Research Paper Environment

Exposure to Lead of Population at Risk in Copşa Mică Area, Romania

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ABSTRACT

– Lead is ubiquitous in the environment of a child. Children are exposed to lead originated from different sources (paints, fuel) and through various contact pathways (air, food, water or dust). Exposure to lead continues being a public health issue because of its serious adverse effects such as cognitive and behavioral disorders. In this paper, we suggest the assessment of the relationship between lead pollution and health status of children aged 2-11 years in Copşa Mica town, Romania. The objective of this study was the statistical analysis of the relationship between blood lead levels determined in the investigated subjects and several risk factors associated to lead exposure, investigated by questionnaire. The results showed that the blood lead levels in the investigated population did not correlate with the subjects' residence, the height/weight development was likely related to lead exposure, and significant correlations were found between blood lead levels and habits of children.

KEYWORDS lead, children, health status, Copşa Mică.

INTRODUCTION

Scientific data concerning lead, released by the U.S Centers for Disease Control (CDC) confirm that the adverse health effects due to this toxic substance occur at increasingly lower levels. It is also widely accepted by scientists that the population at risk in the non-occupational field is mainly represented by preschool children, fetuses (through exposure of the mother) and pregnant women (Committee on Measuring Lead in Critical Populations, 1993).

In CDC reports on the issue of lead referring especially to these populational groups (CDC,1997) it was initially stated that 25 µg/dL is the level of action for the blood lead level, although it is known that the adverse effects occur at a lower level. Later scientific data have shown that some adverse health effects occur in children at blood lead concentrations of about 10 µg/l, and they have become so overwhelming that they needed to be taken into account with priority in the case of an approach regarding lead exposure in children.

In Romania, lead is widespread in all areas of the country, being considered an almost "ubiquitous" toxic substance. There are areas with high lead levels in the environmental factors caused by road traffic, presence of non-ferrous metallurgy industries (Zlatna, Baia Mare, Copşa Mică, etc.) or mining areas rich in non-ferrous ores. These areas are characterized by high levels of inorganic lead in the environmental factors. The situation is different in case of sources represented by road traffic, where organic forms of lead are present, even if the health effects on the populational groups at higher risk are identical for the two cases mentioned above (Gurzău et al., 1995; Gurzău et al., 1996).

In Romania, the main routes of exposure for the populational group at high risk, i.e. children aged 1-6 years are soil and house dust, and less water, food, etc. Only in areas where vegetables are cultivated and fruit trees are grown, a special attention should be given to exposure via dust deposited on their surfaces.

Things are a little different for other populational groups with higher sensitivity, such as pregnant women and women during lactation. Generally, in these cases exposure is due mainly to poor working conditions, obviously in workplaces where lead concentrations are high. In Romania, there are few studies that have highlighted high lead exposures for these two types of populations with increased sensitivity (Copşa Mică) (Gurzau et al., 1992; Gurzau et al., 1993; Gurzau et al., 1995).

The objective of this study was to collect and analyze data on the lead exposure of children in Copşa Mică area, paying a particular attention to the spatial dynamics of this exposure.

MATERIALS AND METHODS

Risk and health impact assessment of lead exposure was performed by identifying the area, i.e. Copşa Mică town and people with increased susceptibility, i.e. school children aged 7-11 years and preschool children aged 2-6 years. Actions were taken to obtain the parents' consent in order to examine the children. A representative sample of subjects was chosen for which questionnaires on exposure and health status were applied and biomarkers of exposure and effect were determined.

RESULTS

The investigated sample in Copşa Mică area included 109 subjects for whom height, weight, and blood lead level were determined and blood pressure was measured, while parents filled in a questionnaire containing questions regarding the risk factors related to exposure to lead.

In order to estimate the impact of lead exposure for preschool and school children, the group of 109 subjects was investigated by objective measurements for the blood lead level determination. 72 subjects (group A) resided in Copşa Mică and 37 subjects resided in neighbouring localities (Agârbiciu, Axente Sever and Micasasa) (group B).

The demographic structure of the subjects by age and gender amounted to 57 children aged 2-6 years and 52 children between 7-11 years old, with a distribution of 58 girls and 51 boys.

The parents of the children included in the sample of subjects residing in Copşa Mică locality were asked to fill in a questionnaire on exposure to lead, alonside the blood lead level objective determinations. A total of 87 questionnaires were valid and were introduced in the database.

Group A) The blood lead levels determined in children aged 2-11 years in Copşa Mică area, ranged from a minimum level of 12.2 µg/dL to maximum levels of 65 µg/dL. Blood lead levels above 65 µg/dL were analyzed qualitatively. As a result, all those cases in which the blood lead levels were equal to or greater than 65 µg/dL were introduced in the database as blood lead concentrations of 65 µg/dL.

Group B) The blood lead levels determined for children in Copşa Mică locality showed higher values in the age group of 2-6 years old in comparison to children older than 7-11 years, both in female subjects (55.3 mg/dL towards 44.3 mg/dL) and in male subjects (58.4 mg/dL towards 53.4 mg/dL). The minimum blood lead level found in this sample of children was 25.2 mg/dL. Analysis of the subjects' distribution by gender groups and blood lead levels shows a high preponderance of boys in the category of blood lead levels higher than 60 mg/dL, while girls had a higher preponderance in the category of blood lead levels of 20-35 mg/dL. The percentage difference between boys and girls on categories of blood lead levels is not significant statistically.

Table 1. The distribution of girls and boys on blood lead levels.

Blood lead level group (mg/dL)	Gender		Total
	Girls	Boys	
10-20	3	2	5
	5.26	4.00	4.67
20-35	11	12	23
	19.30	24.00	21.50
35-60	30	30	60
	52.63	60.00	56.07
> 60	13	6	19
	22.81	12.00	17.76
Total	57	50	107
	100.00	100.00	100.00
Pearson chi2(3) = 2.3746 Pr = 0.498			

Group A) Assessment of the correlation between height, weight and blood lead levels for children aged 2-11 years in Copşa Mică area indicates a very low negative correlation between blood lead levels and height and between blood lead levels and weight, respectively. The following tables show the linear regression coefficients and statistical significance regarding the blood lead level estimated impact on the somatometric development in children. Results of linear regression estimates indicate a negative correlation between blood lead levels and height and weight in both simulations, but without being statistically significant (Table 2).

Table 2. The impact of different categories of blood lead levels recorded in children upon the somatometric indicator height and weight - Group A.

Source	SS	df	MS	Number of obs = 106 F(7, 98) = 0.42 Prob > F = 0.8873 R-squared = 0.0292 Adj R-squared = -0.0402 Root MSE = 15.981		
Model	752.247135	7	107.463876			
Residual	25029.6491	98	255.404583			
Total	25781.8962	105	245.541869			
height	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
gender	2.247928	3.180345	0.707	0.481	-4.063363	8.559219
age	.0476899	.630324	0.076	0.940	-1.203168	1.298547
type_loc	-1.21282	1.613548	-0.752	0.454	-4.414853	1.989214
educ_mo	1.147863	1.681095	0.683	0.496	-2.188216	4.483942
IPb_gr_2	-2.727213	8.066651	-0.338	0.736	-18.73522	13.28079
IPb_gr_3	-5.929489	7.57584	-0.783	0.436	-20.9635	9.104518
IPb_gr_4	-2.584631	8.446563	-0.306	0.760	-19.34656	14.1773
_cons	29.44704	8.967444	3.284	0.001	11.65144	47.24264
Source	SS	df	MS	Number of obs = 106 F(7, 98) = 47.49 Prob > F = 0.0000 R-squared = 0.7723 Adj R-squared = 0.7561 Root MSE = 3.3807		
Model	3799.51319	7	542.787599			
Residual	1120.07171	98	11.4293032			
Total	4919.58491	105	46.8531896			
weight	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
gender	.5388732	.6727749	0.801	0.425	-.7962266	1.873973
age	2.299516	.1333397	17.246	0.000	2.034908	2.564124
type_loc	.1442856	.3413324	0.423	0.673	-.5330774	.8216486
educ_mo	.3634231	.3556214	1.022	0.309	-.3422961	1.069142
IPb_gr_2	-.4252121	1.706431	-0.249	0.804	-3.811569	2.961145
IPb_gr_3	-.8357139	1.602604	-0.521	0.603	-4.01603	2.344602
IPb_gr_4	-.56179	1.786798	-0.314	0.754	-4.107633	2.984053
_cons	-2.49272	1.896986	-1.314	0.192	-6.257227	1.271788

For Group B), the assessment of the blood lead levels impact for children in stature-weight development was processed identically as for Group A), analyzing the evolutions of height and weight, respectively on different categories of blood lead levels, separately by age and gender groups. Results of linear regression estimates indicate a negative correlation between blood lead levels and height and weight in both simulations, but without being statistically significant.

From the statistical analysis of questionnaire data on the influence of various factors upon the lead exposure in children it is observed that most of the studied factors have an effect on the blood lead level. Factors with potential impact upon the exposure to lead of investigated children, such as children playing with soil, not washing hands before eating, previous occupational exposure to lead of the investigated children's parents and the low income of the family, although not being found significantly associated with higher blood lead levels, the results show that the blood lead levels averages as well as the percentage of subjects with elevated levels are higher in subjects having these habits. In this study almost all families of the investigated children do not wipe dust with a damp cloth and consume almost exclusively vegetables, fruit and animal products from the area.

CONCLUSION

The blood lead levels determined for children were not associated statistically significant with the distance from the subjects' residence to the investigated industrial facility. The stature-weight development likely related to the lead exposure of the child was not found statistically significant being negatively affected by the blood lead levels. Processing of the data resulted from the questionnaire of lead exposure assessment highlighted a statistically significant correlation between the blood lead levels in investigated children and children playing with sand, carrying to mouth dirty/fallen on the ground toys, children not spending time outside Copşa Mică area during the holidays.

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