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# Level of serum heavy metal concentration in pregnant and non-pregnant women of district Sargodha: A comparative study

**Faiza Zubair[1], Naila Amjad[2], Ammara Nawaz[2], Shafaat Yar Khan[1], Muhammad Arshad[1], Noor Nasir Khattak[3], Muhammad Saleem Khan[*4]**

[1]*Department of Zoology, University of Sargodha, Sargodha, Punjab, Pakistan*

[2]*Department of Zoology, University of Lahore, Sargodha Campus, Punjab, Pakistan*

[3]*Department of Gynecology & Obstetrics KIMS, KMU, Pakistan*

[4]*Department of Zoology, Government College University, Faisalabad, Pakistan*

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## Abstract

In present study, level of some heavy metals was evaluated among pregnant females living in industrial areas and compared with non-pregnant females in University of Sargodha. Blood samples were collected from females of different age group. The samples were processed through wet acid digestion and flame Atomic Absorption Spectroscopy was used for comparison. The mean values of blood Pb (104.4±78.1ppm), Zn (51.9±61ppm), Cd (31.2±19.9ppm) and Cr (10.5±10.7ppm) was significantly higher in pregnant females as compared to non-pregnant females. The present study concludes that increased blood level of Pb, Cd, Cr and decrease level of Cu may be a risk factor for pregnant females.

* **Corresponding Author:** Muhammad Saleem Khan ✉ samiikhan@yahoo.com

## Introduction

Environmental pollution is one of major curses to human health (Hamid *et al.*, 2016). Humans are exposed to environmental pollutants everywhere in their life because the spectrum of pollutants has been widened to drinking water, soil and food, along with its presence in air. There are several routes through which these pollutants become a part of our environment like fungicides, insecticides, mining, smelting, industrial effluents, cosmetics and herbal products (Glanze *et al.*, 1986; Umar *et al.*, 2016). One of major component of environmental pollutants is heavy metals which are affecting human health adversely (Khan *et al.*, 2015; Khan *et al.*, 2016). There are 35 metals in total and 23 are categorized as heavy metals.

The environmental pollution has predominantly influenced pregnant females which also affects the neonates and fetus. The concentration of heavy metals in maternal cord is transferred to fetus and cause problems in pregnancy outcomes (Gerhard *et al.*, 1998). Pregnant females exposed to heavy metals through water and diet (like fish, ghee). However, it was observed that neonates are affected more by mother's exposure to pollutants (Gerhard *et al.*, 1998). In severe cases the maternal exposure to heavy metals like Pb, Cd, Hg, Ar, Ni, may interfere with normal pregnancy and result in miscarriage, fetal mal-development and other birth defects (Gerhard *et al.*, 1998). Among the metals, Pb excess leads to severe complications. It enters the pregnant female's bodies through contaminated environment. The pregnant women stored Pb in her bones and other body organs thus act as reservoir of Pb.

The Pb is remobilized through natural aging process and under physiological stress of pregnancy. This remobilized Pb passes through blood stream and placenta, reaching fetus and again gets stored (Anderson *et al.*, 1996).

The Cadmium (Cd) is also very toxic even in trace and it accumulates in placenta resulting in low birth weight and developmental impairments in neonates (Salpietro *et al.*, 2002).

It enters the body through contaminated water and smoking in the pregnant females. It is present in higher amount in mother's cord but transfers in traces to the neonatal blood (Baranowska, 1995; Colborn *et al.*, 1996). Like Cd, chromium is also very toxic to female and developing fetus. An animal study shows that absorption of Cr (VI) through dermal route Cr leads to toxicity nearby cells (Dayan and Paine, 2001).

The Cu can also produce adverse health effects in both excess and deficiency (Stern *et al.*, 2007). The level of Cu in serum is less than 80.0µg/dl in pregnant females is a sign of Cu deficiency (Corporation, 1964). During pregnancy Cu deficiency may result in low birth weight (Al-Rashid and Spangler, 1971). Its deficiency in pregnancy also induces hypertension, placental abruption, premature rupture of membrane, still birth and low birth weight (Pathak and Kapil, 2004). During embryonic and fetal development, Cu deficiency results into numerous structural and biochemical abnormalities (Pathak *et al.*, 2003). The excess of Cu leads to toxicity. The last studied metal was zinc. It is necessary for fertility as in males it protects prostate gland infection, maintains sperm counts, mobility and normal level of serum testosterone while in females Zn helps in treating menstrual problems. Moreover, Zn is essential for growing fetus, avoids congenital abnormalities and preterm delivery (Prasad, 2008; Terrin *et al.*, 2015). However, the elevated concentration causes toxicity to exposed organisms (Asghar *et al.*, 2015; Asghar *et al.*, 2016).

The review of the previous studies showed that, the deficiency or excess if any metal leads to serious problems for both mother and developing fetus. Therefore, in the present study the level of Pb, Zn, Cd, Cu and Cr in the blood serum of pregnant women of industrial area was studied and compared with the non-pregnant women of District Sargodha, Pakistan.

## Materials and methods

*Sampling*

The blood samples for experimental group were taken from pregnant females of age below 45. The sampling females were nonsmokers, free of diseases and didn't take any iron supplements.

The blood samples for control group were taken from females of university of Sargodha, living in posh areas. 3 ml of blood was collected from each sampling individual. Serum was separated by centrifuging at 3000 rpm for 5 minutes and stored at -4°C for 6 months.

*Digestion of the sample*

Wet Acid digestion was done for sampling. In brief methodology, 0.5ml of serum was taken and diluted with 0.5 ml of distilled water to make volume of 1 ml. Then 2 ml of concentrated sulphuric acid ($H_2SO_4$) and 1 ml of hydrogen peroxide ($H_2O_2$) was added. Beakers were covered and left overnight. On next day it was placed on hot plate till removing all the vapors and allowed to cool. It was again placed on hot plate till a clear transparent solution. The solution was allowed to cool at room temperature filtered it and final volume of 50ml was made with distilled water. This solution was stored in Teflon bottles. The samples were run through flame atomic absorption spectroscopy (FAAS) for heavy metals estimation.

*Statistical Analysis*

The comparison of heavy metals concentration in pregnant and non-pregnant women was done with 2-sample t-test was using Mini tab (V.17).

**Results**

The blood level of some selected heavy metal was compared between pregnant and non-pregnant female of district Sargodha in the present study.

The results revealed that Pb level in pregnant females were 104.4±78.1ppm which was significantly higher than the blood Pb level in non-pregnant females (34.6±19.6ppm).

The concentration of Zn was 51.9±61ppm while in non-pregnant women the Zn concentration was significantly low (8.93±8.8ppm). Among pregnant females the mean concentration of blood Cd was found as 31.2±19.9ppm. On the other hand among non-pregnant females, the estimated concentration was 1.66±1.28ppm. The blood cadmium in pregnant females was higher in comparison with non-pregnant females ($p<0.001$).

The level of Cu in blood serum of pregnant women was 27.75±24.27ppm which was significantly lower than the estimated concentration of copper in blood serum among non-pregnant women.

The blood Cr level in pregnant females was significantly higher than the level in non-pregnant females (Table 1, Fig.1).

**Table 1.** Concentration of heavy metals in pregnant and non-pregnant females.

| Heavy Metal | Concentration of heavy metals | | t-value |
|---|---|---|---|
| | Pregnant women | Non- Pregnant women | |
| Lead (Pb) | 104.4±78.1** | 34.6±19.6* | 10.85 |
| Zinc (Zn) | 51.9±61** | 8.93±8.8* | 9.33 |
| Cadmium (Cd) | 31.2±19.9** | 1.66±1.28* | 20.51 |
| Copper (Cu) | 27.75±24.27** | 114.65±59.68* | -6.445 |
| Chromium (Cr) | 10.5±10.7** | 4.89±3.78* | 5.73 |

**values are statically different between pregnant and non-pregnant females ($p<0.001$).

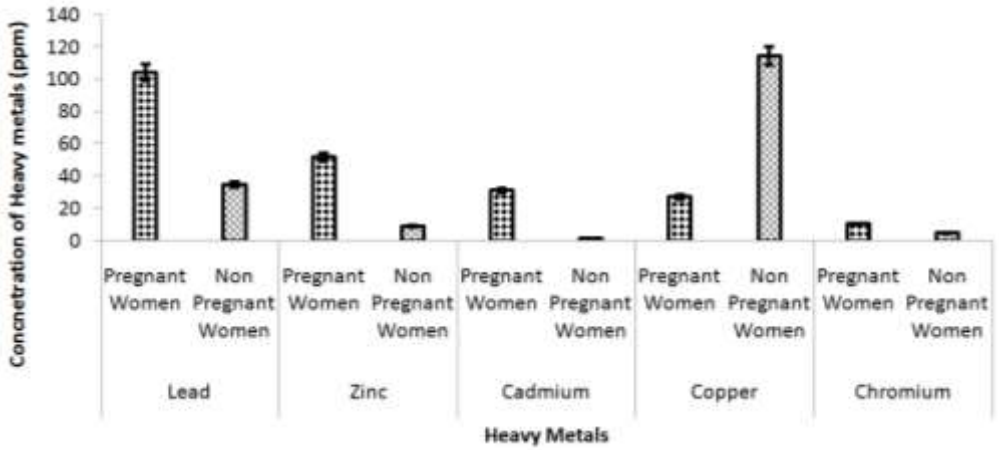


**Fig. 1.** Comparison of mean heavy metals concentration (ppm) in pregnant and non- pregnant females.

**Discussion**

The mortality and morbidity is continually increasing throughout the world due to environmental exposure of heavy metals (Olaifa and Ayodele, 2004). Along with dust, Pb glazed pottery and Pb pigment in toys and pencils is also a source of Pb exposure (Finkelman, 1996). The main targets of Pb include physiological systems like renal, nervous, hematopoietic, immune, reproductive and endocrine system (Anetor *et al.*, 2002). In the present study estimated mean concentration of Pb in pregnant females of district Sargodha was 104.4±78.1ppm (Table 1). The results showed a significant increase in blood Pb level of pregnant females as compared to control. A number of studies revealed that blood level of Pb below 5µg/dl causes significant toxicity. In pregnant female, Pb causes disruption of endocrine balance during pregnancy, renal and reproductive abnormalities along with neurotoxicity in neonates. In case of human, some severe effects of intrauterine exposure of Pb include, reduced birth weight, preterm delivery with neuro developmental abnormalities in offspring (Awasthi *et al.*, 1996). Furthermore pre-natal exposure of Pb may also result in decreasing intelligence of new born as compare to one which was not exposed to maternal blood Pb in utero. The mother also faces elevation in both systolic and diastolic blood pressure which adversely effects the normal fetal development (Miranda *et al.*, 2010).

Zn is known as one of life's essential element as it play wider role in normal cell division of growing tissue and Zn deficiency in animals may result into abortion, premature delivery, low birth weight and congenital malformation (Bahl *et al.*, 1994). In the present study mean concentration of Zn in pregnant females was 51.9±61ppm significantly different than control group. Maternal serum Zn concentrations correlated negatively with gestational age (McMichael *et al.*, 1982). Zn levels were lower in pregnant than in non-pregnant women (Dreosti *et al.*, 1982). In elderly individuals deficiency of Zn causes T- lymphocyte impairments and cellular immunity reduction (Chernoff, 2005).

Zn deficiency also cause decrease neural conduction, neuropsychiatric disorders, neurosensory disorders, mental lethargy, thymic atrophy, skin lesions and infertility (Colagar *et al.*, 2009). Along with systemic toxicity, Zn is also involved in the regulation of decisions regarding cellular death programs as in different tissues and cell types as excess of Zn causes apoptosis (Wätjen *et al.*, 2002).

In the present study estimated mean concentration of Cd in pregnant females was 31.2±19.9ppm. The results showed a significant increase in blood Cd level of pregnant females as compared to control. The children have average 0.088 ppm of Cd in their blood, pregnant females have 0.099ppm, and non-pregnant females have 0.080 ppm while men have 0.099 ppm of Cd in their blood (Nkolika and Benedict, 2009). Their results indicate that pregnant women have higher mean concentration of Cd than the other women which justify our results.

The mean concentration of Cr in pregnant females was 10.5±10.7ppm. The results showed a significant increase in blood Cr level of pregnant females as compared to control.

In this study, mean concentration of Cu in pregnant females was 27.75±24.27ppm. The results showed a significant decrease in blood Cu level of pregnant females as compared to control. Significantly higher level of serum Cu had been reported in healthy pregnant Nigerian women (Ajose *et al.*, 2001). Similar increase in serum copper had been reported in Spanish (Álvarez *et al.*, 2007) and Turkish women (Meram *et al.*, 2003).

**Conclusion**

The result of the present study revealed that pregnant women in industrial area of district Sargodha are at risk due to high level of Pb, Zn, Cd and Cr and deficiency of Cu during pregnancy. There is needed to look for the redress of these risks in order to avoid maternal and neo natal morbidity and mortality. Moreover, the redressal of these risks may also lead to reduction in congenital abnormalities.

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