Assessment of cadmium levels in serum, toenails and diet: A cross sectional study in Modena, Northern Italy.

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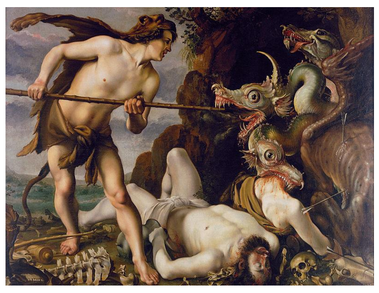

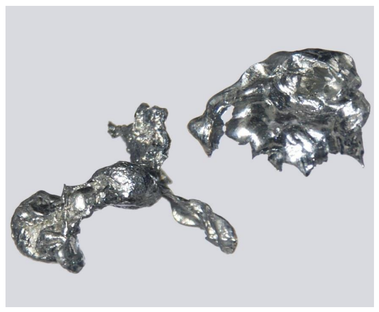

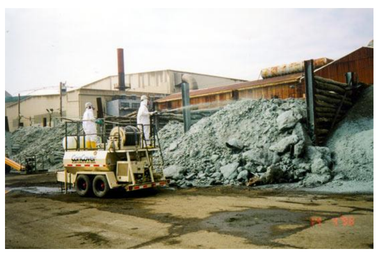

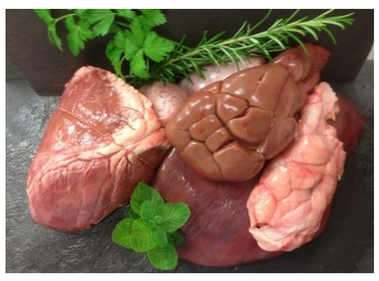

Background and aims

Cadmium (Cd) is a heavy metal that poses serious environmental health hazards to humans. Cigarette smoking and some occupations are major sources of exposure, while for non-smokers and subjects unexposed in the workplace, ingestion through food is the most important source, mainly due to vegetables and cereals, but also to fish, offal, wild mushrooms and chocolate. Blood Cd concentration represents both short and long-term exposures, while toenails Cd reflects medium-term exposure. The aim of the study was to assess Cd exposure and its determinants in fifty adults randomly drawn from the municipal population of Modena, by determining Cd levels in plasma and toenails, as well as its dietary intake using a semi-quantitative Food Frequency Questionnaire (FFQ).

Methods

We randomly sampled eligible subjects from each sex- and age-specific subgroup of Modena residents aged between 35 and 70 years. We contacted these subjects by telephone to ask for their participation in the study, attempting to obtain an age- and sex-balanced sample of the municipal population. After we had obtained their written informed consent, the participants were invited to a Modena National Health Unit Center to give a fasting venous blood sample. In addition, each participant completed a questionnaire collecting detailed information on education, marital status, height and current weight, smoking habits, occupational history and consumption of dietary supplements and finally collected a toenails sample for Cd analysis. Dietary habits and specific Cd dietary intake were assessed using the FFQ from the European Prospective Investigation into Cancer and Nutrition (EPIC).

Table of Cd content into different strata and matrix

	N	Mean	5th	25th	50th	75th	95th	P*
Serum								
Total	50	45.17	19.05	30.05	40.85	53.50	90.30	
<50 y	23	52.18	19.50	36.50	42.95	58.65	117.50	*0.395*
≥50 y	27	39.21	18.15	27.45	34.70	48.15	72.05	
<25 BMI	23	38.48	19.50	29.35	37.70	48.15	55.75	*0.156*
≥25 BMI	27	50.88	19.05	30.05	43.50	63.45	117.50	
Non-smoker	26	43.03	19.05	29.10	35.60	43.50	117.50	*0.007*
Former smoker	15	43.63	18.15	29.35	45.80	57.50	72.50	
Current smoker	9	53.93	25.45	42.45	54.75	58.65	90.30	
Toenails								
Total	50	10.42	0.50	0.50	5.66	11.39	41.07	
<50 y	23	6.54	0.50	0.50	5.62	10.69	19.42	*0.777*
≥50 y	27	13.73	0.50	0.50	5.70	14.19	66.66	
<25 BMI	23	9.67	0.50	0.50	5.70	11.39	28.78	*0.777*
≥25 BMI	27	11.06	0.50	0.50	5.62	11.78	41.07	
Non-smoker	26	7.53	0.50	0.50	5.66	10.69	28.78	
Former smoker	15	18.09	0.50	0.50	4.97	19.42	95.41	*0.915*
Current smoker	9	5.99	0.50	0.50	6.01	8.94	16.58	
Dietary								
Total	50	14.01	4.49	10.45	13.36	16.63	23.57	
<50 y	23	13.67	4.49	9.93	13.26	16.23	23.57	*0.395*
≥50 y	27	14.29	4.93	10.45	14.02	17.81	22.32	
<25 BMI	23	13.25	5.98	9.93	13.11	16.23	22.39	*0.156*
≥25 BMI	27	14.65	3.46	10.78	14.17	17.81	33.40	
Non-smoker	26	13.29	3.46	6.83	12.84	16.35	23.57	
Former smoker	15	16.10	6.60	12.43	15.80	18.39	34.55	*0.244*
Current smoker	9	12.57	9.93	10.45	12.08	13.36	16.63	

******P value* **using nonparametric equality-of-medians test**

Results

Median (25^{th}-75^{th}) values were 40.85 (30.05 – 53.50) ng/l, 5.66 (0.50 – 11.39) ng/g and 13.36 (10.45 – 16.63) µg/die in serum, toenail and diet, respectively. In stratified analyses for gender, age and smoking habits, males shown higher serum Cd content than females, as did current smokers versus never-smokers, while age shown an inverse correlation. Pearson's correlations were 0.028 (95%CI -0.252, 0.304; *P=0.845*) between serum and dietary Cd, 0.001 (-0.277, 0.280; *P=0.993*) between toenail and dietary Cd, and -0.075 (-0.346, 0.208; *P=0.606*) between serum and toenail Cd, with little gender-related differences. When we excluded current smokers from analysis, only the correlation between serum and dietary Cd changed, slightly increasing (r=0.068, 95% CI -0.245,0.367; *P=0.675*).

Conclusions

Our cross-sectional study provided reference values for Cd content since sample was representative of Modena municipalities residents and confirmed evidences for cigarettes smoke as significant source of Cd, while inverse correlation of age is in contrast with other investigations. Cd levels between indicators showed quite null inter-relation. Possible explanations could be for toenail matrix the large amount of toenail sample with Cd content above the detection limit and for dietary Cd, the difference between Cd intake and absorption, because less than 5% of total Cd ingested with food is absorbed.

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