Long-term monitoring of $PM_{2.5}$-bound nickel (Ni) in an urban environment in Xi'an, Northwestern China

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A large data set of $PM_{2.5}$-bound nickel (Ni) concentration has been produced from filter samples collected in urban environment of Xi'an, Northwestern China, over 10-year period (2004-2013), in order to determine the trend of Ni pollution status, its potential sources and health risks. The average concentration of Ni measured during the whole study period was 5.9±5.5 ng m^{-3}, ranging from <0.08 (MDL) to 88.1 ng m^{-3}. Annual average Ni concentration increased firstly and then decreased obviously (The turning point was 2008) (Table 1), owing to changes in strengthening management and improvement techniques in industrial sources and motor vehicles (Tian et al., 2012).

Table 1. A statistical summary of Ni concentrations over ten years (2004-2013).

Year	Ni (ng m^{-3})		
	Average	Stdev[a]	Range
2004	6.5	5.0	0.44- 53.8
2005	6.6	5.3	MDL[c]-32.8
2006	7.3	6.6	MDL-88.1
2007	7.7	8.3	0.76-76.6
2008	6.2	5.2	0.90-56.6
2009	7.0	7.1	MDL-59.4
2010	5.8	5.1	1.20-41.9
2011	4.8	4.2	0.43-59.5
2012	4.2	5.4	0.13-70.9
2013	3.0	2.6	0.44-19.6

To assess the effect of major sources of Ni on the long term distribution, comparisons of Ni concentration, enrichment factor, and potent sources between workday and non-workday periods were examined over these ten years. It can be seen that weekend-affected-sources, i.e., industrial and motor vehicle emissions (Cempel and Nikel, 2006), of Ni was reduced obviously (Figure 2).

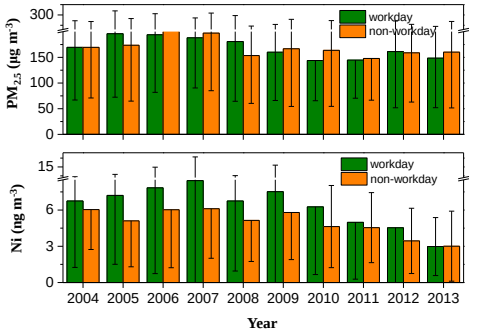

Figure 1. $PM_{2.5}$ and Ni concentrations comparisons between workday and non-workday from 2004 to 2013.

Moreover, the health risk assessment showed that non-cancer risk of Ni can be ignored in Xi'an, but not for cancer risk (Figure 2). Although Ni incremental lifetime cancer risk was relative significance on workday period in Xi'an, Ni showed a distinct decline for both workday and non-workday periods from 2006, due to more and more strict air pollution control policies (Cao et al., 2012).

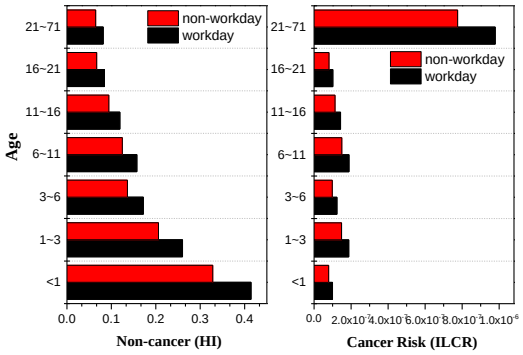

Figure 2. Comparison of non-cancer (HI) and cancer (ILCR) risks of Ni for different age groups and for workday and non-workday periods in Xi'an.

Implementations of motor vehicle and industrial emissions control policies and advanced technologies have led to a great healthy benefit, and it can be served as a positive sign for China air pollution source control strategies over these years.

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