TRACING OUT THE LEAD AND THE CADMIUM IN THE BIOLOGICAL PRODUCTS OF MOTHER AND FOETUS

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Abstract

The present article presents a study in progress which demonstrates the presence and the transmssion of the atmospheric pollutants in the foetus from the Copşa Mică – Mediaş area through their determination in biological products. The purpose of this study is to present the health of the population, especially for the future infants.

Material and Method. *The study consists in determination of the main pollutants from the regarding area – lead and cadmium – in the foetus, through measurements from placenta and in the mother through measurements from maternal milk in 46 cases.*

Results. *The results obtained by assay of the heavy metals in this biological products demonstrate their presence, both in placenta and milk, in variable concentrations, especially based on the distance from the pollution source to the residence, on the social and economical statute of the pregnant, on the maternal age, on the smoking or nonsmoking pregnant statute. The consequence of this pollution was a smaller average infant weight reported to the gestational age at the delivery.*

Conclusions. *The social and economical characteristics from Copşa Mică – Mediaş area, the pollution and enviromental conditions play an important role generally in the population's health statute, especially in pregnant and foetus, with impact over the future generations, which impose profilactic measurements.*

Keywords: lead, cadmium, placenta, milk.

DETERMINAREA PLUMBULUI ŞI CADMIULUI ÎN PRODUSELE BIOLOGICE ALE MAMEI ŞI FĂTULUI

Rezumat

Articolul de faţă prezintă un studiu aflat în desfăşurare care demonstrează prezenţa şi transmiterea poluanţilor atmosferici din zona Copşa Mică – Mediaş la făt, prin determinări ale acestora în produse biologice. Lucrarea are rolul de a prezenta starea de sănătate a populaţiei şi, în mod special, starea produsului de concepţie.

Material şi metodă. *Lucrarea constă în determinrea principalilor poluanţi din zona amintită – plumbul şi cadmiul – la făt prin măsurători din placentă şi la mamă, prin măsurători din laptele matern, la 46 de cazuri.*

Rezultate. *Rezultatele obţinute prin măsurarea metalelor grele în aceste produse au demonstrat prezenţa lor, atât la nivelul placentei cât şi la nivelul laptelui matern, în concentraţii ce variază, în special în funcţie de distanţa faţă de sursa de poluare până la domiciliul de reşedinţă, de statutul socioeconomic al gravidelor, de vârsta mamei, de statutul de fumătoare sau nefumătoare al gravidei. Consecinţa acestei poluări s-a dovedit a fi o greutate medie mai mică raportată la vârsta gestaţională la naştere.*

Concluzii. *Particularităţile socio – economice ale zonei Copşa Mică – Mediaş, poluarea şi condiţiile de mediu joacă un rol important în starea de sănătate a populaţiei în general, a gravidei şi a fătului în special, cu impact asupra generaţiilor viitoare, care impun măsuri profilactice.*

Cuvinte cheie: antiplatelet therapy, Aspirin, Clopidogrel, gastrointestinal bleeding, risk.

INTRODUCTION

As an important industrial and railway center, Copşa Mică is the third interest center from the county for population of the area. Sometra SA is the main producer of ferrous and chemical products as lead and lead alloys, cadmium, zinc and zinc oxides, stibium and stibium alloys, bismuth, sulphuric acid, sodium antimony. The relief's characteristics, hydrographic network and the climate favour atmospheric pollution, the water, the vegetation and ground pollution, which affect the population [1].

Acute poisoning by heavy metals is given by occupational exposure, while chronic poisoning occurs in the population in polluted industrial areas, too.

The lead is responsable for appearance of general signs like weight loss, paleness, gray skin coloration, low muscular tonus, hematological signs (anemia), gastrointestinal signs (metalic taste), anorexia, constipation, abdominal paines, sometimes colicative paines, peri-umbillical muscular contractures, neuromuscular signs (palsy - rare today), central nervous signs (saturnine encephalopathy, especially to children), progressive mental deterioration, kidney deseases (especially at the children), carcinogenity [2-4]. Regarding human reproduction, the lead was incriminated in decreasing of masculin reproductive activity through the altered spermatogenesis, decreasing of sexual activity, spermasthenia, theratospermia, hypospermia [5-7], high risk of premature rupture of membranes [8], premature delivery [9], high blood pressure induced by pregnancy [10], intrauterin growth retardation and neurotoxicity in the breast feeded infant [11,12].

Cadmium interacts with the calcium at the kidney and bone level, with the zinc and with the iron [13]. It has oestrogen-like effects in the uterin and mamals tissue. Cd bounded by metalothionein doesn't pass through the placenta (the new born is virtual not intoxicated at birth), but it affects the placenta and gets miscarriages, low weigh infant, decreasing new born antropometric measures, high blood pressure induced by pregnancy, it passes into the breast milk [15-17].

The relation between atmospheric pollution and pregnancy is generally insufficiently studied. There are diferences between the type of pollutants, the manner and the moment of exposure. Some authors sustain the hypothese that the exposure in the first quarter of pregnancy is more susceptible for abnormalities of pregnancy and for the foetus, contrawise, other sustain that the pollutants react especially to the end of the pregnancy [18-21]. In puerperality conditions, the interractions between trace elements and heavy metals as the most important pollutants, get specifically importance due to the pregnant bodies changes and due to the effects over the foetus [22-24].

The aim of this study is to establish the presence of principal pollutants from Copşa Mică and neighbour area, in biological products to the pregnant, by lead and cadmium measuring in placental tissue and milk, in the social and economical context of the area. The study is a part of a bigger one, in which were assessed amniotic liquid, maternal venous blood, placental tissue, umbillical blood, umbillical tissue, venous blood from the new born and milk, in 147 cases, therein were measured since now only the heavy metals in placenta and milk in 46 cases.

MATERIAL AND METHOD

The study was made on 46 cases between October 1, 2008 and January 10, 2009 by harvesting at delivery of minimum 1 gram placental tissue in Eppendorf tubes, demetalisated before and three days after delivery and by 5 ml maternal milk in simple vacuteiners for determination of the lead (Pb) and cadmium (Cd) presence. The samples were frozen at - 18º C until transportation in freezer bag for analyse. The measurements were made at Occupational Medicine Institute from Cluj Napoca. The determination method was spectrophotometry of athomic absorbtion with flame, which gives the smallest errors. The values obtained were recorded in ppb (µg/kg, respectively µg/l).

The cases's selection was made by taking into account to residence, so that to include and nearest areas to the pollutant centre, so variable remote areas from this. The pregnants's locality of residence, pregnants's number from each place and the distance to Copşa Mică, being considerated the pollutant center, can be seen in Table I. We recorded the maternal age, marital status, education, occupation, deliveres's number, pregnancies's number, pregnancies's age, social and economical situation, biological status, the life and work conditions, especially the smoker or nonsmoker statute.

The age of the patients in study was between 16 and 37 years, with an average of 24,52 years. From these, 22 (47,8%) were married, 44 (52,2%) were unmarried, 9 (19,6%) were employee, 37 (80,4%) unemployee. In terms of education, we considered the records about level of schooling: 5 cases (10,9%) were illiterate, 12 (26,1%) graduated primary school, 15 (32,6%) graduated the grammar-school, 8 (17,4%) graduated the professional school, 5 (10,9%) graduated the high school and 1 (2,2%) had higher education.

The pregnancies's number of the patient was between 1 and 10, with an average of 2,93, the parity was between

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1 an 10, with an average of 2,11. The age pregnancy of the cases was between 34 and 42 weeks, with an average of 38,78. Birth occurred naturally in 38 (82,6%) cases and by caesarean section in 8 (17,4%) from these. The weight infant was between 2300 and 4300 g, with an average of 2792,72 g. The APGAR score at one minute was 7 in 1 case (2,17%), 8 in 2 cases (4,34%), 9 in 12 (26,09%) cases and 10 in 29 (63,05%) cases.

From 46 pregnants, 27 (58,7%) were smoker and 19 (41,3%) nonsmoker. The social and economical conditions were assessed by appreciation of the rate person's number/ chamber's number and the biological statute were assessed by body mass index (BMI). One patient had high blood pressure: 220/120 mmHg, the other had normal values.

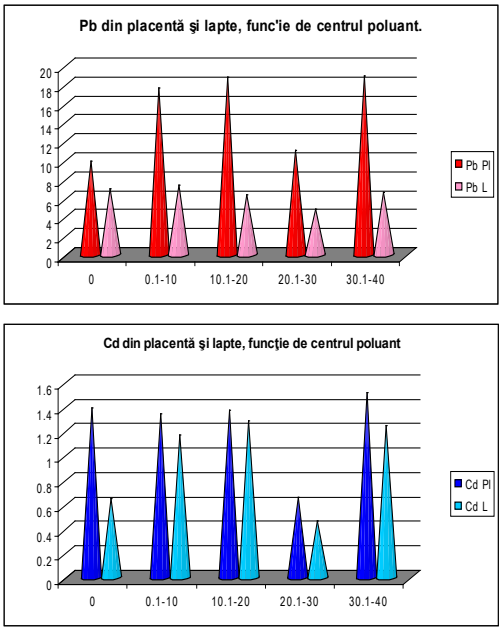

Figure 1. Pb in placenta (Pl Pb) and milk (Pb L), Cd in placenta (Pl Cd) and milk (Cd L) depending on the distance to Copşa Mică.

The maximum admitted concentration (MAC) is 0,5 µg/cm/year and 0,7µg/cm/24 hours for Pb and 0,02 µg/cm/year, respectively 0,02 µg/cm/24 hours for Cd. The situation of the pollution of the area and period in which determinations were made according Environment Agency of the County Sibiu, can be seen in Table II.

RESULTS

From the performed examinations we found that the lead level from placental tissue increases reaching a maximum at a distance of 10,1 – 20 km, respectively 29,1 – 30 km from the pollutant center, Copşa Mică. In the milk the values vary a little. The values of Cd in placenta are close, more large variations being observed in milk, with maximum at a distance of 10,1 – 20 km from Copşa Mică. The question is whether if is really a correlation between the distance between residence and pollutant center or if the cadmium's level depends less on the pollution and more on the smoker or nonsmoker statute of the patients (Figure 1).

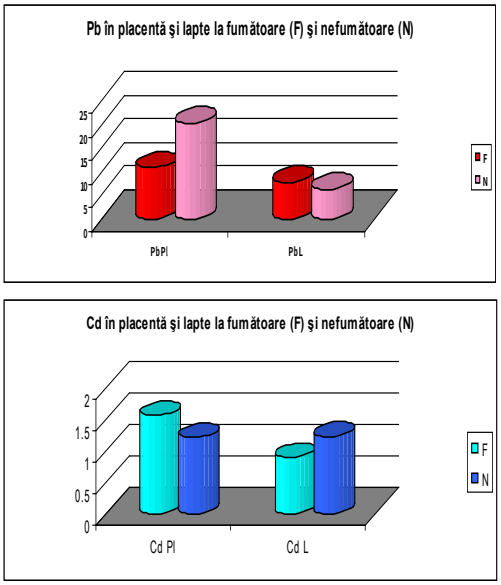

Figure 2. Pb in placenta (Pl Pb) and milk (Pb L), Cd in placenta (Pl Cd) and milk (Cd L) in smokers (F) and non-smokers (N).

Residence	Distance	Nr. Exceed
Copşa Mică	0	17 (36,96%)
Valea Viilor	3.96	3 (6,52%)
Axente Sever	3.98	4 (8,69%)
Târnava	4.72	7 (15,22%)
Agârbiciu	7.21	1 (2,17&)
Ighişul Nou	7.96	1 (2,17%)
Medias	9.47	3 (6,52%)
Micăsasa	13.93	2 (4,35%)
Nemşa	17.02	1 (2,17%)
Richiş	20.32	1 (2,17%)
Valchid	30.25	1 (2,17%)
Dumbrăveni	30.29	2 (4,35%)
Mălânvrav	33.89	1 (2,17%)
Laslea	35.1	2 (4,35%)
Motiş		1 (2,17%)
		Total: 46

Table I. Distribution of cases in territory and distance from Copşa Mică.

Month	Copşa Mică		Mediaş	
	Pb	Cd	Pb	Cd
Oct-08	1.002 nr. depăşiri 15 din 22	0.016 nr. depăşiri 7 din 22	0.194 nr. depăşiri 2 din 31	0.008 nr depăşiri 2 din 31
Nov-08	1.431 nr depăşiri 19 din 26	0.031 nr. depăşiri 16 din 26	1.38 nr. depăşiri 19 di	0.044 nr depăşiri 11 din 27
Dec-08	0.979 nr. depăşiri 12 din 22	0.065 nr. depăşiri 16 din 22	1.705 nr. depăşiri 17 din 22	0.086 nr depăşiri 22 din 22
Jan-09	0.48	4.23	0.54	3.69

Table II. The level of pollution in the sampling period.

The level of Pb in placenta at smokers was lower, instead Pb in smoker's milk had highest levels than in nonsmoker population. Contrariwise, Cd had higher levels in the placenta of smokers and lower in milk (Figure 2).

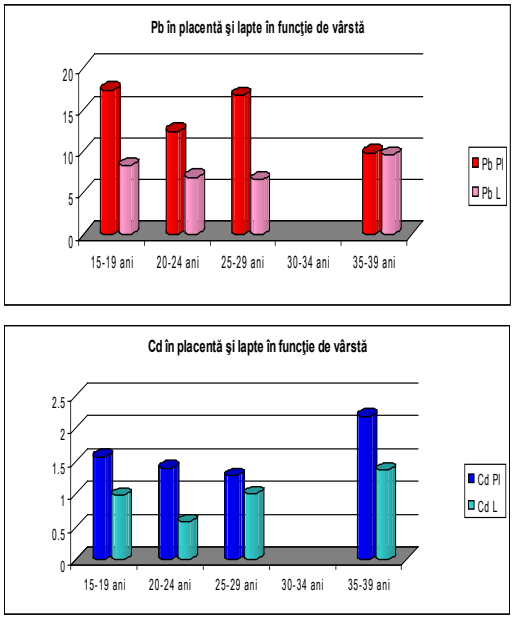

Figure 3. Pb in placenta (Pl Pb) and milk (Pb L), Cd in placenta (Pl Cd) and milk (Cd L) depending on maternal age.

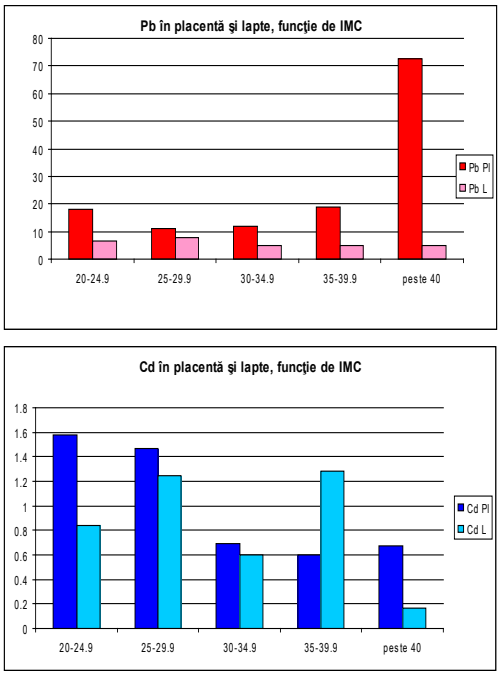

Figure 4. Pb in placenta (Pl Pb) and milk (Pb L), Cd in placenta (Pl Cd) and milk (Cd L) according to BMI.

In terms of maternal age, at range of 15 – 19 years and 25 – 29 years Pb in placenta was higher, decreasing at range of 35 – 39 years. Instead, Pb in milk was relatively constant, higher levels recording after 35 years. Cd was high especially in placental tissue and had it lower variations in maternal milk, with maximum at range of 35 – 39 years, both in placenta and milk (Figure 3). The Pb level in pregnants's placenta depending on the body mass index (BMI) was higher at extremes: to low BMI (20-24,9) and, especially to BMI over 40, which shows the high risk of absorbtion in obesity. The lead in maternal milk had no variations depending on BMI. Cd in placenta had lower levels at the persons with high BMI and high values to BMI over 40 (Figure 4).

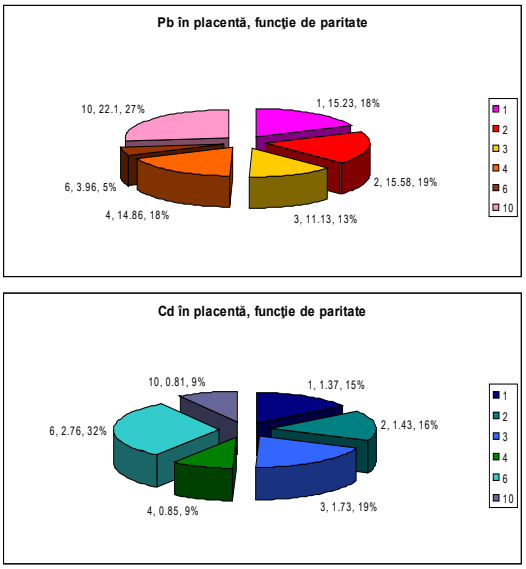

Figure 5. Pb in the placenta, according to the parity, Cd in placenta, depending on the parity.

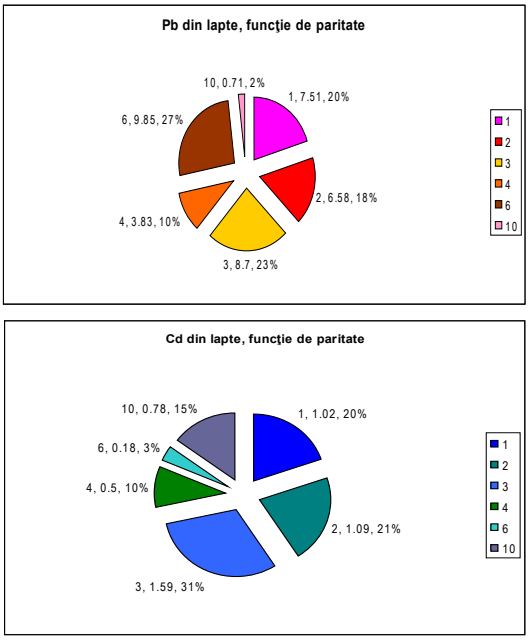

Figure 6. Pb milk by parity Cd milk by parity.

Regarding the pregnancy's number of patient and the number of deliveries, we found that and Pb in placenta so Cd in placenta had variable levels with increasing the number of deliveries (Figure 5), instead, in maternal milk, the toxicals levels was higher at first three pregnancies (Figure 6).

In terms of the age pregnancy, we found a maximum level of Pb in placenta at 38 weeks, respectively 40 weeks, decreasing to 42, while Cd in placenta had no different values. Also, the toxic products level had no variations in maternal milk at different age pregnancy.

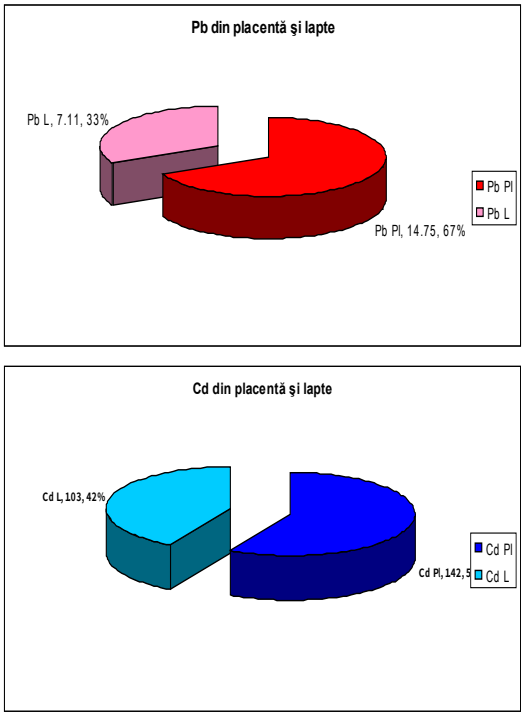

Figure 7. Pb in placenta (Pl Pb) compared to milk (Pb L), Cd in placenta (Pl Cd) compared with that in milk (Cd L).

All this results have shown a discrepancy in distribution of the Pb and Cd between the two compartments assessed, placental tissue and maternal milk. And Pb so Cd had higher values in placenta compared with milk [7].

DISCUSSION

Concerning the distance to the pollutant center, we found an higher level of Pb in placenta to 0,1-10 km, 10,1-20 km and 30,1-40 km from Copşa Mică and relative constant levels in maternal milk. The question is over the barrier role of the placenta for the transfer of Pb to the foetus and it's transmission in a lesser extend through the milk. Instead, Cd had constant high placental levels and the transmission through the milk had lower levels. In both metals we found low values at the distance of 20,1-30 km. It is necessary to make corrections about the distance to the pollutant center, regarding climatic conditions – wind direction, water direction like contributing factors to pollutants distribution. At the same distance, the values can vary in pregnant living downstream or upstream from the pollutant center, in the direction of the wind or against them. Because at smokers we found higher levels of Cd in placenta compared with Pb, the question is if in placenta it is a competition between the two metals.We should mention that the cigarette smoke contains high level of Cd. The lower level of placental Pb at smokers could be explained by the place of Cd. The barrier role of the placenta is exhausted for Pb in smoking conditions. After delivery, the lack of placenta favors the Pb transmission through the breastfeeding. The lower level of the Cd in milk could be explained also by the competition between the two toxic products. The presence of the Cd in placenta at smokers was demonstrated and in pollution conditions so in it's absence [15,25], so other authors raised the problem if the placenta is a good indicator for Cd and Pb exposure [7]. They tried using experimental methods to measure Cd effects by monitoring the energy load with spectroscopy in magnetical resonance in perfused placenta [26].

In terms of number of pregnancies, the values were contradictory. We didn't account the number of miscarriages or abortions from the history of the pregnants to establish how big is the role of these for actual Pb and Cd placental concentration. And Pb so Cd seem to have a higher concentration in both – placenta and milk – at the first three deliveries account (Figures 5 and 6).

Age pregnancy that occurred the delivery didn't influence Pb and Cd level, neither in placenta or milk.

Along with increasing BMI, placental Pb increased and placental Cd decreased. The Pb increasing along with BMI can be explained by primary accumulation of Pb in soft tissues – liver, spleen, kidney, myocardium, fatty tissue, secondary in bone foam and bone compact. Instead, Cd is accumulated especially in kidney and bones, the pregnancy leading to it's increasing in kidney.

The most important observation which clears from these determinations is the relative low infant weight (2792,72 g) for the average age pregnancy when occurred the delivery (38,78 weeks). It is difficult to interpret how much are directly responsible the heavy metals for this, considering the pregnant's socioeconomical statute: 69,6% of these have a low tuition (maximum grammar-school), 80,4% are unemployee and 52,2% unmarried. The patients didn't present specific symptoms for chronic intoxication (cases more frequently prone to sterility and infertility) and none were employee in SC Sometra, responsible for pollution in the area).

Because of the barrier role of the placenta, the higher number of deliveries by caesarian section (17,4%), the status of the infants at birth was good, the most having the APGAR score 9 or 10. The question is if the pollutants transmission through the maternal milk continues by breastfeeding.

The limits of these determinations are the still small

number of cases, regarding the study in progress, that's why they have been considered insufficient for a statistical processing.

CONCLUSIONS

The determination of the heavy metals in pregnant bodies and the transmission to the foetus is a certainty, demonstrated by previous studies and confirmed for Copşa Mică - Mediaş area. It is a metter of public health and it is necessary to find proper measures to counter of their effects with profilactic methods.

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