

# BIOMONITORING OF THE POPULATION LIVING NEAR THE SOLID WASTE INCINERATOR PLANT IN MODENA, ITALY

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## Background and aims

As part of the authorization process for the expansion of the municipal solid waste incinerator of Modena, a cross-sectional biomonitoring study on toenail samples was conducted to identify biomarkers of exposure in resident population.

## Methods

Approximately 500 people were enrolled between October 2013 and May 2014, among residents (for at least 3 years) within 4 km from the plant. Sampling method implied stratification by exposure, gender and age-group (18-34, 35-49 and 50-69 years). Sampling exposure level was measured through the annual mean PM<sup>10</sup> concentration map for 2010.

- Toenail samples were disintegrated by acid mineralization and tested through inductively coupled plasma mass spectrometry for concentrations of cadmium, chromium, manganese and nickel.
- Confounders were assessed through a questionnaire covering: personal and biometric data, lifestyle, residential information including traffic exposure, occupational history, health condition and diet.
- Effective exposure was estimated through fall-out maps from a quasi-gaussian dispersion model. Biannual PM<sup>10</sup> concentration prior to the collection date (second semester 2013/first semester 2014) was assigned according to subjects residence and workplace address; exposure values were divided into quartiles. Multivariate regression analyses were performed.

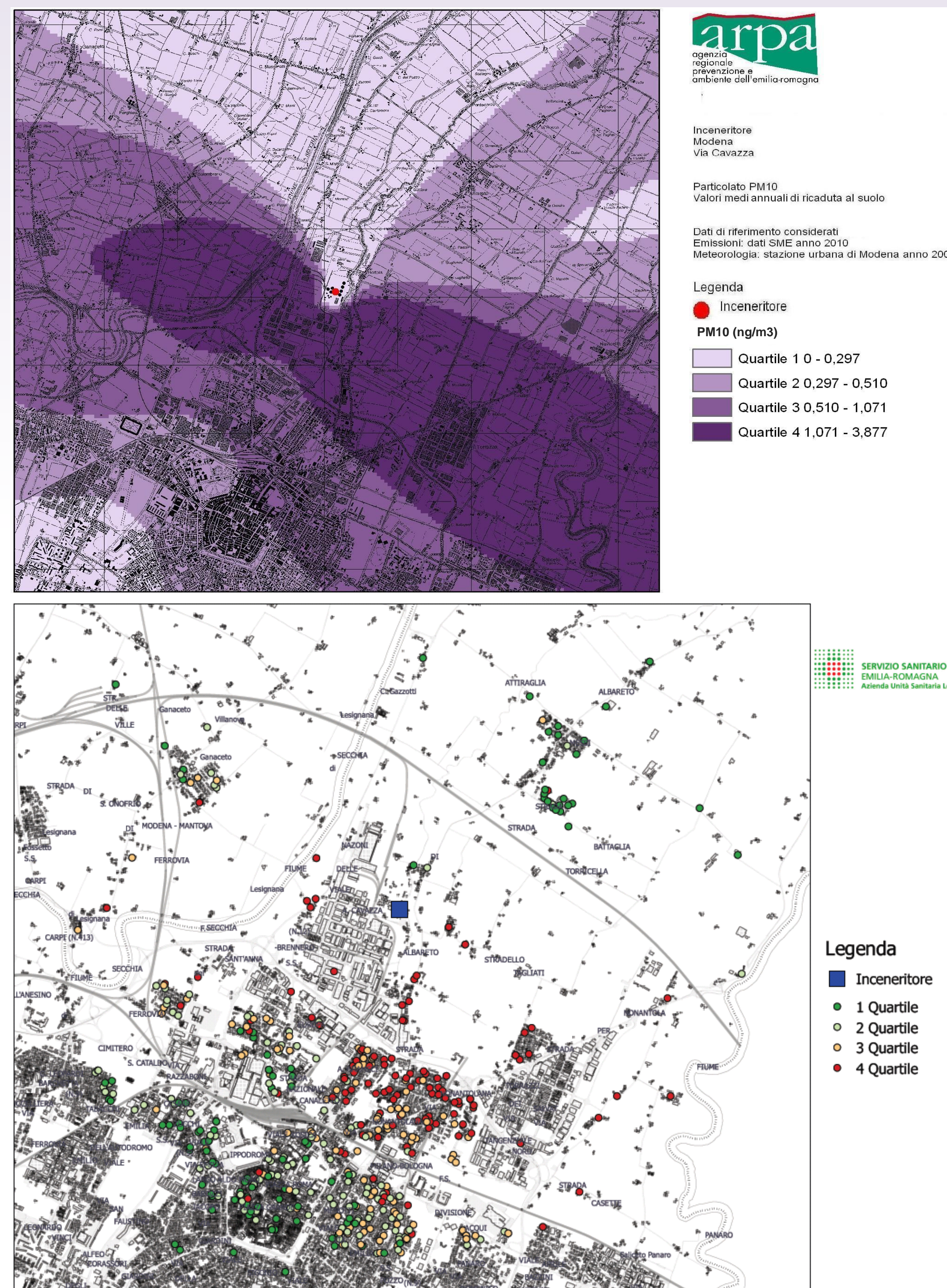


Fig. 1-2 Incinerator emissions fall-out map (2010); subjects residence addresses (quartiles of effective exposure)

	Cr		Mn		Ni	
	$\beta$	$p$	$\beta$	$p$	$\beta$	$p$
Exposure level 2	<b>.2861</b>	<b>0.092</b>	-.0902	0.515	-.1886	0.404
Exposure level 3	<b>.3019</b>	<b>0.067</b>	-.0176	0.901	-.1689	0.448
Exposure level 4	.2017	0.237	<b>.2654</b>	<b>0.059</b>	-.128	0.571
Gender (Female)	<b>.3479</b>	<b>0.033</b>	<b>.2364</b>	<b>0.079</b>	-.2673	0.282
Age	<b>.0137</b>	<b>0.012</b>	<b>-.0153</b>	<b>0.002</b>	<b>-.0127</b>	<b>0.091</b>
Education	<b>.1151</b>	<b>0.047</b>	-.056	0.239	.0196	0.797
Occupational exp.	.71	0.395	<b>.5513</b>	<b>0.004</b>	.0378	0.895
Foreign citizenship	<b>-.5632</b>	<b>0.029</b>	-.3336	0.127	.0037	0.993
Hair dye use	<b>.4546</b>	<b>0.040</b>	-.0355	0.844	-.2857	0.323
Permanent make-up	<b>1.0817</b>	<b>0.028</b>	/	/	/	/
Sculpture hobby	/	/	<b>.7486</b>	<b>0.010</b>	/	/
Woodworking hobby	<b>.5254</b>	<b>0.066</b>	/	/	/	/
Time outdoor 3h+	-.1943	0.372	<b>.4588</b>	<b>0.021</b>	-.3437	0.238
Prostheses	/	/	<b>.226</b>	<b>0.055</b>	/	/
Wood for heating	/	/	<b>.7989</b>	<b>0.007</b>	/	/
Costume jewelry	/	/	/	/	<b>.6473</b>	<b>0.014</b>
Amalgam fillings	/	/	/	/	<b>.4512</b>	<b>0.005</b>
Locally grown food	<b>.3368</b>	<b>0.054</b>	<b>.2845</b>	<b>0.051</b>	/	/
Tomatoes	/	/	/	/	<b>.0059</b>	<b>0.025</b>
Red wine	/	/	<b>.0016</b>	<b>0.008</b>	/	/
Orange juice	<b>.0012</b>	<b>0.061</b>	/	/	/	/
Vegetable pies	/	/	/	/	<b>.0265</b>	<b>0.010</b>

Tab. 1 Relations observed in multivariate regression models

## Results

Chromium, manganese and nickel were measurable in >95% of samples. Concentrations varied between 0.02-35.11  $\mu\text{g/g}$  for chromium (median 0.52, 5<sup>th</sup>-95<sup>th</sup> perc 0.09-4.95), 0.02-7.23 for manganese (median 0.25, 5<sup>th</sup>-95<sup>th</sup> perc 0.07-0.97), 0.004-39.28 for nickel (median 0.28, 5<sup>th</sup>-95<sup>th</sup> perc 0.03-3.74). Cadmium resulted under the limit of quantification in 74.1% of the samples (range 0.006-0.19  $\mu\text{g/g}$ ), and was not included in the analysis.

The relations found in regression models are shown in table 1.

## Conclusions

The analysis of heavy metal levels in toenails is a relatively recent technique, therefore reference levels are not available in literature and an analysis on the general distribution of sample levels cannot be performed. However, the presence of some expected associations in multivariate analysis (nickel with costume jewelry use and tomatoes consumption; manganese with firewood use) suggests that our study method can be appropriate in assessing chronic exposures. Results showed associations with incinerator exposure for manganese and chromium levels. Findings should be reassessed as soon as more accurate traffic exposure control is available.

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