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Concentration of Lead, Cadmium, Zinc and Iron in maternal blood and umbilical cord in Zeliten city, Libya

*Adel. M. Mlitan *, Hanan. S. Derrat, Wafa. R. Griba and Najla. M. Worayet*
E-mail: adel_mlitan@sci.misuratau.edu.ly

Chemistry Department, Faculty of Science, Misurata University, Libya

Abstract

The present study was carried out to determine the lead, cadmium, zinc and iron concentration in maternal and umbilical cord blood. Samples were collected from Zeliten delivery hospital in the period from February to April 2018. A total of 70 pregnant women participated in this study, We compared the concentration of Lead, Cadmium, Zinc and Iron in maternal blood and umbilical cord. There is significant difference in maternal blood concentration of iron compared with umbilical cord blood iron concentration (P value 0.047), while there is no significant difference found in concentration of other studied metals (Zn, Fe, Cd).

Keywords: *heavy metals, maternal blood, umbilical cord*

1. Introduction

The increasing pollution originated from industrialization exposes the entire population to several toxic agents such as heavy metals, organic hydrocarbons, and pesticides [1]. Therefore, the overall population may undergo a daily exposure to these pollutants through several pathways, including inhalation of contaminated air, consumption of contaminated drinking water, exposure to contaminated soils or industrial waste, or consumption of contaminated food [2,3]. Heavy metals are environmental contaminants with toxic properties for wildlife and humans. The placenta is a privileged organ that, along with the fetal membranes and amniotic fluid, enables growth and development of the fetus during the physiological pregnancy. It also acts as a filter reducing the passage of harmful substances, protecting the embryo and then the fetus from exposure to pollutants [4-6]. Fetal exposure to environmental factors occurs through the amniotic fluid, the placenta, and the umbilical cord. It has been widely demonstrated that the placental barrier is not completely impermeable to the passage of harmful substances, such as drugs or toxic agents [7-8].Studies have demonstrated the role of Essential trace elements include iron (Fe), zinc (Zn), copper (Cu), selenium (Se), and manganese (Mn) with vitamin A and vitamin D in antioxidant activity which is very

important in pregnancy [9].heavy metals can damage human health through an oxidative cell stress (e.g. Cadmium Cd, Chromium Cr, lead P, Arsenic As)[7,10,11] neurological damage (e.g. Pb, Mercury Hg)[12,13], DNA injury (e.g. As, Cr, Antimony Sb)[11,14,15] altered glucose (As)[16], or calcium (Cd, Pb)[17,18] metabolism, and they can interfere with essential elements (Cd, Hg)[19,20]. Lead easily cross the placenta and the fetal blood-brain barrier, and can irreversibly affect cognitive development [21-25]. Lead exposure can also cause spontaneous abortions,[26] congenital malformations [27], reduced birth weight[28] and length [29], gestational hypertension [30] or impaired neurodevelopment [31]Cadmium had effect on several measures of birth outcome. Crown-heel lengths, Apgar 5-minute scores, birth weights and small for gestational age (SGA) births below the 10th percentile were influenced by cadmium levels in the umbilical cord [32]. Cadmium high levels of exposure could alter endocrine function, causing various reproductive problems [33]. It could interfere with the production of placental progesterone which in turns could impair steroidogenesis and consequently have an effect on fetal growth and development [34].

2. Materials and methods:

Samples collection:

The study included 70 samples from maternal serum and umbilical cord serum with age ranged from 16-45 years old. Samples were collected from Zeliten delivery hospital, Libya in the period from February to April 2018.All of the samples were obtained soon after delivery. 15cc of maternal blood sample was obtained from the veinand 15 cc of umbilical cord blood, then put into tubes containing anti-coagulant EDTA solution.

Sample preparation:

Analysis of Sample Solution:

The concentration of metals (Zn, Fe, Cd, Pb) determined using Atomic Absorption Spectrophotometer AA-220FS(Varian Techtron Autosampler Pty .Ltd Australial Blank). The serum solution was shaken well to get homogeneity of concentration throughout the solution to perform analysis. Emissions of all the standards were noted and plotted against the concentrations of standard in order to have the calibration line. The emissions of all the samples (maternal serum and umbilical

cord serum) were also noted and the concentrations were found from the respective calibration line for each element (Zn, Fe, Cd and Pb).

Statistical Analysis

Wilcoxon (Z- test) was applied for data analysis using IBM SPSS 17statistical software. 95% confidence interval was applied. P value <0.05 was considered to be statistically significant.

3. Results and discussion

Zinc and iron had the highest blood concentration in maternal and umbilical cord, while the cadmium has the lowest blood concentration in maternal and umbilical cord as showed in figure 1, iron blood concentration of umbilical cord higher than iron blood concentration of maternal, while zinc blood concentration of maternal higher than zinc blood concentration of umbilical cord. lead blood concentration of maternal higher than lead blood concentration of umbilical cord. On the other hand, cadmium blood concentration of maternal was similar to cadmium blood concentration of umbilical cord.

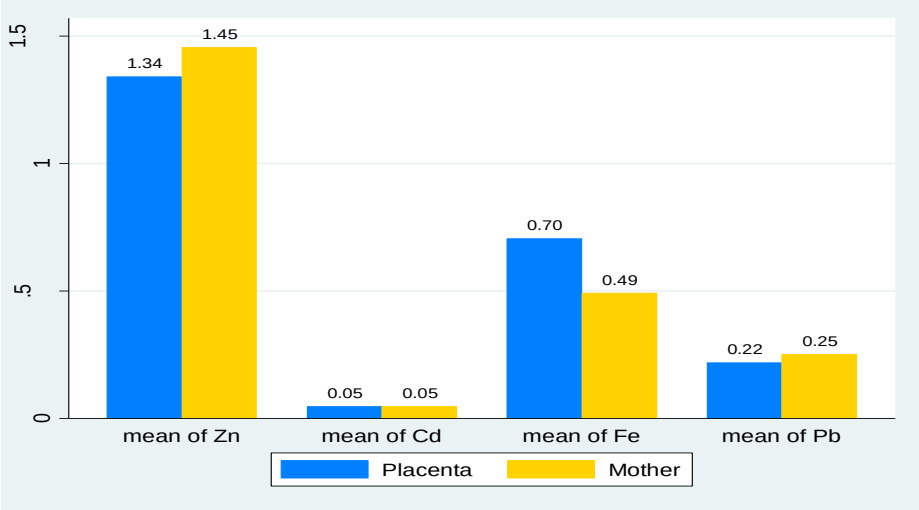

Figure 1: Showe mean of Zinc, iron, lead and cadmium blood concentration in maternal and umbilical cord

Table 1 presents the main descriptive statistics for zinc, iron, lead and cadmiumin all study participants.

Iron blood concentration of maternal was 0.49 ± 0.068µg/dl, umbilical cordiron concentration was 0.70 ± 0.081µg/dl. Zinc blood concentration of maternal was 1.45 ± 0.160µg/dl, umbilical cord zinc concentration was 1.34 ± 0.149µg/dl. lead blood concentration of maternal was 0.25 ± 0.165µg/dl, umbilical cord lead concentration was 0.22 ± 0.012µg/dl. Cadmium blood concentration of maternal was 0.70 ± 0.081µg/dl, umbilical cord cadmium concentration was 0.05 ± 0.003µg/dl

Table 1. concentration of zinc, iron, lead and cadmium in maternal and umbilical cord blood.

Metal	Maternal serum (mean±S.E)	umbilical cord serum (mean±S.E)	P value
Iron (ppm)	0.49 ± 0.068	0.70 ± 0.081	0.047
Zinc (ppm)	1.45 ± 0.160	1.34 ± 0.149	0.509
Lead (ppm)	0.25 ± 0.165	0.22 ± 0.012	0.184
Cadmium (ppm)	0.70 ± 0.081	0.05 ± 0.003	0.903

In this study we found significant differences in iron blood concentration of maternal and umbilical cord (P value 0.047), while no significant differences found in concentration of other studied metals (Zn, Fe, Cd) in maternal and umbilical cord blood. lead and cadmium deposits in the umbilical cord appear to reflect exposure to these metals throughout the pregnancy period, while it is thought that concentrations of lead in blood reflect more recent exposure. Toxicity of these metals occurs and they are being transferred to the fetus during pregnancy. Several studies showed that micronutrient supplementation and higher concentration of zinc and iron have a positive impact to mitigate lead toxicity [35, 36]. Pb had moderate positive correlation with Hg, which might be caused from contaminated environment. It is speculative to say that the micronutrients Mn, Fe, Cu, Zn and Se had synergistic mechanism to fight the “unwanted” ones, Hg and Pb. However, much is unknown regarding umbilical cord and its homeostasis and protective mechanism.

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