

Comparison of two alternative methodologies to estimate the weekly intake of cadmium in an Italian population

Tommaso Filippini¹, Carlotta Malagoli¹, Bernhard Michalke², Marco Vinceti¹

¹Environmental, Genetic and Nutritional Epidemiology Research Center - University of Modena and Reggio Emilia, Modena, Italy;

²Helmholtz Center Munich-German Research Center for Environmental Health GmbH - Research Unit Analytical BioGeoChemistry, Nuerberg, Germany.

Background and aim

Cadmium (Cd) is a human carcinogen, and represents one of the prioritized substances included in the current European Human Biomonitoring Initiative. A Tolerable Weekly Intake (TWI) for this heavy metal of 2.5 µg/kg body weight (bw) was recently set by the European Food and Safety Authority. In order to estimate the weekly intake of cadmium,

commonly implemented methods include the dietary assessment and use of biomarkers such as urine and blood/serum Cd levels. We assessed dietary Cd intake within a biomonitoring survey using these two alternative methods in order to estimate the weekly intake of our Italian not-occupationally exposed population from Northern Italy.

Results

In the 51 subjects investigated (men/women: 26/25; mean age 50 years, range: 35-71) the median dietary Cd intake estimated with the questionnaire was 13.4 µg/day (interquartile range (IQR) 10.4-16.8), yielding a weekly intake (WI) of 1.34 µg/kg body weight (IQR: 0.85-1.70,

range: 0.26-3.18). On the contrary, based on measured serum Cd levels (median of 0.041 µg/L, IQR: 0.030-0.054) in this population and taking into account tobacco smoking habits, we estimated instead a WI of 0.80 µg/kg body weight (IQR: 0.62-1.09, range: 0.27-2.47).

Table 1. Estimation of weekly intake using two different methods, serum Cd (sCd) and dietary Cd from FFQ (dCd).

	N	WI from blood			WI from diet		
		Mean	SD	<i>P</i> ^a	Mean	SD	<i>P</i> ^a
Total	51	0.90	0.48		1.38	0.68	
Sex							
Men	26	0.88	0.57	0.738	1.37	0.68	0.927
Women	25	0.92	0.37		1.39	0.70	
Age							
<50 years	23	1.02	0.59	0.087	1.40	0.76	0.881
≥50 years	28	0.79	0.34		1.37	0.62	
BMI							
<25	23	0.87	0.30	0.671	1.47	0.64	0.385
≥25	28	0.92	0.59		1.31	0.71	
Smoking habits							
Non-smokers	42	0.97	0.49	0.021	1.43	0.73	0.270
Current-smokers	9	0.57	0.21		1.15	0.29	
Se-supplement use							
No	33	0.87	0.51	0.537	1.30	0.63	0.221
Yes	18	0.95	0.42		1.54	0.76	

^a*P* value of two-sample *t*-test. FFQ: food frequency questionnaire; SD: standard deviation; WI: weekly intake.

Conclusions

In this Italian population, we found higher estimates of Cd intake using a dietary questionnaire than when we estimated it through its serum levels. Dietary assessment methods based on food frequency questionnaires might therefore overestimate Cd intake, or alternatively a higher ratio

between dietary and serum Cd has to be considered compared to what predicted by literature data. Finally, possible health concern arose when, based on dietary assessment method, some subjects of the study population may exceed the Cd TWI set by the European Food Safety Authority.

Methods

In a random sample of the adult general population of Modena municipality we assessed Cd intake using the EPIC semi-quantitative self-administered food frequency questionnaire. Then we also estimated Cd intake with an alternative method based on serum Cd levels measured through ICP-MS. To do that, we considered that 10% of

circulating Cd is found in plasma/serum and that 5% of Cd ingested with foods is generally absorbed. We also took into account the contribution to Cd exposure by tobacco smoking, i.e. around 50% in current smokers. The weekly intake of Cd was estimated using equations implemented for each method in Box 1.

Box 1. Equations implemented for the estimation of Cd weekly intake from serum levels in non-smokers (1) and current smokers (2) and from dietary intake estimated with the FFQ (3).

$$(1) \quad \frac{sCd (\mu g/L) * 100}{10} * \frac{100}{5} * \frac{7}{body\ weight\ (Kg)}$$
$$(2) \quad \frac{[sCd (\mu g/L) - sCd/2] * 100}{10} * \frac{100}{5} * \frac{7}{body\ weight\ (Kg)}$$
$$(3) \quad dCd\ (da\ FFQ) * \frac{7}{body\ weight\ (Kg)}$$

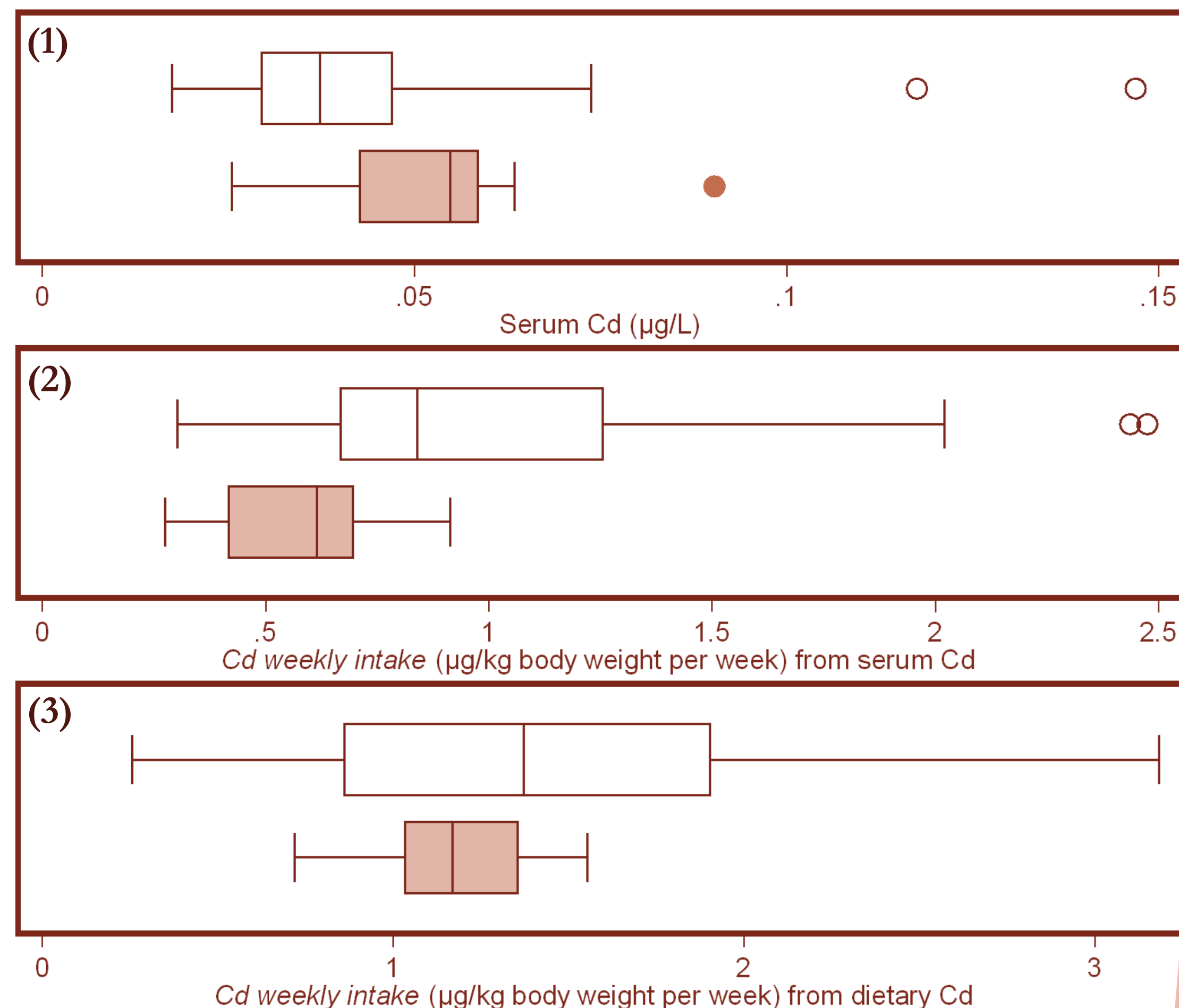


Figure 1. Levels of serum cadmium (1), estimation of weekly cadmium intake from serum (2) and dietary (3) cadmium, splitted in non-smokers (white box) and current-smokers (rouge box).

keywords
correlation questionnaire analysis exposure FFQ serum population smoking subjects biological matrix heavy metal sample age toxicity limitations assessment epidemiology
cadmium research dietary EFSA distribution biomonitoring weekly intake cancer sex trace elements methodology BMI contaminants



Dr. Marco Vinceti - University of Modena and Reggio Emilia
Via Campi, 287 – 41125 Modena.
marco.vinceti@unimore.it



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