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Dietary determinants of serum seleniums species in an Italian population

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Background and aim

Selenium (Se) is a metalloid considered both essential and toxic, depending on the level of exposure and the kind of species alternatively considered while cadmium (Cd) is established as a human carcinogens. Previous findings showed that cereals, meat, fish, and dairy products are generally the leading dietary determinants of Se intake in the Italian diet, although large variation of Se content in foods could be influenced by geographical variation of Se content in soil and water, the different availability and absorption through plants and the use of Se dietary supplements. Generally, Se speciation demonstrate a large variation of Se species between investigated subjects.

In this study we sought to assess the influence of different foods intake and the toxic element cadmium on the levels of Se serum species in a representative sample of Northern Italian population.

Methods

We determined levels of total Se, Se species and Cd in 51 serum samples drawn from the general population of Modena municipality using anion exchange chromatography coupled with inductively coupled plasma dynamic reaction cell mass spectrometry according to methodologies previously established for biological matrices. We assessed their dietary habits through a semi-quantitative food frequency questionnaire specifically designed for the Central-Northern Italian population within the EPIC study. This questionnaire assessed the frequency and amount of consumption of 188 food items over the previous year, and allowed to calculate the frequency and quantity of consumption of foodstuffs and the related intake of nutrients and contaminants (including selenium, cadmium) using an *ad hoc* software previously implemented.

Results

Table 1 shows Pearson's correlation coefficients (r) between total serum Se and its species between investigated food categories. Cereals are positively associated with total Se, due to organic species (mainly Se-Cys), while were negative/null for inorganic ones. Meat shows generally null correlation. Fish and seafood demonstrates an inverse correlation with organic species, but positive with inorganic forms. In milk and dairy products organic Se species shows null relation (except for Se-Met), but inverse relation with inorganic ones. Vegetables intake shows inverse relation with overall serum Se, but positive with Se-Cys as well as for Se-Gpx, whilst null/inverse correlation for inorganic forms. Legumes reveals a positive correlation with Se-Cys and Se-IV, while inverse correlation with other Se-species (mainly SePP, Se-Met and Se-Gpx). Tubers (e.g. potatoes) intake shows contrasting results for organic species with inverse relation when overall considered, due to SePP and Se-HSA, and opposite with Se-Cys and Se-Gpx. Inorganic species demonstrates null relation. Correlations between Se intake estimated through the food frequency questionnaires and Se serum species are shown in Table 2. Correlations were null/inverse with Total Se and generally negative with organic species, mainly GpX, whilst inorganic species demonstrated positive correlation. inorganic species with cadmium.

Table 1. Pearson's correlation coefficients (r) between Se serum and its species in selected food categories.

	r	95% IC	*P*	r	95% IC	*P*	r	95% IC	*P*	r	95% IC	*P*
		Cereals			Meat			Fish and seafood			Dairy products	
Total Se	0.215	(-0.068 to 0.465)	*0.134*	-0.027	(-0.303 to 0.254)	*0.855*	-0.088	(-0.358 to 0.195)	*0.543*	-0.297	(-0.531 to -0.020)	*0.036*
Organic Se	0.269	(-0.010 to 0.509)	*0.058*	-0.030	(-0.305 to 0.251)	*0.839*	-0.226	(-0.475 to 0.055)	*0.113*	-0.068	(-0.340 to 0.214)	*0.638*
SePP	0.040	(-0.241 to 0.315)	*0.783*	0.028	(-0.252 to 0.304)	*0.845*	-0.171	(-0.428 to 0.113)	*0.236*	0.071	(-0.211 to 0.343)	*0.623*
SeM	-0.146	(-0.408 to 0.138)	*0.310*	-0.040	(-0.315 to 0.241)	*0.781*	0.130	(-0.154 to 0.394)	*0.370*	0.221	(-0.061 to 0.471)	*0.122*
SeC	0.299	(0.022 to 0.533)	*0.035*	-0.018	(-0.294 to 0.262)	*0.903*	-0.048	(-0.322 to 0.234)	*0.743*	-0.010	(-0.288 to 0.269)	*0.945*
GpX	-0.012	(-0.290 to 0.267)	*0.932*	-0.005	(-0.283 to 0.274)	*0.973*	-0.102	(-0.370 to 0.182)	*0.482*	0.113	(-0.171 to 0.380)	*0.433*
TrxR	0.164	(-0.119 to 0.423)	*0.253*	-0.105	(-0.372 to 0.179)	*0.470*	0.092	(-0.192 to 0.361)	*0.527*	0.080	(-0.203 to 0.350)	*0.583*
HSA-Se	0.156	(-0.127 to 0.417)	*0.278*	-0.025	(-0.301 to 0.255)	*0.862*	0.008	(-0.271 to 0.286)	*0.955*	-0.286	(-0.522 to -0.008)	*0.044*
Inorganic Se	-0.059	(-0.332 to 0.223)	*0.684*	0.008	(-0.271 to 0.285)	*0.957*	0.187	(-0.096 to 0.442)	*0.193*	-0.180	(-0.436 to 0.104)	*0.211*
Se-IV	-0.059	(-0.332 to 0.223)	*0.682*	0.011	(-0.268 to 0.288)	*0.941*	0.171	(-0.113 to 0.429)	*0.236*	-0.205	(-0.457 to 0.078)	*0.154*
Se-VI	-0.027	(-0.303 to 0.254)	*0.854*	-0.009	(-0.286 to 0.270)	*0.951*	0.158	(-0.126 to 0.418)	*0.273*	0.022	(-0.258 to 0.298)	*0.882*
Unknown spp.	-0.096	(-0.365 to 0.187)	*0.506*	-0.010	(-0.287 to 0.270)	*0.947*	-0.054	(-0.328 to 0.228)	*0.708*	-0.236	(-0.482 to 0.046)	*0.099*
		Vegetables			Fruits			Legumes			Tubers	
Total Se	-0.188	(-0.443 to 0.095)	*0.190*	0.224	(-0.058 to 0.473)	*0.117*	-0.218	(-0.468 to 0.064)	*0.128*	-0.295	(-0.530 to -0.019)	*0.037*
Organic Se	-0.153	(-0.414 to 0.131)	*0.288*	0.151	(-0.132 to 0.412)	*0.293*	-0.289	(-0.525 to -0.011)	*0.042*	-0.169	(-0.427 to 0.115)	*0.241*
SePP	-0.159	(-0.419 to 0.125)	*0.270*	-0.212	(-0.463 to 0.070)	*0.138*	-0.160	(-0.420 to 0.123)	*0.265*	-0.141	(-0.403 to 0.143)	*0.329*
SeM	-0.103	(-0.370 to 0.181)	*0.478*	0.016	(-0.264 to 0.293)	*0.914*	-0.203	(-0.455 to 0.080)	*0.158*	0.006	(-0.272 to 0.284)	*0.965*
SeC	0.405	(0.143 to 0.614)	*0.003*	0.484	(0.238 to 0.672)	*<0.001*	0.188	(-0.095 to 0.443)	*0.190*	0.171	(-0.113 to 0.429)	*0.236*
GpX	0.138	(-0.146 to 0.401)	*0.340*	0.114	(-0.170 to 0.380)	*0.430*	-0.240	(-0.486 to 0.042)	*0.093*	0.090	(-0.193 to 0.360)	*0.533*
TrxR	-0.032	(-0.308 to 0.248)	*0.824*	0.116	(-0.167 to 0.382)	*0.421*	0.124	(-0.160 to 0.389)	*0.392*	0.033	(-0.248 to 0.308)	*0.820*
HSA-Se	-0.106	(-0.374 to 0.177)	*0.462*	0.217	(-0.066 to 0.467)	*0.130*	0.017	(-0.262 to 0.294)	*0.905*	-0.102	(-0.370 to 0.182)	*0.482*
Inorganic Se	-0.022	(-0.298 to 0.258)	*0.881*	0.062	(-0.221 to 0.334)	*0.670*	0.190	(-0.094 to 0.445)	*0.186*	-0.085	(-0.355 to 0.198)	*0.558*
Se-IV	-0.013	(-0.290 to 0.267)	*0.931*	0.054	(-0.228 to 0.327)	*0.711*	0.191	(-0.093 to 0.445)	*0.184*	-0.129	(-0.393 to 0.155)	*0.373*
Se-VI	-0.049	(-0.323 to 0.232)	*0.733*	0.063	(-0.219 to 0.336)	*0.663*	0.085	(-0.198 to 0.355)	*0.555*	0.148	(-0.136 to 0.410)	*0.304*
Unknown spp.	0.017	(-0.263 to 0.294)	*0.908*	0.003	(-0.276 to 0.281)	*0.984*	-0.271	(-0.511 to 0.008)	*0.056*	-0.144	(-0.406 to 0.140)	*0.319*

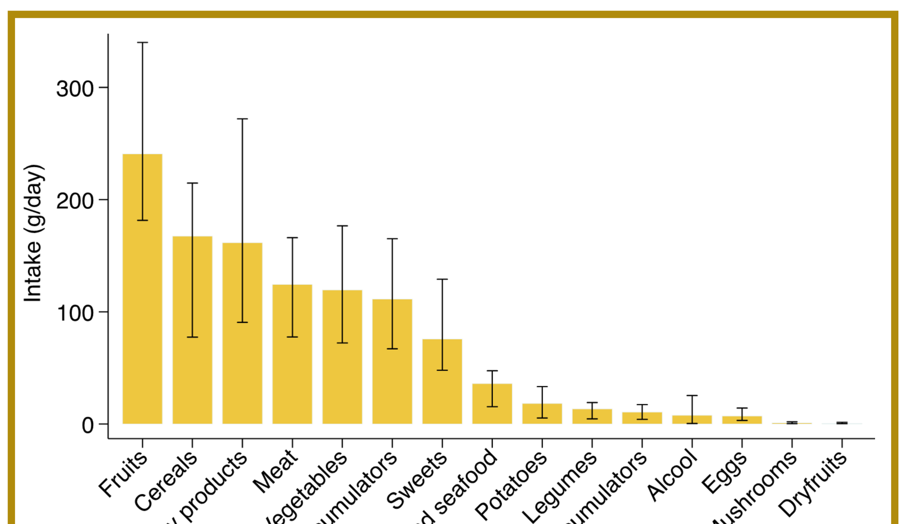

Figure 1. Main foodstuff intake (g/day) in our sample population.

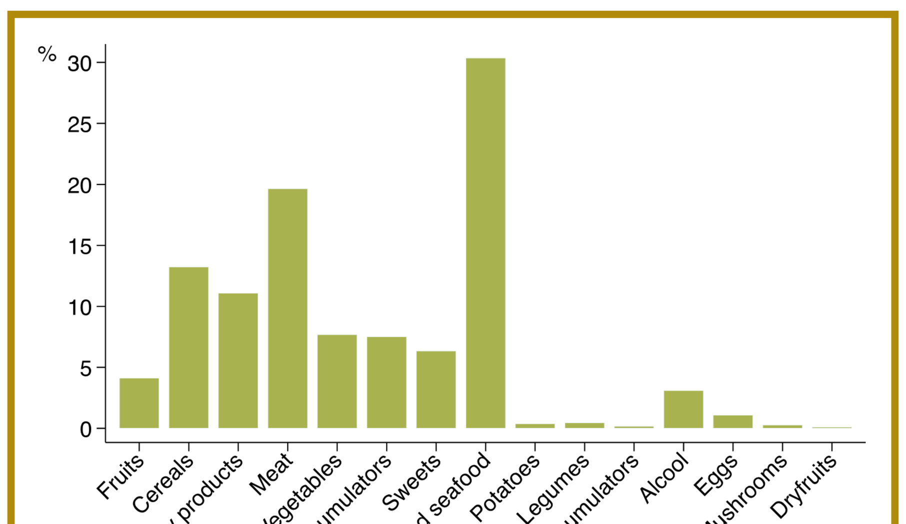

Figure 2. Main food contributors of diatary Se intake using FFQ.

	r	95% IC	*P*
Total Se	-0.104	(-0.372 to 0.179)	*0.472*
Organic Se	-0.271	(-0.511 to 0.007)	*0.057*
SePP	-0.058	(-0.331 to 0.224)	*0.687*
SeM	0.025	(-0.255 to 0.302)	*0.861*
SeC	-0.083	(-0.354 to 0.199)	*0.564*
GpX	-0.378	(-0.594 to -0.112)	*0.007*
TrxR	0.133	(-0.151 to 0.396)	*0.358*
HSA-Se	0.014	(-0.265 to 0.291)	*0.923*
Inorganic Se	0.237	(-0.044 to 0.484)	*0.097*
Se-IV	0.221	(-0.061 to 0.471)	*0.123*
Se-VI	0.182	(-0.102 to 0.438)	*0.207*
Unknown spp.	-0.106	(-0.373 to 0.178)	*0.465*

Table 2. Pearson's correlation (r) between serum Se with dietary Se.

The main food categories according to daily intake (g/day) are fruits, cereals, milk and dairy products, flowed by mead and vegetables (Figure 1) while the main contributors for the estimation of dietary Se intake using the FFQ are fish and seafood, meat and cereals (Figure 2). Table 2 shows correlation between estimation of Se intake through the FFQ and Se serum total and species levels. Table 3 and Figure 3 show correlation between Se total and species with cadmium.

	r	95% IC	*P*
Total Se	-0.374	(-0.589 to -0.110)	*0.007*
Organic Se	-0.125	(-0.387 to 0.156)	*0.382*
SePP	0.241	(-0.037 to 0.484)	*0.089*
SeM	0.074	(-0.206 to 0.342)	*0.608*
SeC	-0.248	(-0.490 to 0.030)	*0.079*
GpX	-0.031	(-0.304 to 0.246)	*0.828*
TrxR	0.075	(-0.204 to 0.344)	*0.599*
HSA-Se	-0.395	(-0.605 to -0.134)	*0.004*
Inorganic Se	-0.211	(-0.460 to 0.069)	*0.138*
Se-IV	-0.176	(-0.431 to 0.105)	*0.217*
Se-VI	-0.128	(-0.390 to 0.153)	*0.370*
Unknown spp.	-0.016	(-0.290 to 0.261)	*0.912*

Table 3 Pearson correlation (r) between serum Se with serum Cd.

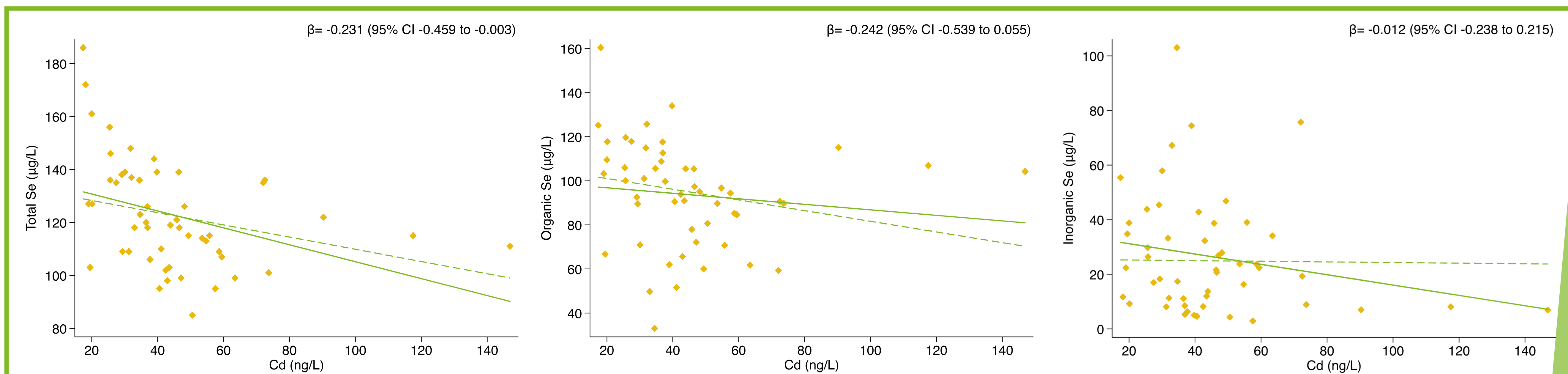

Figure 3. Scatter plots between cadmium and total Se, Organic and Inorganic species serum levels with linear regression models crude (solid line) and adjusted for age, sex, time storage of the sample and smoking habits (dash line and beta coefficients).

Conclusions

Our results show highly specific associations between intake of selected foods and circulating Se species levels. Finally, and inverse correlation between cadmium and total Se levels could be outlined, mainly due to inverse association with such organic species

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