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RESEARCH ARTICLE

RELATION BETWEEN ANEMIA AND BLOOD SERUM LEVELS OF LEAD, CADMIUM, ZINC, COPPER AND IRON AMONG PREGNANT WOMEN OF INDUSTRIAL AREA

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ABSTRACT

Pregnancy, which is essential in the course of a woman's life, is a period during which there is high sensitivity to toxic substances. Difficulties of pregnancy on the other hand are reproductive health issues or problems that arise during pregnancy and may involve the mother's health, the child's health or both. Exposures to toxic metals by pregnant women have been an under distinguished health issues in developing countries such as India.

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INTRODUCTION

Heavy metals describe as any metallic chemical element that has a high density and is poisonous at lower concentration. Heavy metals contains arsenic, lead, copper and mercury which specially effects reproductive system and especially toxic to growing fetus. These heavy metals are not filtered by placenta from mother to child and are directly deposit in growing fetal tissue. Women under the control of toxic metals may be infertile, wildly irregular hormone level. Their unborn children receive heavy metals from their pregnant mother (Goeringa, 2009). Toxic metals and reduced maternal diet in pregnancy are example of environmental causes that can impact negatively on the human reproductive system. Studies in animals disclosed that the increased uptake of lead, cadmium and other toxic metals interfered among the usual pregnancy course and result in abortion with other physiological dysfunctions (Ajayi, 2012). In addition, the unique route of exposure that is endogenous calls for a big concern as various metals can mobilize from gathered organs such as bones to the blood stream during pregnancy after period of exposures (Semczuk, 2001). These metals has the propensity to cross the fetal membrane and potentially damage the fetus and since no level has been confirm safe during pregnancy for many toxic metals, focus is now on low-dose exposures that may reason sub clinical problems (Hackley, 2003). Lead It may entry into body through inhalation, through ingestion or through absorption by skin and mucous membrane (www./cdcgov/mmwr/pdf/wil/ mm6133.pdf). When women meted to lead throughout pregnancy can reason a miscarriage, premature birth Low birth weight and it effects growth of fatuous brain and development of new born baby also retarded. Lead causes health risks for everyone, however young children and unborn baby more porn to lead toxicity which contributes to effect development of developing children and their behavior and learning ability (Altmann, 1993).

Copper: Copper in metallic form is not poisonous but several of its salts are poisonous such as blue vitriol and sub acetate. Copper is a dominant inhibitor of enzyme. Sources of copper are ordinary in the diet, particularly in vegetarian diets, and can be found in the water due to copper plumbing (Sinkovic, 2008). Several multiple vitamins hold relatively high doses of copper. The hormone estrogen promotes the withholding of copper and this is why women are particularly susceptible to the problem of copper toxicity. Copper toxicity may leads to poor fertility rate (Franchitto, 2008).

Cadmium: Cd has been revealed to be both embryotoxic and teratogenic in a variety of animal species (Thompson, 2008), but this has not yet been proved in humans. Cd gathers in

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human placenta, but the placenta is not a entire barrier, and Cd concentrations in cord blood enhance with maternal exposure (Kippler, 2010). There is increasing proof of associations between maternal Cd exposure and adverse pregnancy results, such as decreased size at birth (Galicia-Garcia, 1997) and preterm delivery (Nishijo, 2002). Zinc - Zinc is extremely vital in the development and growth of the foetus. It is also necessary for embryogenesis and protein production. Exploring the effects of zinc on immune functions in healthy pregnant women subjects, it was found that zinc raises the mitogenic influence on human lymphocytes exerting its largest proliferative influence in concentrations somewhat higher than those present in common human plasma (Schoetal, 1979). In patients with pregnancy difficulties, the proliferative responses of peripheral blood lymphocytes to zinc were lowered to the similar extent as to the phytomitogen PHA. Response of zinc stimulation would show to be adaptable as a reasonably sensitive method for the in vitro immunologic evaluation of patients with pregnancy difficulties (Goksu, 1986). According to (Kirksey, 1994), plasma zinc level reduces as pregnancy growths. But the moment a woman conceives the micronutrient level of zinc raises with increased metabolism in both the mother and the foetus.

General Symptoms

Heavy metal toxicity may be considered by any of these symptoms: i. Chronic pain all over the muscles and tendons or any soft tissues of the body, ii. Chronic malaise – common feeling of discomfort, fatigue, and illness, iii. Brain fog – state of forgetfulness and misunderstanding, iv. Chronic contaminations such as Candida, v. Gastrointestinal complaints, for example diarrhea constipation, bloating, gas, heartburn, and indigestion, vi. Food allergies vii. Dizziness, viii. Migraines or headaches, ix. Visual disturbances, x. Mood swings, depression, and anxiety, xi Nervous system malfunctions – burning extremities numbness, tingling, paralysis, or an electrifying feeling hole body (Kapoor Neeti, 2013).

Effects of metallic poisons on new born baby

Lead: Adverse effect on neurodevelopment, brain increase isretarded, raises risk of miscarriage and enhances changes of premature birth, effects IQ level of developing children, It reduces fetal growth. Copper: enhances chances of miscarriage, difficulty during delivery, poor birth weight, muscular weakness in recent born baby, it leads neurological difficulties in developing children.

Cadmium: Effect growth of new born baby, small IQ level, creates cardiac abnormalities, It produces craniofacial abnormalities for example eyes of new born baby is small, nasal bridge is reducibly formed, leads to renal abnormalities.

MATERIALS AND METHODS

Study site: The present study was conducted in industrial area of J.P cement Rewa. Rewa is situated in north east border of Madhya Pradesh state of India and covers an area of about - 6900 Sq KM. Jaypee cement limited (JCL) is part of Jaiprakesh industries limited (JIL). Which has wide rang of interst in cement, hydro-electric power projects, dams, power houses. JCL is planning for expansion of the two cement plants (JRP and JBP) and two mines.

Sample collection and prepration: Blood sample were collected from J.P hospital Nabusta Rewa (M.p). Blood sample were randomly selected. The study groups consisted of 26 pregnant women's with anemia. Who they were between 20-50 years age groups. About 4ml of veinous blood from the antecubital vein was collected from the subjects using sterile, disposable syringes into sterile heparinized sample containers, mixed and kept temporary in the refrigerator (2-8^{o}C) for the measurement of blood toxic metal –(lead, copper, cadmium and zinc) levels.

Acid Digestion: Before to measurement about 2ml of whole blood samples were transferred to pre-labelled digestive tubes and 4ml of concentrated nitric acid inserted. The samples were placed on a hot plate in the fume chamber and afterwards heated to just below boiling point. The samples were digested slowly for about 3 hours. When the volume had decreased to about 1/3, 2ml of 30% hydrogen peroxide solution was added. The samples were then evaporated slowly, residues dissolved in 1% nitric acid and filtered to provide sample solutions ready to be aspirated into AAS or ICP-MS.

.**Biochemical Measurements**: Analysis were done using Electrothermal Atomic Absorption Spectrophotometer (Peckin Elmer Analysts 800, Norwalk USA) adopting the method of Olmedo for the analysis of lead, cadmium and copper and zinc.

Procedures for Lead, Cadmium ,Zinc and Copper Analysis: Lead, cadmium Zinc and Copper were analyzed with Electrothermal Atomic Absorption Spectrophotometer (Peckin Elmer Analysts 800, Norwalk USA) adopting the method of Olmedo (Olmedo P.et,al2010,)as below: The hollow cathode lamp precise for each metal was added. The wavelength was adjusted properly with respect to the metal under analysis; The instrument was standardized and calibrated with standard blank and standard for every metal; An aliquot (20µl)of the prepared sample was inserted directly into the graphite furnace. The concentration of analyte under analysis was displayed on the screen after a run time of about 4 minutes. Other findings ;- For the determination of GSH and GSSG we utilized 5,5´-dithio-bis-2 nitrobenzoic acid (DTNB) as illustrated by Ellman (Ellman, 1959). The LPO levels were calculated by the method of (19). CAT (EC 1.11.1.6) activity was assayedas per the technique of Aebi (20). The CAT activity was expressed like mmol H_2O_2 catabolized/min/mg protein. The SOD (EC 1:15.1.1) activity was determined from its capacity to inhibit the decrease of NBT in existence of PMS according to the process of Mc Cord and Fridovich (Mc Cord, 1969). The reaction was observed spectrophotometrically at 560 nm. The SOD activity was stated as U/mg protein(1 unit is the amount of enzyme that reduce the reduction of NBT by one half in above reaction mixture). Whole protein of sample was determined by the process of Lowry et al. (Lowry, 1951).

Detoxification of body: Detoxification means elimination of metal toxicity from body, it is significant for a lady to detoxifying their body previous to conception. The average time for detoxification depend upon the concentration of metal toxicity and effectiveness of detoxifying organs. It is desirable to adopt healthy life style. Intake organic food and all organs which responsible for secretion must be opened for detoxification Treatment (Kapoor Neeti, 2013).

Chelation therapy: Chelation therapy is a treatment process used to treat heavy metal poisoning.

Observation

Table 1. Serum trace elements in health non pregnant women and Anemic Pregnant women

(Mean±S.E)

No.	Metals	Anemic Pregnant women (26)	Controls (29) healthy non pregnant women	P value
1	Cd(µg/l)	17.25±1.340	5.067±0.2956	333 P<0.0001
2	Zn(mg/l)	0.8812±0.02686	1.156±.03208	333 P<0.0001
3	Cu(mg/l)	1.245±0.01927	1.240±0.02078	333 P=0.8816^{ns}
4	Pb(µg/l)	523.6±18.61	58.30±2.067	333 P<0.0001
5	Fe(mg/l)	65.76±4.151	94.33±0.04334	333 P<0.0001

ns =Non significant

Table 2. Blood index values (Mean±SE) of Healthy non pregnant women and Anemic Pregnant women

S.N	Parameters	Anemic Pregnant women' (26)	Controls (29) healthy non pregnant women	P value
1	Hb (g/dl)	6.51±0.13	12.83±0.15	P<0.0001
2	Hct (%)	21.95±1.05	34.81 ±0.52	P<0.0001
3	MCV (fl)	62.37±1.75	84.13±1.14	P<0.0001
4	MCH (pg)	20.74±0.28	30.17±0.36	P<0.0001
5	MCHC (g/dl)	26.93±0.51	32.24±0.21	P<0.0001
6	RBC ($X10^{12}$/l)	3.69±0.23	5.16±0.19	P<0.0001

Table 3. Oxidant and antioxidant parameters (Mean ±SE) of healthy non pregnant women and Anemic Pregnant women

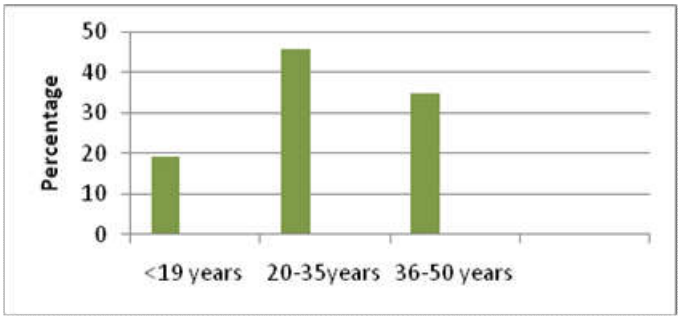
S.No	Parameters	Anemic Pregnant women' (26)	Controls (29) healthy non pregnant women	P value
1	GSH (µM)	331.05±515	413.82±5.71	P<0.0001
2	GSSG(µM)	216.21±4.17	145.97±2.91	P<0.0001
3	LPO(U/mg protein)	5.23±0.21	2.41±0.05	P<0.0001
4	SOD(U/mg protein)	0.64±0.04	1.13±0.01	P<0.0001
5	CAT(U/mg protein)	28.10±1.25	56.51±1.80	P<0.0001

This therapy taking part in injection of ethylene diamine tetra acetic acid (EDTA), a chemical that binds, or chelate, heavy metals, as well as lead, mercury, cadmium, and arsenic. The term chelation" comes from the Greek word 'chele', which denotes "claw," referring to the way the chemical grabs onto metals chelation therapy appling EDTA. The human body cannot break down heavy metals, which can construct up to toxic levels in the body and interfere with usual functioning. EDTA and other chelating drugs reduced the blood levels of metals attaching to the heavy metal molecules, which helps the body eliminate them through urination. EDTA can decrease the amount of calcium in the bloodstream, so help to reopen arteries blocked by mineral deposits, a situation called atherosclerosis or hardening of the arteries. They claim it is an effective and minor expensive alternative to coronary bypass surgery, angioplasty, and other methods designed to unclog blocked arteries (Kapoor Neeti, 2013).

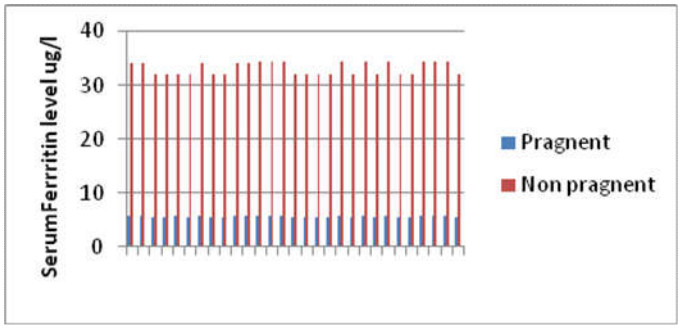
RESULTS

Table -1 Shown that the Pb, Cd levels were significantly ($p<0.0001$) higher in all anemic groups as compared to control groups. In contrast, the Zn, Fe levels were significantly ($P<0.0001$) lower in anemic groups as compared to control groups. Whereas Cu level insignificantly higher in anemic patients than control groups .Because copper level twice the normal value during pregnancy .Three month after baby birth Cu level get normal. Table-2 Summarizes the haematological parameters (blood index values) of two groups. All haematological parameters lowered significantly ($p<0.0001$) in all anemic groups as compared to control groups. Table-3 summarizes the oxidant (LPO) and antioxidant (CAT, SOD, TAC, GSH and GSSG) parameters of two groups. The levels of GSSG and LPO were significantly ($p<0.0001$) higher in anemic patients than control groups .

While levels of GSH, SOD, and CAT were significantly($p<0.0001$) lower in anemic patients as compared to control groups. Graph-1 shown that the present study, 12 cases were in age group 20 - 35 years, which comprises 46.1 % of total, number of 20-30 years pregnancies were 5 (19.2%) in the study. Whereas 36-50 years of age 9 (35%) cases were reported. Graph -2 Shown that Serum ferritin level significantly lower in anemic pregnant women than control groups.



Graph 1. Distribution of Anemic Patients according to the Age groups



Graph 2. Serum Ferritin level in Anemic Pregnant women and healthy non pregnant women

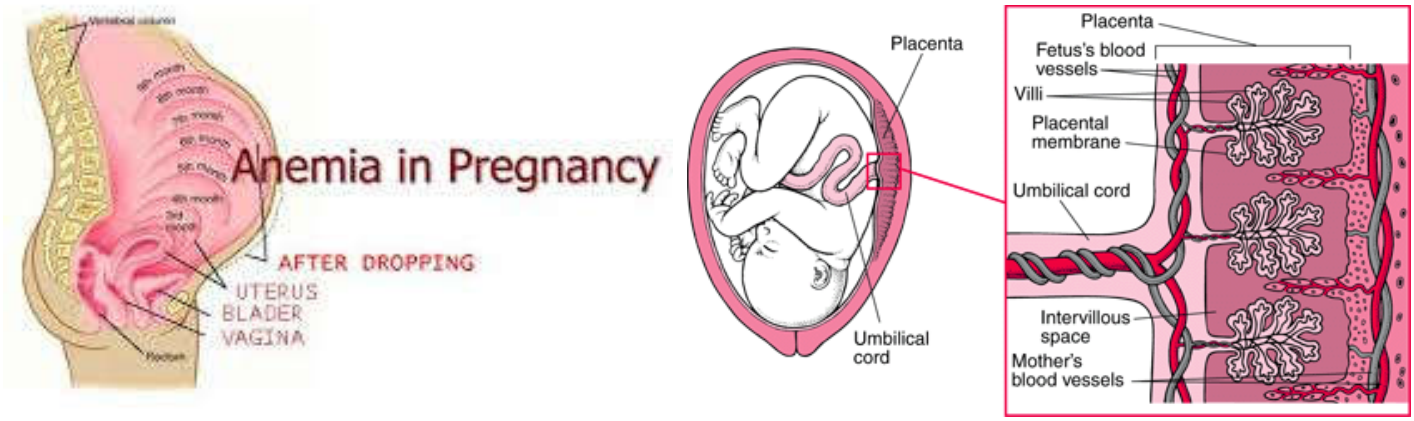


Figure 1. Anemia during pregnancy and fetus positions

DISCUSSION

We observed important alterations in oxidant and antiox-idant parameters of anemic pregnant women when compared with controls and this showed that oxidative damage can happen even at reduced blood lead levels. A strong correlation between blood Pb concentration and oxidative stress markers for example CAT, SOD and lipid peroxidation products was examined suggesting a possible involvement of Pb produced oxidative damage in anemic patients. Serum lead concentration in subject with anemia was found to be appreciably higher compared to the control group. Consequently, these results view that a relationship may exist between anemia and elevated lead levels. According to our results, the serum Pb levels raised although serum iron levels and Hb concentration reduced. Lead is also a problem among young children and women in several developing countries where exposure may be elevated due to continued use of lead in gasoline, urbanization, and industrial pollution (Wong et,al 2004). We originated a high cadmium level in serum of Anemic group compared to control. But this increase was statistically significant . Serum Fe and Zn levels were low, whereas Cd levels high significantly. past studies have described that lead and Cadmium can interact with gastrointestinal absorption of calcium, iron and zinc. This interaction with divalent cations is measured one of the molecular bases for the toxicity of these heavy metals. The replacement of zinc innumerous enzymes and the reduced in the availability of iron could be a mechanism by which lead and cadmium exert their toxic effects, like is the case of the anemia associated with their poisoning (Oyer 1995).

Deficiency of a few trace elements usually causes hypochromic microcytic anemia (Allen and Casterline-Sabel 2001). Serum Cu and Zn concentrations differ significantly between the anemic and control groups in this study. Hemoglobin is the usual indicator of anemia, and ferritin serum is the mainly used indicator of iron deficiency. In this study, Anemia was detected by an internal diseases clinic to take the source of the value of Hb, MCV,RBC and ferritin. These parameters were establish to be significantly lower in subjects with Anemia compared to those of the controls (Table 2).Some antioxidant molecules like GSH and GSSG levels and the activities of antioxidant enzyme levels such as SOD, CAT, glutathione peroxidase (GPx) and glutathione reductase (GR) are most usually used parameters to estimate Pb induced oxidative damage (Kasperczyk et al., 2005).

Several studies have shown reduced in GSH levels during Pb toxicity (Bechara 2004). Similarly in our study we also viewed significant reduction of GSH in anemic women compared to controls. Significant change was also find in the oxidized form of GSH, i.e. GSSG. CAT and SOD are metalloproteins and complete their antioxidant functions by enzymatically detoxifyingthe peroxides (–OOH), H_2O_2andO_2 respectively. CAT has been suggested to give vital pathway for H_2O_2 decomposition into H_2O and O_2at elevated steady state H_2O_2 concentration, while SOD eliminates the superoxide ions into $H_2O_2$and requires copper and Zn for its activity. There are conflicting reports concerning influence of Pb on SOD and CAT activities. Several studies viewed redued activities of SOD and CAT (Valenzuela et,al1989), In our study we find a significant reduce in CAT and SOD activities in Fe deficient pregnant anemic women when compared with controls (Table3). The reduced activities of CAT and SOD may be described in part mostly due to interaction of Pb with vital metals such as copper, Zn, Fe and induction of free radical. As stated previous copper and Zn are necessary cofactors for SOD. CAT have heme as the prosthetic group; the biosynthesis of which is repressed by Pb (Patil et al., 2006).

Conclusion

Our outcomes revealed that blood toxic metal levels in women during pregnancy were significantly increased compared to non-pregnant women, Clearly, this work is suggestive of a deeper research in order to recognize the actual sources of Metal exposure among the citizenry mainly our pregnant mothers. This study may therefore serve like a wake-up call on the State governments (M.P) and perhaps the government of India as a entire to execute programmes aimed at decreasing the blood metals levels in reproductive age women . So as to reduce the exposures of our pregnant mothers to metals toxicity thereby adverting possible negative pregnancy results.

REFERENCES

Aebi H. Catalase in vitro. Methods Enzymol. 1984;105:121–6.

Ajayi, O. D., Charles-Davis, M. A. and Avinola, O. G. (2012): Progesterone, selected heavy metals and micronutrients in pregnant Nigeria women

Allen L., Casterline-Sabel J. Prevalence andcauses of nutritional anemias. In: Ramakrishnan U (ed):Nutritional anemia, CRC Press, Boca Raton, pp. 7-21,2001

Altmann L., Weinsberg F., Sveinsson K., Lilienthal H., Wiegand H. and Winneke G., Impairment of long-term potentiation and learning following chronic lead exposure, Toxicol Lett, 66(1),105-112 (1993)

Bechara EJH. Lead poisoning and oxidative stress. Institute of deQuimica, Universidade de Sao Paulo, Brazil. SFRR's 12th biennial meeting progamme and abstracts, 5–9 May 2004, CrownPlaza, Panamericano Hotel, Buenos Aires, Argentina, S9–46, vol.36. Free Radic Biol Med; 2004

Ellman GL. Tissue sulfhydryl groups. Arch Biochem. 1959;82:70–7.

Franchitto N., Gandia-Mailly P., Georges B., Galinier A., Telmon N., Ducassé J.L. and Rougé D., Acute copper sulphate poisoning: a case report and literature review, Resuscitation,78(1), 92-6 (2008) .

Galicia-Garcia V, Rojas-Lopez M, Rojas R, Olaiz G, Rios C. Cadmium levels in maternal, cord and newborn blood in Mexico City. Toxicol Lett. 1997;91:57–61. [PubMed].

Goeringa P.L. and Barber D.S., Hepatotoxicity of Copper, Iron, Cadmium, and Arsenic, Comprehensive Toxicology, 9,501-526 .

Goksu, A.A., A. Ozsoylu. 1986. In virto immunologic evaluation of pregnant patients with complications. Obstet.101 (10) pp 985-988.

Hackley B, and Katz-Jacobson A. (2003): Lead poisoning in pregnancy: A case study with implications for midwives. J. Midwifery Women's Health. 48: 30 –38.

Kapoor Neeti and Tiwari Prakash Effects of Heavy Metal Poisoning during PregnancyInternational Research Journal of Environment Sciences ISSN 2319–1414 Vol. 2(1), 88-92, January (2013) .

Kasperczyk S, Birkner E, Kasperczyk A, Kasperczyk J. Lipids,lipid peroxidation and 7-ketocholesterol in workers exposed to lead. Hum Exp Toxicol. 2005;24:287–95.

Kippler M, Hoque AM, Raqib R, Öhrvik H, Ekström EC, Vahter M. Accumulation of cadmium in human placenta interacts with the transport of micronutrients to the fetus. Toxicol Lett. 2010a;192:162–168. [PubMed]

Kirksey, A., T.D. Wachs, F. Yunis. 1994. Relation of maternal zinc nutriture to pregnancy outcome and infant development in an Egyptian village. *Am J Clin Nutr* 60: pp 782-792.

Lead poisoning in pregnant women who used ayurvedic medications from India, center and prevention, www./cdcgov/mmwr/pdf/wil/mm6133.pdf,(2012)

Lowry OH, Rosenbrough NJ, Farr AL, Randell RJ. Proteinmeasurement with folin–phenol reagent. *J Biol Chem.* 1951;193:265–75

Mc Cord JM, Fridovich I.1969.Superoxide dismutase: an enzymefunctions for erythrocuprin. *J Biol Chem*. 244:6049–55.

Nishijo M, Nakagawa H, Honda R, Tanebe K, Saito S, Teranishi H, et al. Effects of maternal exposure to cadmium on pregnancy outcome and breast milk. Occup Environ Med. 2002; 59:394–396. [PMC free article] [PubMed].

Ohkawa H, Oshiba N, Yagi K. Assay of lipid peroxides in animaltissue by thiobarbituric acid reaction. Anat Biochem. 1979;95:351–8

Olmedo P., Pla A., Hernadez A. F., Lopez-Guanid O.,Rodingo L. and Gil F (2010) : Electrothermal Atomization –Atomic Absorption Spectrometry (ET-AAS), Analytical Clinical Acts 659: 60 –67.

Oyer R.A. Nutrition and metal toxicity. Am J Clin Nutr;61, 646, 1995

Patil AJ, Bhagwat VR, Patil JA, Dongre NN, Ambekar JG,Jailkhani R, Das KK. Effect of lead (Pb) exposure on the activityof superoxide dismutase and catalase in battery manufacturingworkers (BMW) of Western Maharashtra (India) with Referenceto Heme Biosynthesis. Int J Environ Res Public Health. 2006;3:329–37.

Schoetal, R.B., J.F. Pearson, E.C. Coles. 1979. Relation of heamoglobin levels in first and second trimesters to outcome of pregnancy. Lancet 2 (1) 299-305

Semczuk, M. and Semczuk –Sikora A. (2001): New data on toxic metal intoxication (Cd. Pb and Hg in particular) and Mg. status during pregnancy. Med. Sci. Monit. 7:332 –340.

Sinkovic A., Strdin A. and Svensek F., Severe acute copper sulphate poisoning: a case report, Severe acute copper sulphate poisoning: a case report, Arh Hig Rada Toksikol,59(1), 31-5 (2008)

Thompson J, Bannigan J. Cadmium: toxic effects on the reproductive system and the embryo. Reprod Toxicol. 2008;25:304–315. [PubMed]

Valenzuela A, Lefauconnicer JM, Chaudiere J, Bourre JM.Effects of lead acetate on cerebral glutathione peroxidase and catalase in the suckling rat. Neurotoxicology. 1989;10:63–9.

Wong W.T., Friello P., Semba R.D. Interactionsbetween iron deficiency and lead poisoning: epidemiology and pathogenesis. *Sci Total Environ;* 330, 21, 2004

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