Assessing multiple sources of cadmium exposure in an Italian population

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Objectives

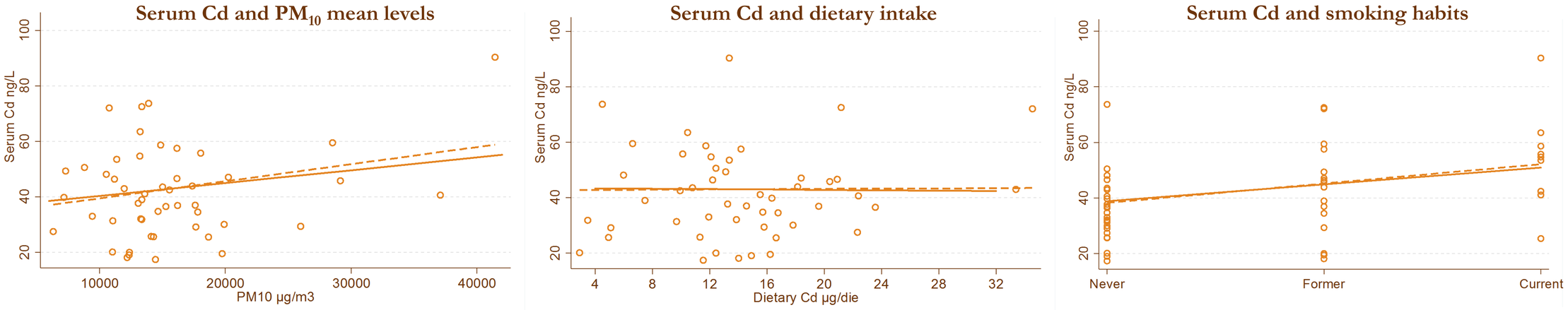
Cadmium (Cd) is a heavy metal representing a serious environmental hazard to the human. Even though food and cigarette smoking are usually by far the main sources of exposure, outdoor air pollution could be an additional important source to be taken into account. Main anthropogenic sources of outdoor air cadmium are non-ferrous metal industrial production and fossil fuel combustion, followed by ferrous metal and cement production, and waste incineration. The aim of our study was to assess the influence of outdoor air pollution on a biomarker of cadmium exposure.

Methods

Outdoor exposure to particulate matter ≤10 μm (PM_{10}) from motorized traffic was assessed for fifty subjects randomly selected from Modena municipality residents, aged 35-70. We geocoded the residence of these subjects and modeled the corresponding ambient air PM_{10} concentration using the CAlifornia LINE Source Dispersion Model version 4 (CALINE-4) as a proxy of environmental air Cd level. We compared these estimate with the serum Cd, measured with inductively coupled plasma – sectorfield – mass spectrometry. Information on smoking habits and cadmium dietary intake were collected with a semi-quantitative food frequency questionnaire in order to assess possible confounding factors. We used both crude and multivariate linear regression models to determine the influence of outdoor PM_{10} levels, smoking and dietary Cd intake on serum Cd.

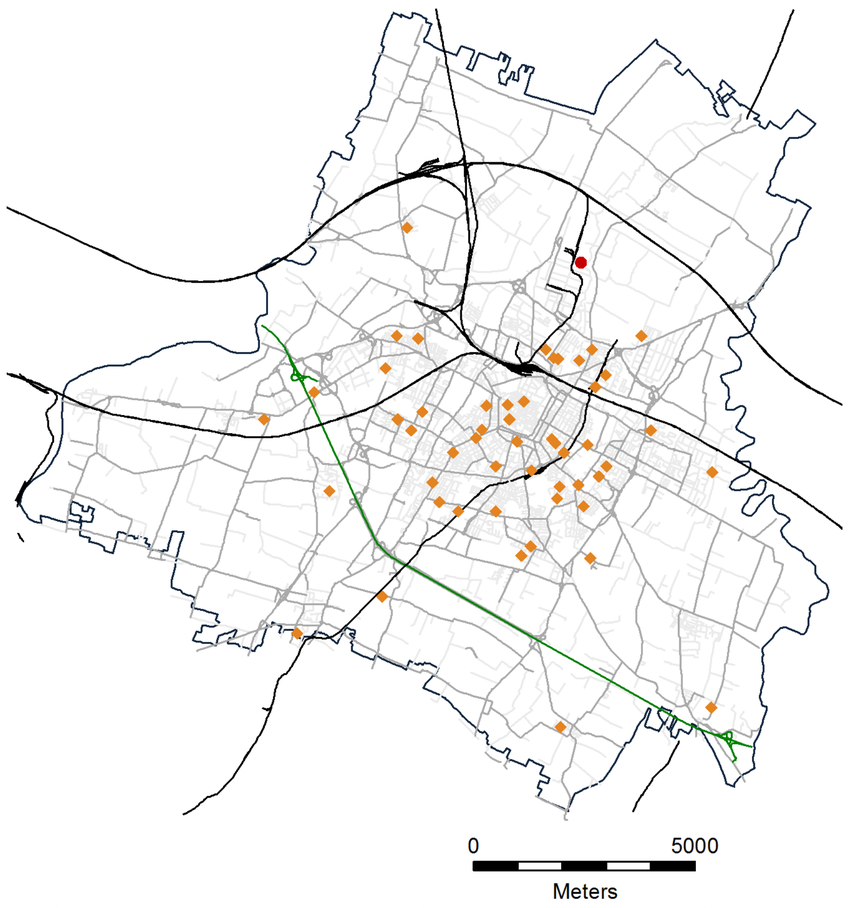
Results

Median values (25th–75th) for serum and dietary Cd were 40.85 ng/l (30.05 – 53.50) and 13.36 μg/die (10.45 – 16.67). Crude β-coefficients were 0.617 (95% CI -0.194 – 1.428, *P=0.133*), 0.026 (-0.827 – 0.829, *P=0.952*) and 6.962 (-0.022 – 13.945, *P=0.051*) for PM_{10}, diet and smoking, respectively. Corresponding adjusted values were 0.463 (-0.365 – 1.292, *P=0.266*), -0.036 (-0.866 – 0.793, P=0.930) and 6.057 (-1.175 – 13.289, *P=0.099*), respectively.



Figures and Table: linear regression analysis between serum cadmium (ng/L) and PM_{10} (μg/m³), dietary intake (μg/die) and smoking habits (smoking categorized as 0=never smokers, 1=former smokers, 2=current smokers). Multivariate model included as adjusting variable each factor alternatively.

	Crude			Adjusted		
Sources of Cd	β	95% CI	*P*	β	95% CI	*P*
Outdoor PM_{10} levels	0.617	(-0.194 – 1.428)	*0.133*	0.463	(-0.365 – 1.292)	*0.266*
Dietary intake	0.026	(-0.827 – 0.879)	*0.952*	-0.036	(-0.866 – 0.793)	*0.930*
Smoking habits	6.962	(-0.022 – 13.945)	*0.051*	6.057	(-1.175 – 13.289)	*0.099*



Modena Municipality Map with layers of interest for outdoor PM_{10} exposure assessment: railway lines (black), highway (green), highroads (dark gray), urban roads (light gray), waste incinerator (red point) and study subjects (orange diamonds).

Conclusions

In our population the most important factor influencing Cd serum content appears to be cigarette smoking, followed by outdoor air pollution (measured by PM10 levels) and lastly diet, possibly for the limitations of dietary assessment methodology. In addition, other unmeasured factors could have influenced serum Cd content, such as a slow release from liver and kidney due to long term exposure.

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