Analysis of intrapersonal variance of hourly PM exposures

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Table 1. Statistics for predicting personal exposures using fixed station data from Riogrovy sady school.

Data statistics	$PM_{2.5}$ Exposure		Fixed	Model - all		Model - filtered		Model statistics		
	E1h	E1hf	site PM_{10}	PredE	ResidE	PredE	ResidE	Statistic	All	Filtered
mean ($\mu g\ m^{-3}$)	54.9	37.3	26.9	53.3	1.6	37.0	17.8	**R**	0.139	0.557
sd ($\mu g\ m^{-3}$)	175.4	29.1	18.5	21.3	174.1	15.5	174.2	**R2**	0.019	0.311
min ($\mu g\ m^{-3}$)	1.3	1.3	0.0	20.8	-150.6	13.5	-104.3	**ß0**	19.6	12.6
max ($\mu g\ m^{-3}$)	5453.3	174.6	142.0	195.6	5422.5	140.5	5432.6	**ß1**	1.2	0.9
count	5270	5150	4632	5270	5270	5270	5270	**n**	5270	5169

E1h: hourly personal exposure, E1hf: E1h filtered for high-end outliers, FSM: fixed site monitoring (PM10)

Long-term exposures to air pollution, especially particulate matter (PM), have been shown to be significant determinants of cardiovascular events and potentially associated with the onset of the development of corresponding diseases. Personal exposure studies have clearly shown that especially for short-term exposures the ambient measurements are poor predictors. For long-term exposures this relationship is not known, as direct measurements of long-term exposures is not possible for practical reasons.

The current work uses a 1-year time series of personal $PM_{2.5}$ exposures of a one individual to estimate the relationship of the personal and ambient air variance components according to equation 1:

Eq 1. $\sigma_{Tot}^2 = \sigma_P^2 + \sigma_A^2$

Personal $PM_{2.5.}$ mass concentrations were collected by non-smoking female adult by using a portable, real-time photometric aerosol monitor (TSI DustTrak 8520) from February 2006 to January 2007 (Branis *et al*. 2010). The monitor with rechargeable battery was carried by the person daily and in nighttime or during special activities, it was placed in her close vicinity. The sampling interval was set to 5 minutes. The equipment was switched off only during periods where measurements could not be made. The original 5-minute time series was transformed into 1-hour averages and combined with the corresponding fixed site PM_{10} measurements from the Riogrovy sady school, located South-East from the Prague Central Railway Station and approximately 1.5 km from the city center. Fixed site data extended from February to December in 2006.

Personal exposure levels peaked at 8.5 mg m^{-3} with maximum 1-hour average being over 5400 µg m^{-3}. When all data is included in the regression analysis, the fixed site data explains only 1.9% of the variance (Table 1), suggesting that the personal activities dominate exposure variability. However, when the extreme high exposures above 175 µg m^{-3} are filtered from the data as being related with high exposure events, the coefficient of determination of the regression model reaches 31%, suggesting that almost one third of intrapersonal exposure variance can be attributed to ambient air quality when excluding highest events. The remaining 69% of intrapersonal variance in this case is attributable to the personal behavior, including time-activity.

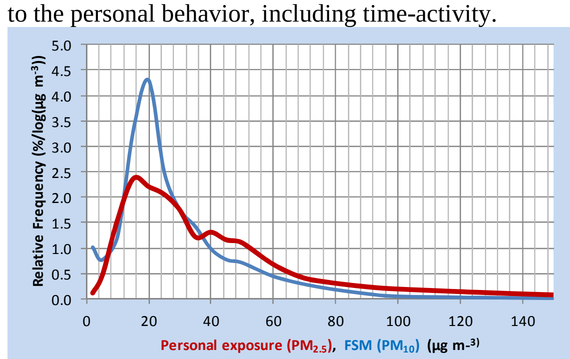

Figure 1. Probability distributions of $PM_{2.5}$ personal exposure levels and PM_{10} fixed site monitoring data.

The probability distribution of personal exposures exhibits a clearly multimodal shape (Figure 1), suggesting that microenvironments visited during the year can be divided into several domains and that division of time-use between these domains would be a significant predictor of the exposure variance and levels.

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