



Spatio-temporal exposure to fine particles and polycyclic aromatic hydrocarbons, short term effects on mortality in Rome, 2011-2012 - the EXPAH project

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Background

Short-term association between fine particles (PM_{2.5}) and mortality is well established, while evidence on the effects of PM components, e.g. polycyclic aromatic hydrocarbons (PAHs) is less clear.

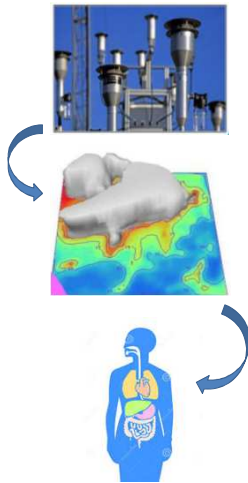
Objective

The project EXPAH, funded by EU within the LIFE+ framework, aims at estimating population exposure to PM_{2.5} and PAHs using spatio-temporal modelling, and investigating their short-term association with mortality in Rome, Italy.



Methods

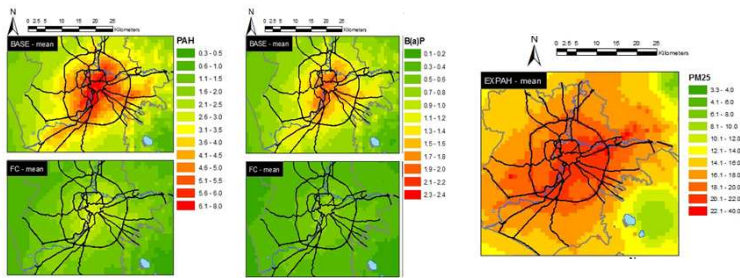
- PM_{2.5}, PAHs (sum of 4 congeners) and benzo[a]pyrene (B(a)P) were measured in 18 locations in Rome during two field campaigns from December 2011 to May 2012.
- In addition, PM_{2.5} and PAHs were modeled by means of the chemical transport model FARM using measurements for model validation, improvement, and data assimilation (for PM_{2.5}).
- Daily mean exposures were estimated for each km² of Rome from June 2011 to May 2012.
- All natural deaths were collected and geo-referenced.
- A case-crossover analysis was applied to estimate the percent increases of mortality per interquartile ranges (IQR) of the pollutants.



Results

Concentration maps of PAH, B(a)P and PM_{2.5} as annual means, Rome Jun11-May12.

For PAH and B(a)P. Top: "base" model, bottom: monthly adjustment



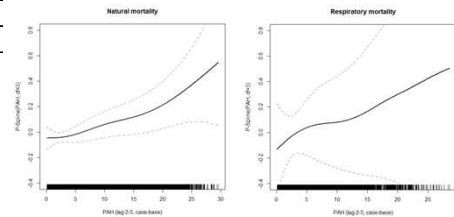
Correlation between exposures

Exposures	PAH base	PAH m. adj.	BaP base	BaP m. adj.	PM2.5 base	PM2.5 ARPA	Temp. Airport
PAH Base-case	1.00						
PAH Monthly adj.	0.95	1.00					
BaP Base-case	1.00	0.95	1.00				
BaP Monthly adj.	0.92	1.00	0.92	1.00			
PM2.5 Base-case	0.74	0.75	0.74	0.74	1.00		
PM2.5 ARPA stations	0.64	0.64	0.64	0.63	0.95	1.00	
Temperature Airport monitor	-0.70	-0.71	-0.71	-0.72	-0.48	-0.37	1.00

Very high correlations among all exposures, whatever the estimation method

Effects on mortality: % increases of risk per IQR variations in the pollutant

Exposure	IQR	Lag	Natural	
			% IR	95% CI
PAH, base-case	1.61	2-5	2.39	0.45 4.37
PAH, monthly adj.	0.65	2-5	2.03	0.47 3.60
BaP, base-case	0.47	2-5	2.38	0.50 4.29
BaP, monthly adj.	0.17	2-5	1.91	0.36 3.48
PM2.5, base-case	13.08	0-5	1.02	-3.60 5.87
PM2.5, ARPA	14.00	0-5	1.52	-3.41 6.71



Exposure	IQR	Lag	Cardiac		Cerebrovascular		Respiratory	
			% IR	95% CI	% IR	95% CI	% IR	95% CI
PAH, base-case	1.61	2-5	1.82	-1.51 5.27	-0.24	-6.88 6.88	2.99	-4.39 10.94
PAH, monthly adj.	0.65	2-5	1.58	-1.09 4.32	-0.45	-5.77 5.18	2.76	-3.22 9.10
BaP, base-case	0.47	2-5	1.88	-1.35 5.22	-0.08	-6.52 6.81	2.80	-4.36 10.51
BaP, monthly adj.	0.17	2-5	1.69	-1.00 4.46	-0.53	-5.81 5.06	2.65	-3.31 8.97
PM2.5, base-case	13.08	0-5	-1.59	-9.50 7.00	4.45	-11.76 23.64	14.36	-5.25 38.02
PM2.5, ARPA	14.00	0-5	-0.84	-9.49 8.63	7.04	-10.78 28.41	14.98	-5.79 40.33

Strong effects on natural and respiratory mortality, linear relationships with PAH (lag 2-5)
No differences between methods

Effects of PAH (lag 2-5) by population subgroups

Natural mortality and PAHs (lag 2-5)	No.	%	Effects per 1.61 ng/m ³		
			% IR	95% CI	P _{adj}
Age					
0-64	2,609	11.8	3.39	-0.93 7.89	-
65-84	10,781	48.6	1.16	-1.24 3.62	0.345
85+	8,782	39.6	3.55	0.98 6.19	0.046
Gender					
Males	10,489	47.3	2.14	-0.28 4.63	-
Females	11,683	52.7	2.62	0.27 5.02	0.741
Season of death					
Cold (October-March)	12,104	54.6	3.04	1.05 5.07	-
Warm (April-September)	10,068	45.4	-16.50	-26.48 -5.16	0.001
Place of death					
Home	7,556	34.1	2.17	-0.53 4.93	-
In hospital	13,468	60.7	2.71	0.46 5.00	0.722
Other or missing	1,148	5.2	-0.04	-0.98 0.96	0.542

Effects of PAH on elderly, during colder months
Similar effects by gender and place of death
Unclear estimates on warmer months

Conclusions

- A novel spatio-temporal model was applied to estimate population exposure to PAHs and PM_{2.5} in Rome, and to investigate short-term health effects of PAHs.
- We found evidence of an association of all the exposures with mortality, especially for respiratory causes.