*BioMetals* **17:** 597, 2004.



# Concluding remarks

*International Symposium on Health Impact of Cadmium Exposure and its Prevention in China, Nov 17$^{th}$-19$^{th}$ 2003, Shanghai, PR China*

Antero Aitio
*International Programme on Chemical Safety, World Health Organization, Geneva, Switzerland*

The work presented in this symposium demonstrates that views on the toxicology of cadmium are converging. This is true equally of the important target organs of cadmium toxicity in humans and in experimental animals in a qualitative sense and of the quantitative relationships between cadmium exposure and intake, biological markers of exposure and effect, and clinically significant renal damage.

However, studies on long-term effects of environmental exposure to cadmium raise concerns of potential neurotoxicity, notably developmental neurotoxicity, of effects on the endocrinological system, and on the overall mortality not directly related to nephrotoxicity.

Research is in progress on mechanisms of action of cadmium notably on end points other than nephrotoxicity, especially on the generation of oxygen radicals and on subsequent oxidative stress, as well as on the effects of cadmium in mixtures.

Research is also in progress on the mitigation of risks due to soil cadmium contamination with the intent of providing cost-effective means of decreasing the cadmium content of soil and of cadmium uptake by crops.

Cadmium research is an important model for the research in genomics, and proteomics: for years already, an array of different end points has been used in the investigations of mechanisms of cadmium toxicity and of the relationship between exposure, exposure- and effect markers, and of cadmium-induced damage. Research on cadmium had demonstrated that even when extensive databases are available, the age-old scientific paradigm of hypothesis generation and hypothesis testing is still valid: mere data is not information, and still less knowledge.

The ChinaCad project was justified from the financial point of view as an opportunity for technology transfer and capacity building. The sponsor should be very happy with the outcome of the project: The project represents a well-functioning multi-centre collaboration, where there are several participating centres within China, and in different European countries; study planning, design, execution and reporting are of highest standard, and careful consideration is given to such important aspects as analytical quality and advanced statistical analysis. The project includes important components employing the most modern molecular techniques in genomics and proteomics.

The main aim of the ChinaCad project was the assessment of the cadmium pollution situation in south eastern China, which set limitations to the study planning: the emphasis was in representative sampling, rather than in the scientifically most interesting low-exposure range. This limitation notwithstanding, the project has achieved important results scientifically. It has demonstrated extensive cadmium exposure, and presence of early renal tubular effects and effects on calcium metabolism within the studied population. The project results are in agreement with studies on cadmium dose-response relationship elsewhere and has significantly contributed to the convergence of the views on the matter. The project has shown that there are clinically significant effects on bone density, with consequent increased incidence of bone fractures among the exposed population. Thus the project has also established the need for risk reduction measures.

The ChinaCad project has raised the question of an effect on adverse endocrine effects in exposed males, and pioneered in the development of a biomarker of susceptibility in cadmium exposure.

Identification of an exposed cohort, and strengthened collaboration with several leading laboratories, achieved in the ChinaCad project, provide means for further advances in the assessment of low-dose toxicity of cadmium.