
AN ASSOCIATION BETWEEN RENAL DAMAGE AND URINARY CADMIUM AND LEAD LEVELS IN YOUNG RUSSIAN CHILDREN: ANALYTICAL EPIDEMIOLOGY AND INTERVENTION

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Objectives: The aim of the study was to find out whether a sub-clinical renal damage in children of urban areas in an industrial region could be associated with the combined toxicity of cadmium and lead.

Material and methods: In 2004–2005 we examined 3–7 year-old preschool children from four towns in the Middle Urals, three towns being polluted by the copper industry. Only children who had no known renal disease were included into the studied groups. Urinary concentrations of Cd, Pb, and β -2-microglobulin (β 2u), along with standard clinical indices, were measured in 184 children in the 2004 cohort, and 89 in the 2005 cohort. A case control study design was used to evaluate the association between β 2u levels and body burdens of Pb and Cd as measured by their urinary levels. Cases were defined as those with β 2u levels above the median and controls as those at or below the median. In 2006 we examined 38 children aged 3–7 years (not excluding those with renal symptoms) in another town polluted with emissions from a big copper smelter. Beside the abovementioned renal indices, we performed liquid crystallography of urine. All the tests in this cohort were performed just before and immediately after the 5 weeks period during which the children were being given the bio-protective complex comprising pectin, glutamate, a multivitamin-multimineral medicine, and a calcium supplement, which complex had been shown to protect laboratory rats against Cd-Pb nephrotoxicity.

Results: Both 2005 and 2006 cohorts demonstrated a statistically significant association between Cd and Pb levels and the probability of having a β 2u level above the median. The adjusted odds ratios (ORs) per μ g/l were 1.89 (1.13–3.16, $p < 0.02$) for Cd and 1.19 (95% CI 1.07–1.31, $p < 0.001$) for Pb in the 2004 cohort. The ORs were 1.13 (95% CI 1.04–1.22, $p < 0.03$) for Cd and 1.03 (95% CI 1.02–1.05, $p < 0.001$) for Pb in the 2005 cohort. In the 2006 cohort only 5 children (13.2%) had β 2u levels $>300 \mu$ g/l but many children were found to have micro-urolithiasis seen with the polarization microscopy (in 86.8% of children) which revealed also the formation of birefringent lipoprotein crystals characteristic of renal membranulolysis of different extent (in 100%) and the presence of an albuminous ring around microscopy preparations (in 65.7%). One third of the group had abnormally high urine specific gravity (>1025). After the bio-protective intervention the prevalence of all these indices has statistically significantly ($p < 0.05$) diminished.

Conclusions: (a) Our study suggests that urinary cadmium and lead concentrations characteristic of children living in polluted areas may be associated with incipient (mostly sub-clinical) renal damage in some of them. (b) A clear beneficial renal effect produced by a combination of bio-protective agents previously proven in an animal experiment to be inhibitors of cadmium/lead nephrotoxicity may be considered as additional circumstantial evidence of this association.