A correlation of zinc and copper levels with blood pressure in normal pregnancy and preeclampsia

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Abstract
Objective: To estimate the levels of zinc and copper in the cases of preeclampsia. To know the importance of the same in pregnancy.
Materials and Methods: 30 preeclamptic cases and 30 pregnant women with normal blood pressure were estimated for serum zinc and copper levels.
Results: The levels of the trace elements, zinc and copper were found to be decreased in preeclamptic pregnancy when compared to the normal pregnancy without complications.
Conclusion: The decreased levels of zinc and copper in preeclampsia might be responsible for the complications in pregnancy as well as post-pregnancy complications.

Keywords: Zinc, Copper, Preeclampsia, Pregnancy.

Introduction
Preeclampsia, an important disorder in pregnancy, complicates almost 10% worldwide of all pregnancies and is responsible for both maternal and fetal mortality and morbidity.[1] The condition is more common in developing countries as their dietary intake of these micronutrients are low.[2]

Preeclampsia is a progressive, multisystem disease characterized by a triad of symptoms – increased blood pressure (≥ 140/90 mmHg), pedal edema and proteinuria in the second trimester.[3] During pregnancy there are decreased levels of nutrients such as magnesium and zinc in maternal serum. This may be due to multiple reasons like hemodilution, transfer of these minerals from mother to the fetus, increased excretion through urine and accelerated metabolism.[4-6] The risk increases with pregnancy because of increased requirements of these nutrients by the growing fetus as well.[3,7,8]

This study was taken into consideration to estimate the levels of zinc and copper among in preeclampsia and to highlight their importance in preventing the complications of pregnancy.

Materials and Methods
A total of 60 pregnant women attending the Out-patient department of Obstetrics and Gynecology at our Medical College Hospital participated in the study and were grouped as A and B with 30 in each.

Inclusion criteria for Group A:

Age 21-35 years and normal Blood pressure (≤ 120/80 mmHg) and no symptoms of pedal edema or proteinuria.

Inclusion criteria for Group B:

Age 21-35 years and high Blood pressure (≥ 140/90 mmHg), pedal edema and proteinuria developing after 20 weeks of gestation.

Exclusion criteria for Group A and B:

Patients with a history of diabetes mellitus, multiple gestations, and those who were suffering from chronic hypertension, cardiovascular disease, renal disease and liver diseases were excluded from the study.

5ml of venous blood sample was collected from all participants. The blood was allowed to clot and serum was separated by centrifugation at 3000 RPM for 10 minutes. The serum was stored at -20ºC. Zinc and Copper were measured in Auto Analyzer by using standard enzyme kits.

Table 1: Parameters with the methods of estimation.

Parameter	Method
Zinc	Turbidimetry
Copper	Turbidimetry

Results
The study was enrolled with a total of 60 pregnant women, of which 30 were of normal pregnancy under group A and 30 were preeclamptic under group B.

The biochemical study parameters were analyzed with the help of Statistical Product and Service Solutions (SPSS) 22 software.

Table 2: Mean and standard deviation of measured parameters in group A (Normal pregnancy)

Parameters	Mean	Standard deviation
SBP (mm Hg)	108.7	9.8
DBP (mm Hg)	74.2	6.2
MAP (mm Hg)*	95.7	7.4
Zinc (µg/dl)	70.6	11.8
Copper (µg/dl)	106.9	18.9

*Mean Arterial Pressure = {SBP+2(DBP)}/3

Table 3: Mean and standard deviation of measured parameters in group B (Preeclampsia)

Parameters	Mean	Standard deviation
SBP (mm Hg)	154.4	15.1
DBP (mm Hg)	92.7	4.9
MAP (mm Hg)*	113.2	9.3
Zinc (µg/dl)	24.3	15.7
Copper (µg/dl)	44.9	20.8

Calculation of Group Means difference and the statistical significance by student's t test.

Table 4: Comparison of variables with groups A and B

Variable	Group	Group	Mean Difference (A-B)	Std. Error	Significance P	95% Confidence Interval	
						Lower bound	Upper bound
MAP	A	B	17.5	2.17	< 0.0001	13.16	21.85
Zinc	A	B	-46.3	3.59	< 0.0001	-53.48	-39.12
Copper	A	B	-62.0	5.13	< 0.0001	-72.27	-51.73

Table 5: Comparison of Zinc and MAP within group A and group B

Zinc	MAP	Mean Difference (A-B)	Std. Error	Significance P	95% Confidence Interval	
					Lower bound	Upper bound
Group A	Group A	25.1	2.54	< 0.0001	20.01	30.19
Group B	Group B	88.9	3.33	< 0.0001	82.23	95.57

Table 6: Comparison of copper and MAP within group A and group B

Copper	MAP	Mean Difference (A-B)	Std. Error	Significance P	95% Confidence Interval	
					Lower bound	Upper bound
Group A	Group A	-11.2	3.71	0.0037	-18.62	-3.78
Group B	Group B	68.3	4.16	< 0.0001	59.97	76.63

Discussion

The trace elements are required because of their vital functions in the human body. Their daily requirement is increasing during the pregnancy period due to different reasons. According to the World Health Organization, a pregnant woman in the third trimester needs almost double the daily zinc requirement.[9] When this increased need is not met out, it results in various complications during and post pregnancy like preeclampsia, thereby increasing morbidity and mortality both for the mother and fetus.

There are various studies which assessed the reasons behind preeclampsia and its association with zinc and copper.

According to a study conducted by Ikgos et al, it was found that concentrations of zinc and copper were low in the placental tissues in preeclamptic pregnancy when compared to healthy pregnancy.[10]

The functions of zinc and copper were analyzed by various studies as enzyme cofactors like Metallothionein, Ceruloplasmin and Super oxide dismutase, says a study by Cetin et al.[11]

Our study showed a decrease in zinc concentration in preeclampsia than in normal pregnancy. This was in accordance with the study conducted by Joshi et al, Ette et al and Ilhan et al.[12-14]

Lower level of copper was found in group B pregnancy with preeclampsia when compared to group B pregnancy with normal blood pressure. This was supported by others like Akinloye et al and Ugwuja et al.[15,16]

In contrast to our study, higher levels of zinc were also estimated among preeclampsia like the studies conducted by Borella et al and Ajayi et al.[17,18]

There was also studies conducted by Golmohammad et al and a study conducted by Prema K, which showed both the trace elements, zinc and copper to be in normal concentrations among pregnant women with preeclampsia.[19,20] This was also in contrast to our study.

Conclusion

The present study showed a decrease in zinc and copper levels in preeclampsia both mild and severe preeclampsia when compared to the normotensive pregnancy controls, explaining their importance and role in normal pregnancy.

Since there is a significant decrease, the estimation of micronutrients in pregnancy might becomes an important in early diagnosis and treatment of pre-eclampsia. The study thereby recommends the clinicians to include minerals zinc and copper in the prenatal period to prevent preeclampsia and other complications.

Limitations of the Study: A smaller study group limits the study to come to a major conclusion.

Ethical Standards: The study was conducted in Department of Biochemistry collaborated with Department of Obesterics and Gynecology at a Medical College Hospital and Research Centre. The study was approved by the Institutional Ethical Committee.
An informed consent was taken from all the participants in the study group and control group.

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Conflicts of Interest: None.

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References

1. Jain S, Sharma P, Kulshreshtha S. The role of calcium, magnesium and zinc in pre-eclampsia. *Biol Trace Elem Res* 2010;133:162-170.
2. Akinloye O, Oyewale OJ, et al. Evaluation of trace elements in pregnant women with pre-eclampsia. *Afr J Biotechnol* 2010;9(32):5196-202.
3. Cunningham FG, Leveno KJ, Bloom SL. Hypertensive disorders in pregnancy. In: Wenstrom KD (eds) williams obsterics, 22nd edi. 2005. Mc Graw-Hill, New york, pp 761-808.
4. Kumru S, Aydin S, Simsek M, Sahin K. Comparison of serum copper, zinc, calcium and magnesium levels in pre-eclamptic and healthy pregnant women. *Biol Trace Elem Res* 2003;94:105-112.
5. Adam B, Malatyalioglu E, Alvur M, et al. Magnesium, zinc and iron levels in pre-eclampsia. *J Matern Fetal Med* 2001;10:246-250.
6. Standley CA, Whitty JE, Manson BA, et al. Serum ionized magnesium levels in normal and pre-eclamptic gestation. *Obstet Gynecol* 1997;89:24-27.
7. Christian P. Micronutrients and reproductive health issues: an international perspective. *J Nutr* 2003;133:S1969- S1973.
8. Picciano MF. Pregnancy and lactation: physiological adjustments, nutritional requirements and the role of dietary supplements. *J Nutr* 2003;133:S1997- S2002.
9. WHO/FAO/IAEA. Trace elements in human nutrition and health 1996. In: WHO, eds. WHO/FAO/IAEA Report. Geneva, Switzerland: World Health Organisation; 1996:1-361.
10. Ikgoz SA, Harma M, Harma M, Mungan G, Can M, Demirtas S. Comparison of angiotensin-converting enzyme, malonaldehyde, zinc and copper levels in pre-eclampsia. *Biol Trace Elem Res* 2006;13:1-8.
11. Cetin I, Berti C, Calabrese S. Role of micronutrients in the periconceptional period. *Hum Reprod Update* 2010;16(1):80-95.
12. Joshi VK, Sapre S, Govilla V. Role of micronutrients and calcium in pregnancy induced hypertension. *Obs Gynae Today* 2003;8:617–619.
13. Ette A, Ibeziako PA. Plasma zinc and copper concentrations in pregnant Nigerian women and newborn. *Afr J Med Sci* 1985;14:99–103.
14. Ilhan N, Simsek M. The changes of trace element, malondialdehyde levels and super oxide dismutase activities in pregnancy with or without pre-eclampsia. *Clin Biochem* 2002;35:393–397.
15. Akinloye O, Oyewale OJ, Oguntibeju OO. Evaluation of trace elements in pregnant women with pre-eclampsia. *Afr J Biotechnol* 2010;9(32):5196-202.
16. Ugwuja EI, Ejikeme BN, Ugwu NC, Obeka NC, Akubugwo EI, Obidoa O. Comparison of plasma copper, iron and zinc levels in hypertensive and non-hypertensive pregnant women in Abakaliki, South Eastern Nigeria. *Pak J Nutr* 2010;9(12):1136-1140.
17. Borella P, Szilagyi A, Than G, Csaba I, Giardino A, Faccinetti F (1990) Maternal plasma concentrations of magnesium, calcium, zinc and copper in normal and pathological pregnancies. *Sci Total Environ* 99:67–76.
18. Ajayi G. Concentrations of calcium, magnesium, copper, zinc and iron during normal and EPHgestosis pregnancy. *Trace Element Med* 1993;10:151–152.
19. Golmohammed S, Amirabi lou A, Yazdian M, Pashapour N. Evaluation of serum calcium, magnesium, copper, and zinc levels in women with pre-eclampsia. *Iran J Med Sci* 2008;33:231–234.
20. Prema K. Predictive value of serum copper and zinc in normal and abnormal pregnancy. *Indian J Med Res* 1980;71:554–560.

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