Correlation between intake and biomarker levels of cadmium and selenium in an Italian population: implications for biomonitoring studies

Malavolti M [1], Filippini T [1], Malagoli C [1], Cilloni S [1], Michalke B [2], Venturelli M [3], Vinceti M [1]

1   CREAGEN - Environmental, Genetic and Nutritional Epidemiology Research Center University of Modena and Reggio Emilia, Reggio Emilia, Italy
2   Research Unit Analytical BioGeoChemistry, Helmholtz Center Munich - German Research Center for Environmental Health GmbH, Neuherberg, Germany;
3   Human Resources and Health Directions, Relationship Office with National Health Service

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Introduction

Cadmium (Cd) is an established carcinogenic metal, while selenium (Se) is a metalloid with both nutritional and toxic effects that shows an intriguing relation with human health, particularly with cancer and neurodegenerative diseases. This characteristic depends on its concentration and on the chemical species considered. The aim of the study is to investigate, in a general population of Modena municipality, Cd and Se levels and their correlation, having a strong implication for human health and especially when performing biomonitoring studies.
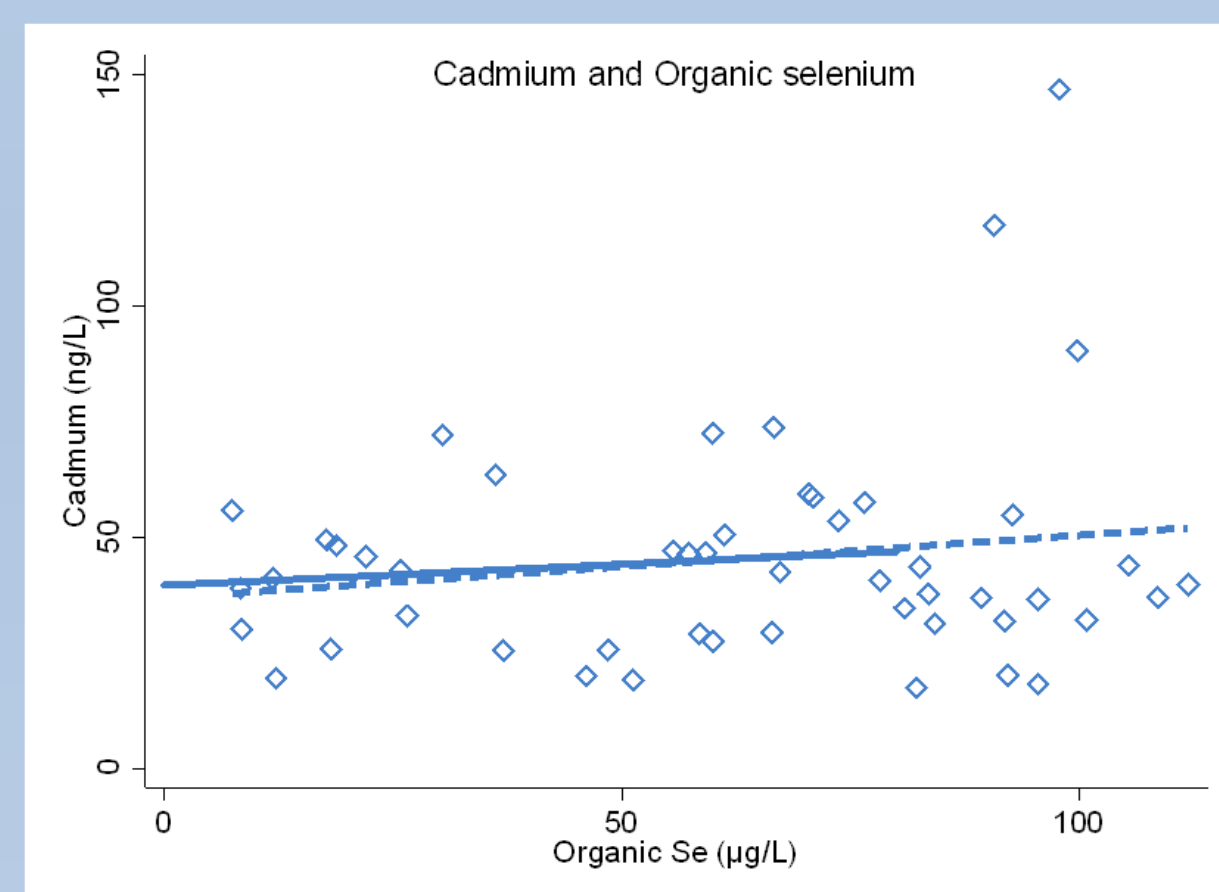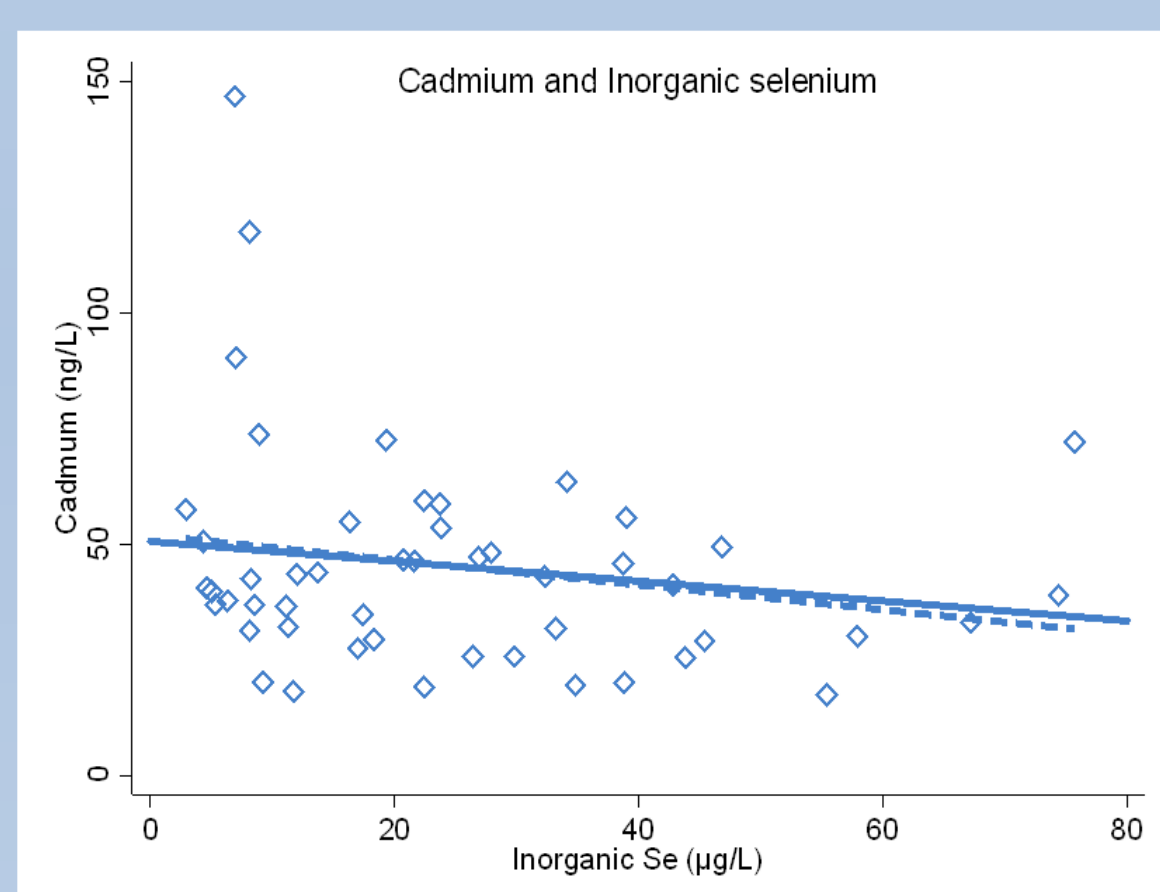
Methodology

Fifty participants, randomly extracted from Modena residents, completed an anamnestic and lifestyle questionnaire. The dietary habits of this population were assessed through a semi-quantitative food frequency questionnaire specifically designed for the central-northern Italian population within the EPIC study, in order to assess Ca and Se intake. Blood samples were analyzed to evaluate the serum concentrations of cadmium, total selenium and its chemical species.

Results

The median intake (interquartile range) estimated by the questionnaire was 13.4 µg/day (10.4-16.6) for cadmium and 92.0 µg/day (68.8-116.3) for selenium. In the current population the foods mainly contributing to cadmium intake were cereals, vegetables and sweet snacks (e.g. chocolate); while for selenium were fish, meat and cereals. Spearman's correlation coefficient between cadmium and selenium intake was 0.88 (95% Confidence Interval 0.80 to 0.93).

Serum concentrations were 0.041 µg/L (0.030-0.055) for Cd, 118.5 µg/L (109-136) for total selenium including 21.2 µg / L (8.9-34.8) for inorganic and 95.9 µg / L (80.7-108.8) for organic species.

The linear correlation coefficient (beta) between cadmium (independent variable) and total selenium, inorganic and organic species, were respectively -0.43 (95% CI -0.75 to -0.12), -0.27 (9% CI -0.63 to 0.10) and 0.14 (95% CI -0.09 to 0.36) in unadjusted model and -0.50 (95% CI -0.87 to -0.13), -0.21 (95% CI -0.62 to 0.19) and 0.09 (95% CI -0.15 to 0.33) in adjusted model for age, sex and smoking habits.
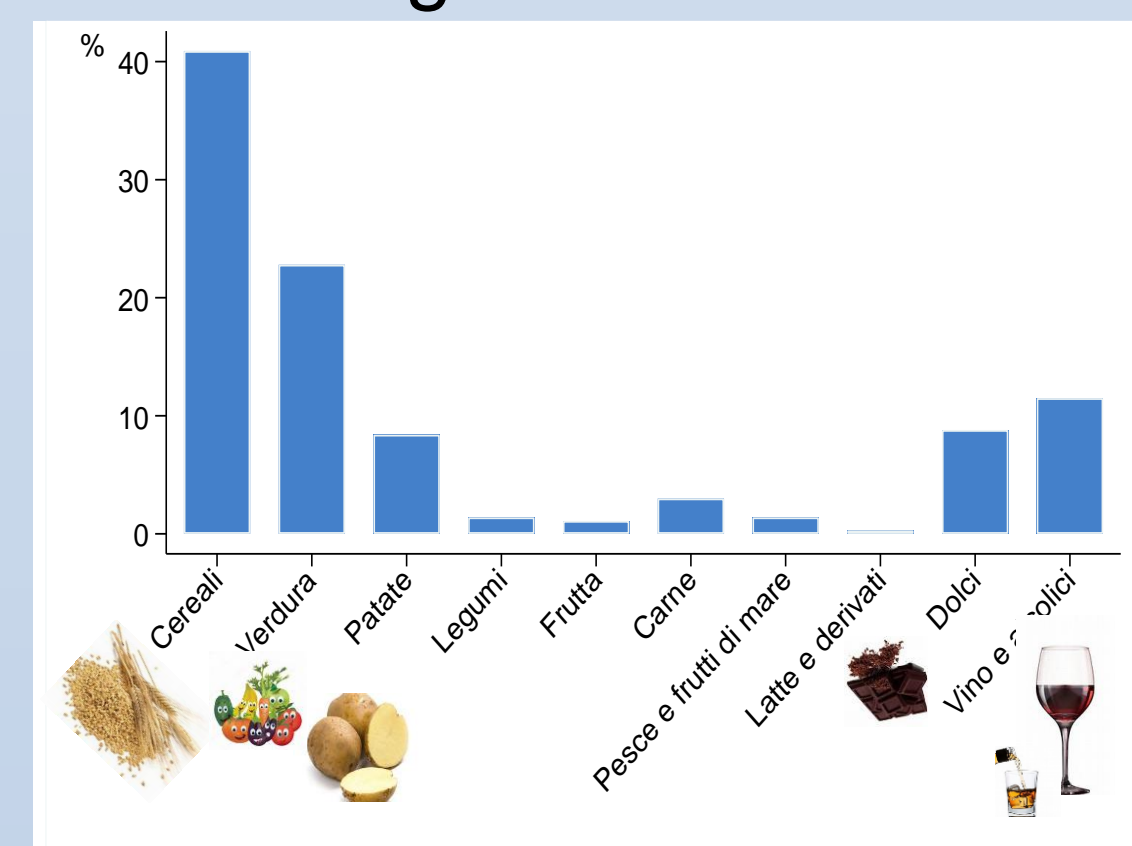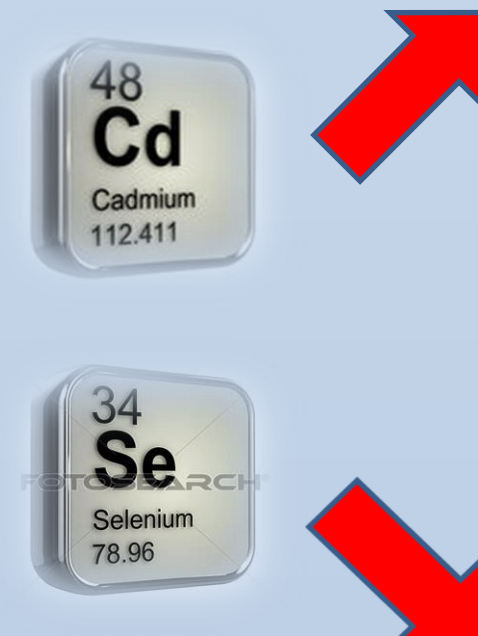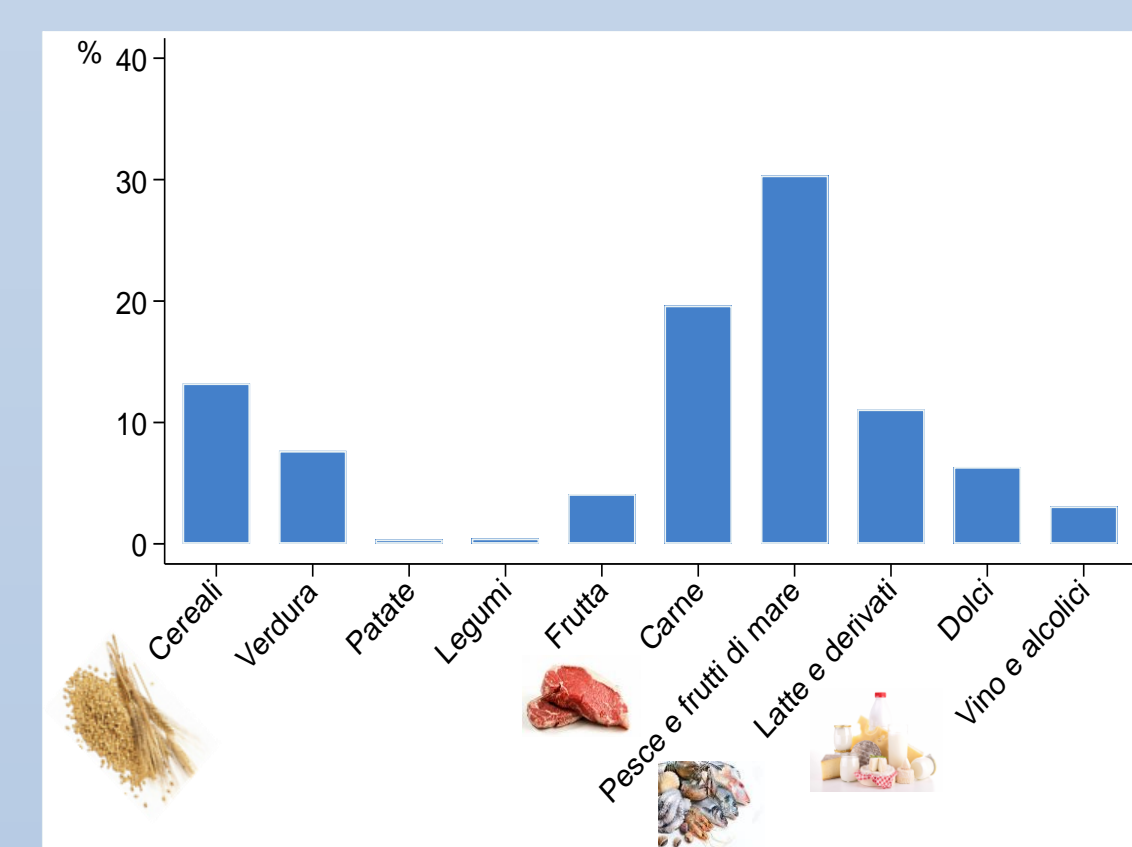

Fig 1. Cadmium in food

Fig 2. Selenium in food

	Crude			Adjusted*		
	Beta	IC 95%	P	Beta	IC 95%	P
Se Total	-0.43	(-0.75; -0.12)	0.008	-0.50	(-0.87; -0.13)	0.010
Se inorganic	-0.27	(-0.63; 0.10)	0.147	-0.21	(-0.62; 0.19)	0.285
Se(IV)	-0.26	(-0.67; 0.15)	0.212	-0.20	(-0.63; 0.24)	0.368
Se(VI)	-1.35	(-3.08; 0.39)	0.125	-1.06	(-2.95; 0.82)	0.263
Se organic	0.14	(-0.09; 0.36)	0.228	0.09	(-0.15; 0.33)	0.440
Se-SelenoP	0.21	(-0.04; 0.46)	0.096	0.18	(-0.09; 0.44)	0.183
Se-Met	0.49	(-1.56; 2.53)	0.633	0.43	(-1.62; 2.48)	0.676
Se-Cys	-1.43	(-2.99; 0.13)	0.071	-1.02	(-2.65; 0.62)	0.217
Se-GPX	-0.07	(-0.57; 0.42)	0.771	-0.20	(-0.71; 0.31)	0.431
Se_TrXR	0.28	(-0.93; 1.49)	0.644	0.27	(-0.93; 1.46)	0.656
Se-HSA	-0.45	(-0.75; -0.16)	0.003	-0.42	(-0.74; -0.09)	0.014

* Adjusted for age, sex and smoking habits.

Tab 1. Correlation coefficient (beta) between cadmium (independent variable) and total selenium, inorganic and organic species

Figures: Analysis between cadmium, inorganic and organic selenium blood levels using univariate(solid line) and multiple (dash line) regression models. Markers size is weighted by age of subjects.

Conclusions

Our results suggest a correlation between the intake of the two elements. On the contrary, the correlation between blood levels of Cd and Se species reveals a different and more complex behavior, showing an indirect association with the inorganic Se species and a slightly positive interaction for organic Se forms.