54.8)	54.8 (42.5 – 67.0)
	Triangular Index	10.7 (9.1 – 12.4)	11.4 (9.4 – 13.3)
	LF-power, ms^2	313 (170 – 455)	414 (233 – 595)
	HF-power, ms^2	76.5 (33.6 – 120.0)	116.8 (52.6 – 181.0)
	LFn, ms	68.2 (60.9 – 75.5)	67.9 (61.9 – 73.9)
	HFn, ms	16.1 (11.9 – 20.3)	16.0 (12.5 – 19.4)
	HF/LF ratio	0.259 (0.173 – 0.344)	0.247 (0.180 – 0.314)

All data expressed as mean (95% confidence interval).
**P<0.01 compared to control (without mask) day, paired Student's t-test.*
P>0.05 for all other parameters compared to control (without mask) day.

Conclusion

- Efforts during the past decades have contributed greatly our understanding of traffic-related air pollution related health effects in China.
- Further studies are needed to identify the adverse impacts of traffic-related air pollution on older people and other vulnerable population and to characterize the personal exposure to traffic-related air pollution.
- Based on the obtained scientific evidence, comprehensive measures could be taken in China to protect human health from traffic-related air pollution.

National Actions

- China introduced Standard I, II and III in 2000, 2005, and 2007, respectively. Standard IV will be adopted nationwide in 2010.
- Beijing became the first city to enforce Standard IV on newly bought and produced cars on March 1, 2008.
- As of Oct 1, 2009, Gasoline-powered vehicles will not be allowed to travel along or within the sixth ring road, the city's outermost highway loop, if their exhaust emissions do not comply with National Emission Standard I. Disel-driven vehicles must comply with National Emission Standard III or higher before they can operate in the same area.
- Comprehensive countermeasure against ambient air pollution will be taken in the area including Beijing, Tianjin, Hebei, Shanxi, Inner Mongolia and Shandong.

Thank you for your attention