BIOMARKERS AND RISK FACTORS AFTER LEAD AND CADMIUM EXPOSURE IN THE AREA OF COPŞA MICĂ

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Abstract: Industrial and urban development in the last decades in the absence of adequate environmental protection measurements led to an increased level of pollution in Romania. Environmental lead levels indicated the need to assess the exposure of susceptible population groups (children) living in the area of influence of a primary smelter in Copsa Mica. Blood lead levels and urinary cadmium levels of a susceptible population group (children aged 3-15 years) were assessed in a cross-sectional study. Most of the subjects (72%) had blood lead levels between 10-30 μg/dL, in case of 13% of them, blood lead levels fall within 30-40 μg/dL, while 5% of them had blood lead levels exceding 40 μg/dL. Only 10% of the investigated subjects had blood lead levels bellow 10 μg/dL. Urinary cadmium levels were bellow the detection limit of the method used for measuring, in case of most of the investigated subjects. The study found negative and statistically significant correlations between blood lead levels and children height.

Cuvinte cheie: expunere la plumb şi cadmiu din mediu, plumbemia, indicatori somatometrici, cadmiu urinar

Rezumat: Dezvoltarea industrială şi urbană care a avut loc în România în ultimele decade a condus la creşterea poluării datorită lipsei unor măsuri adecvate de protecţie a mediului. Nivelele de plumb şi cadmiu determinate în factorii de mediu au semnalat necesitatea evaluării expunerii grupurilor populaţionale cu susceptibilitate crescută (copii) care locuiesc în apropierea unei topitorii de metale neferoase din zona Copşa Mică. Într-un studiu transversal s-au evaluat nivelele plumbemiei şi respectiv nivelele de cadmiu urinar la un grup populaţional cu susceptibilitate crescută (copii cu vârsta cuprinsă între 3-15 ani). Rezultatele măsurătorilor plumbemiei au evidenţiat faptul că majoritatea subiecţilor investigaţi (72%) au avut valori ale plumbemiei situate între 10 şi 30 μg/dL,un procent de 13% s-au încadrat în categoria 30-40 μg/dL, 5% dintre subiecţi s-au încadrat în categoria de plumbemie peste 40 μg/dL, iar 10% au avut valori ale plumbemiei sub 10 μg/dL. Nivelele de cadmiu urinar s-au situat sub limita de detecţie a metodei în cazul majorităţii subiecţilor investigaţi. Dintre indicatorii somatometrici, înălţimea apare negativ (scade cu creşterea valorilor plumbemiei) şi semnificativ statistic corelată cu nivelul plumbemiei.

INTRODUCTION

Human activity emits vast amounts of heavy metals into the environment. (1, 4). Contamination of the environment with lead and cadmium can be ascribe almost entirely to industrial activities (3). The industries involved in producing, using and disposing of the products containing lead and cadmium as long as metallurgic facilities processing raw materials containing heavy metals, are responsable of the contamination of the environmetal media with heavy metals (3). Lead can produce multiple biologic outcomes in humans, depending on the level and duration of the exposure. Chronic exposure to low levels of lead is associated with damage on neurobehavior functions in children and this effect was also observed in workers (adults) when exposed to lead for a long period of time (2). In the same context, lead and cadmium sinergically impact the renal function. As a consequence, at an international level, importance is given to the implementation of risk communication and social marketing programs in order to decrease exposure and risk within the susceptible population groups exposed to heavy metals (2)..

WORK HYPOTHESIS

Assessment of lead and cadmium exposure of a population group living in Copsa Mica area, using biomarkers and aiming to elaborate and implement a communication risk program.

MATERIAL AND METHOD

To estimate the exposure to lead and cadmium, a cross-sectional study was carried out. A representative sample of school and preschool children living in Copsa Mica and some other localities in the area, was investigated. Blood lead levels as a specific biomarker of exposure, were measured using Lead Care System and in order to assess cadmium exposure, urinary cadmium levels were measured using the atomic absorbtion spectrometry with graphite furnance technique. Weight and height, as biomarkers of effect, were determined to evaluate children development.

RESULTS AND DISCUSSIONS

Blood lead levels measured in children 3-15 years old living in Copsa-Mica area varied between a minimum value of 5.3 μg/dL and a maximum value of 57.6 μg/dL. (Table 1)

The results of blood lead levels measurement showed that most of the investigated subjects (72%) had blood lead levels between 10 and 30 μg/dL, a percent of 13% of the investigated subjects had blood lead levels within the category 30-40 μg/dL, while for 5% of the investigated subjects the blood lead levels exceeded 40 μg/dL, and only 10% of the investigated children had blood lead levels bellow 10 μg/dL.

CLINICAL ASPECTS

Table no. 1. Detailed statistical description (mean, minimum value, maximum value, standard deviation, percentiles, variance, skewness, kurtosis) of blood lead level values measured within the investigated population group

Percentile		Minimum		
1%	5.3	5.3		
5%	7.1	5.9		
10%	10	6.9		
25%	15.4	7.1		
50%	20.8		Mean	22.21
		Maximum	Standard Deviation	10.42
75%	27.2	45.5		
90%	36.3	47.7	Variance	108.60
95%	45.5	49.3	Skewness	0.96
99%	57.6	57.6	Kurtosis	4.13

Assessment of the relationship between height, weight and blood lead levels showed a negative correlation between height, weight and blood lead levels (height and weight are decreasing with the increasing of blood lead levels), the correlation between height and blood lead levels being statistically significant. (Table 2)

Table no. 2. Correlations between blood lead levels and height and weight of the investigated subjects, as biomarkers of effect

Correlation coefficient P value	Height	Weight	Blood lead levels
Height	1.0000		
Weight	0.8710* 0.0000	1.0000	
Blood lead levels	-0.2877* 0.0408	-0.2537 0.0910	1.0000

The levels of cadmium measured in the urine were bellow the detection limit of the method (0.1 μg/l), except for six values that were slightly above the detection limit of the method.

The consumption of vegetables and fruit grown in the area does not seem to be statistically significant correlated with the levels of urinary cadmium. (Table 3)

Table no. 3. Liniar regression model assessing the relationship between urinary cadmium levels and the exposure risk factors investigated throughout the questionnaire – Consumption of vegetables and fruit grown in the area – corrected for age and gender

Urinary cadmium	Coefficient	Standard Deviation	t	P>|t|	Confidence Interval 95%
cons_v	0.0012667	0.0288567	0.044	0.965	-0.0566936 0.059227
wash_l	0.0648282	0.0819662	0.791	0.433	-0.0997974 0.2294537
Igender_1	-0.0124808	0.1694346	-0.074	0.942	-0.3528031 0.3278415
age	0.0126133	0.0119015	1.060	0.294	-0.0112915 0.0365181
IgXvar_1	-0.0012903	0.0186874	-0.069	0.945	-0.0388251 0.0362445

Statistical analysis using a liniar regression model did not show a statistically significant correlation between blood lead levels measured in the investigated subjects and the bellow mentioned exposure risk factors. (Table 4)

Table no. 4. Liniar regression model assessing the relationship between blood lead levels and the exposure risk factors investigated throughout the questionnaire – playing with soil, occupational exposure of some family members, the frequency of consumption of vegetables and fruit grown in the area, hands washing, placind dirty fingers or toys into mouth

Blood lead levels	Coefficient	Standard Deviation	t	P>|t|	Confidence Interval 95%
Play with soil	5.265451	5.193142	1.014	0.322	-5.504466 16.03537
Occup. exposure	4.371765	4.658726	0.938	0.358	-5.289842 14.03337
Freq. Veg. Cons.	1.596937	1.587513	1.006	0.325	-1.695363 4.889237
Wash_hands	-1.022232	8.709871	-0.117	0.908	-19.0854 17.04093
Dirty toys	5.336446	5.048106	1.057	0.302	-5.132685 15.80558

CONCLUSIONS

72% of the investigated children had blood lead levels above 10 μg/dL which is the limit established by CDC (Centers for Disease Control and Prevention) within the community, separating normal values from pathological values.

The somatic development of the children seems to be negatively influenced by the blood lead levels.

The levels of urinary cadmium were bellow the detection limit of the method (0.1 μg/l) within the investigated population group.

The statistical analysis did not show a statistically significant correlation between blood lead levels, urinary cadmium levels and the exposure risk factors investigated throughout the questionnaire and mention above in the RESULTS chapter.

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