CADMIUM AND MERCURY LEVELS IN THE URINE OF A BELGIAN ADULT POPULATION

Catherine Pirard[1], N. Dubois[1], L. Dewalque[1], B. Zegels[2], P. Simon[2], P. Jeholet[2], C. Charlier[1]

[1]***CHU of Liege, Laboratory of Clinical, Forensic and Environmental Toxicology, Liege, Belgium***
[2]***Province of Liege, Health and Quality of Life Service, Liege, Belgium***
c.pirard@chu.ulg.ac.be

Keywords: Mercury; cadmium; urine; Belgian population

Introduction

An epidemiological study focusing on several endocrine disruptors was carried out within an adult general population living in Liege, one of the Belgian provinces. The aim was to assess the overall exposure of the population in the province of Liege to these environmental pollutants, but also to identify some potential sources of exposure or lifestyle which may influence the body burden of these chemicals. Here we present the levels of cadmium and total mercury in urine.

Methods

The population was recruited within the Province of Liege by the "Service Santé et Qualité de vie de la Province de Liège" from February to May 2015 and consisted of 127 women and 125 men aged from 18 to 73 years old, homogenously distributed between urban and non-urban residence places. They were asked to provide urine and blood samples, and to answer to a small questionnaire about their home environment (including tobacco exposure), life style, diet habits, amalgam fillings, household income, etc. Total mercury in urine was determined using Flow Injection Mercury system (FIMS) while cadmium was analyzed by Graphite Furnace Atomic Absorption Spectroscopy (GFAAS). Limit of quantification was evaluated at 0.5 µg/l for both metals. The levels measured below the LOQ were replaced by half the LOQ value. Descriptive statistics and non-parametric tests were performed using R® software (R Core Team).

Results

Results of urinary cadmium and mercury analyses are gathered in Table 1. For both metals, no significant difference was observed between women and men although cadmium has been demonstrated to be more efficiently absorbed in women resulting in higher urinary levels (Paschal et al., 2000). On the other hand, as expected, cadmium levels were higher in the urine of the participants older than 60 years, as well as in the smokers vs non-smokers and in the passively exposed non-smokers vs non passively exposed ones ($p = 0.032$), even if no correlation was highlighted between cadmium levels and the daily number of cigarettes smoked. Among the other lifestyle and food habit information collected besides the smoking status, only offal frequency consumption were positively correlated to cadmium with significantly higher levels when participant reported to eat offal more than once a month vs less than once a month or never. Focusing on total mercury in urine, although no linear correlation was observed between number of dental amalgams and mercury levels, people having at least one dental amalgam show significant higher levels than those without ($p<0.0001$). The levels of total mercury in urine were higher for participant eating sea fishes more than once a week compared to those reporting to never consume this kind of fish or less than once a month. These results were not expected since inorganic mercury used to be considered as the main mercury species excreted in urine (Berglund et al., 2005) while fishes are known to accumulate exclusively organic species. Nevertheless, the present results could be explained by the hypothesis of a demethylation of methylmercury within the body suggested by Sherman et al. (2013), or by a higher

proportion of organic mercury in urine than usual for regular fish consumer. Unfortunately no speciation was performed to elucidate this question.

Table 1. Cadmium and mercury levels in the urine of the Belgian participants.

Metals	N (%)	Min µg/l	P25 µg/l	P50 µg/l	P75 µg/l	Max µg/l	p value[1]
Cadmium							
All	252 (100)	<LOQ	<LOQ	<LOQ	0.64	2.99	
18 to 29y	46 (18.2)	<LOQ	<LOQ	<LOQ	0.64	1.17	0.0025
30 to 39y	50 (19.8)	<LOQ	<LOQ	<LOQ	0.25	1.11	
40 to 49y	52 (20.6)	<LOQ	<LOQ	<LOQ	0.64	1.61	
50 to 59y	52 (20.6)	<LOQ	<LOQ	<LOQ	0.63	2.23	
>60y	52 (20.6)	<LOQ	<LOQ	0.55	0.87	2.99	
Men	125 (49.6)	<LOQ	<LOQ	<LOQ	0.65	2.99	0.11
Women	127 (50.4)	<LOQ	<LOQ	<LOQ	0.59	1.75	
Smokers	59 (23.4)	<LOQ	<LOQ	0.54	0.89	2.99	0.003
Non-smokers	193 (76.6)	<LOQ	<LOQ	<LOQ	0.59	1.86	
Total mercury							
All	252 (100)	<LOQ	<LOQ	0.81	1.64	17.30	
18 to 29y	46 (18.2)	<LOQ	<LOQ	0.63	1.13	3.79	0.016
30 to 39y	50 (19.8)	<LOQ	<LOQ	0.73	1.18	4.82	
40 to 49y	52 (20.6)	<LOQ	<LOQ	1.19	2.59	17.30	
50 to 59y	52 (20.6)	<LOQ	<LOQ	1.10	2.02	15.70	
>60y	52 (20.6)	<LOQ	<LOQ	0.79	1.43	3.49	
Men	125 (49.6)	<LOQ	<LOQ	0.73	1.44	15.70	0.11
Women	127 (50.4)	<LOQ	<LOQ	0.86	1.85	17.30	

[1] difference was considered as statistically significant for p values < 0.05.

Finally, cadmium and mercury levels in the urine of our participants were compared to the German HBM values usually recognized as health-based exposure limit values (Schulz et al., 2011). If none of the 252 participants showed cadmium or mercury levels above the HBM-II (4 and 25 µg/l respectively), the HBM-I values for cadmium and mercury (1 and 7 µg/l) were exceeded for 26 and 2 volunteers respectively.

Conclusion

Cadmium and total mercury levels were determined in the urine of 252 participants living in the Province of Liege (Belgium) within the scope of an epidemiological study assessing the endocrine disruptor exposure in the general population. Although none of the 252 participants showed urinary cadmium or mercury levels for which an increased risk for adverse health effects is expected, some of them presented metal levels such that health effects cannot be excluded with sufficient certainty. The main determinants of urinary cadmium levels for this general population were the passive and active exposure to tobacco smoke and the consumption of offal, while having dental amalgams and consuming sea fishes increased the urinary mercury levels.

References

Berglund, M.; Lind, B.; Björnberg, K. A.; Palm, B.; Einarsson, Ö.; Vahter, M. (2005). Inter-individual variations of human mercury exposure biomarkers: A cross-sectional assessment. *Environ. Health: Global Access Sci. Source*, 4 (20), 1-11.

Paschal, D.C.; Burt, V.; Caudill, S.P.; Gunter, E.W.; Pirkle, J.L.; Sampson, E.J.; et al. (2000). Exposure of the U.S. population aged 6 years and older to cadmium: 1988–1994. *Arch. Environ. Contam. Toxicol*., 38: 377-383.

Schulz, C.; Wilhem, M.; Heudorf. U.; Kolossa-Gehring, M. (2011). Update of the reference and HBM values derived by the German Human Biomonitoring Commission. *Int. J. Hyg. Environ. Health*, 215, 26-35.

Sherman, L.S.; Blum, J.D.; Franzblau, A.; Basu, N. (2013). New Insight into Biomarkers of Human Mercury Exposure Using Naturally Occurring Mercury Stable Isotopes. *Environ. Sci. Technol.*, 47, 3403-3409.