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Trace elements in human and animal health: Focus on neurological disease

Methods to assess cadmium intake in biomonitoring surveys

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Background and aim

Cadmium (Cd) is a human carcinogen, and represents one of the prioritized substances included in the current European Human Biomonitoring Initiative. (HBMI4EU).

Dietary intake is the main source of exposure in non-smoking and non-occupationally exposed population. The Tolerable Weekly Intake (TWI) for this heavy metal of 2.5 µg/kg body weight (bw) has been recently set by the European Food and Safety Authority (EFSA) in order to guarantee a high protection to general population.

In this study we are going to compare two different methods to estimate weekly intake of Cd in an Italian population from Northern Italy.

Methods

In a random sample of the adult general population of Modena, Northern Italy, we collected information about personal characteristics and life styles and dietary habits using the EPIC semi-quantitative self-administered food frequency questionnaire. The we measured Cd levels in a fasting serum sample using ICP-MS. Two methods assessing cadmium intake were used implemented, the first through dietary questionnaire and the second from levels of biomarker. To do that we considered the ratio between total and circulating Cd, the percentage of absorption of Cd ingested with foods and the contribution of tobacco smoke. The weekly intake of Cd was estimated using equations implemented for each method in Box 1.

Box 1. Equations implemented for the esstimation 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) $$\frac{\mathrm{sCd}\ (\mu g/L) * 100}{10} * \frac{100}{5} * \frac{7}{body\ weight\ (Kg)}$$

(2) $$\frac{[\mathrm{sCd}\ (\mu g/L) - \mathrm{sCd}/2] * 100}{10} * \frac{100}{5} * \frac{7}{body\ weight\ (Kg)}$$

(3) $$\mathrm{dCd\ (da\ FFQ)}\ * \frac{7}{body\ weight\ (Kg)}$$

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	*P*[a]	Mean	SD	*P*[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.

Results

We recruited 51 subjects, with mean (standard deviation, SD) dietary Cd intake estimated with the questionnaire of 14.1 (SD 6.5) µg/day and serum Cd level of 0.045 (SD 0.024) µg/L. The weekly intake (WI) of Cd was of 1.38 µg/kg/bw (SD 0.41, range 0.26-3.18) and 0.78 µg/kg/bw (SD 0.68, range 0.27-2.47) based on dietary questionnaire and biomarker data, respectively.

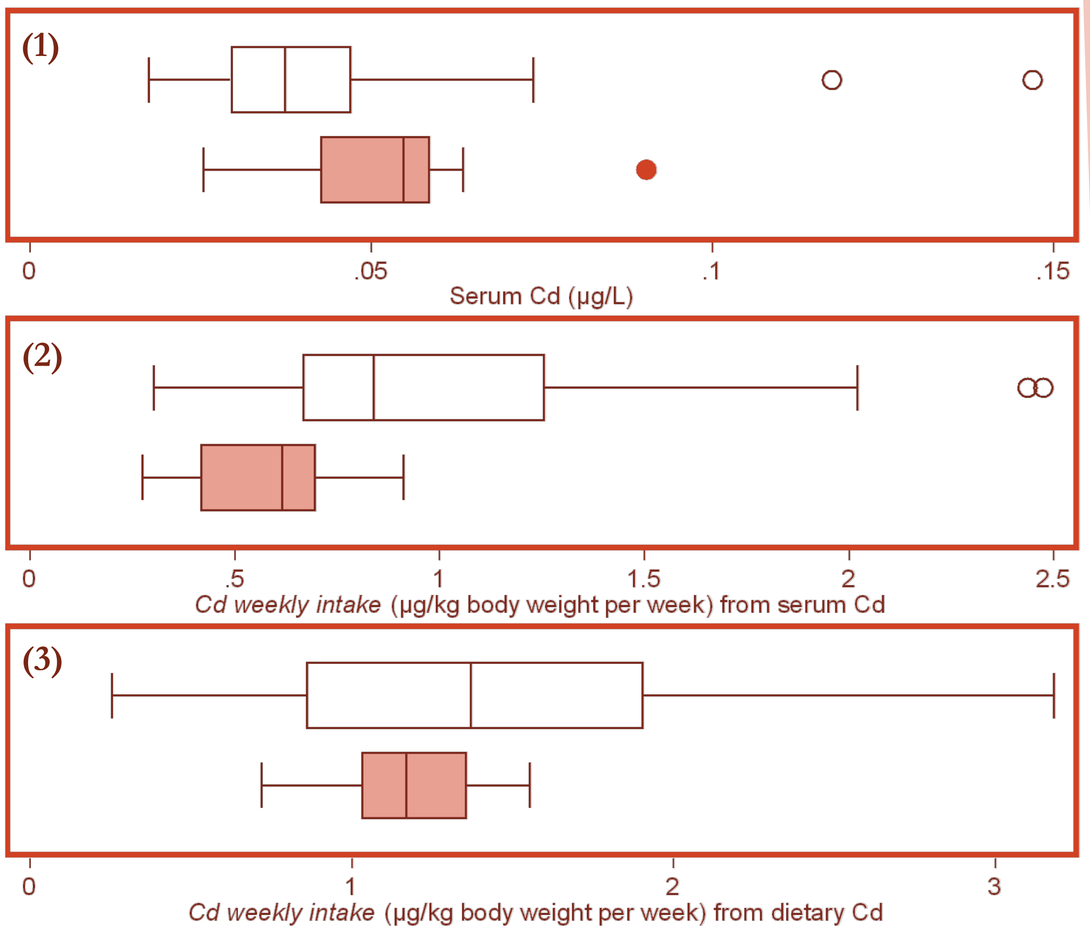
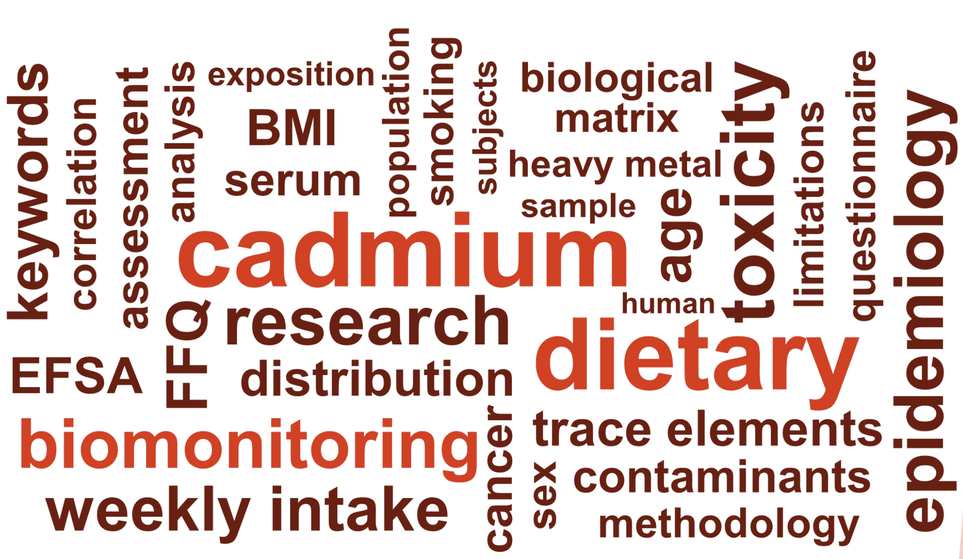


Figure 1. Levels of serum cadmium (1), estimation of weekly intake from serum cd (2) and dietary cd (3) divided in non-smokers (white box) and current-smokers (rouge box).

Conclusions

In this Italian population, we found higher WI of Cd intake using the dietary questionnaire than using serum sample. This difference highlight the importance of the evaluation of the relationship between dietary intake and levels of biomarker when assessing the individual exposure to this metal. 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, based on dietary assessment method, as Cd intake may exceed the reference TWI provided by EFSA, possible health concerns could be highlight for some subjects of the study population.



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