



A comparative study of Copper/zinc ratio and Systolic Blood Pressure in Preeclampsia

Authors

Dr Gayathri.B¹, Mr. A. Sreenivas Reddy^{2*}, Dr V.M.Vinodhini³, Dr Anuradha⁴

^{1,2,3}Department of Biochemistry, ⁴Department of Obstetrics and Gynaecology, SRM Medical College Hospital & Research Centre, Kattankulathur

*Corresponding Author

Mr. A.Sreenivas Reddy

Assistant professor, Department of Biochemistry, SRM Medical College Hospital & Research Centre, SRM IST, Kattankulathur, Tamilnadu, India

Abstract

Objective: *The aim of our study was to assess the levels of copper/zinc ratio among preeclampsia, to compare Systolic blood pressure (SBP) in preeclampsia and normal pregnancy. The objective was targeted at highlighting the role of copper and zinc in preventing the complications of pregnancy.*

Materials and Methods: *120 pregnant women, of which 60 normal pregnancy and 60 pregnant with increased blood pressure along with pedal edema and proteinuria were estimated for serum copper and zinc.*

Results: *Copper/zinc ratio was low in preeclampsia than the normal pregnancy without complications. The decrease in the copper/zinc ratio was indirectly proportional to the SBP.*

Conclusion: *The importance of copper and zinc in perinatal complications is explained by the fall in copper/zinc ratio in accordance with the increase in SBP among the cases of preeclampsia. Hence, the screening of these minerals becomes mandatory early in the first trimester.*

Keywords: *Copper, Zinc, Systolic blood pressure, Preeclampsia, Pregnancy.*

Introduction

Pregnancy and Childbirth are natural processes in women. However, the reality is that women and children die and suffer as a consequence of childbearing process.

Worldwide, 10 % of all pregnancies are complicated by hypertension, with pre-eclampsia and eclampsia being the major causes of maternal and prenatal morbidity and mortality^[3].

Preeclampsia is defined as a combined presence of hypertension, edema and proteinuria developing after the 20th week of pregnancy^[4].

According to the National Institution for Transforming India, MMR was around 130 for whole India and almost 66 in Tamilnadu during the year 2014-2016. It was also found that among the reasons of MMR, hypertension topped the list as second contributing nearly 14% of all causes, according to a study.

Pregnancies complicated by hypertension are associated with increased risk of adverse maternal, neonatal and fetal outcomes, including intrauterine growth restriction (IUGR), preterm birth, perinatal death, acute renal failure and

hepatic failure, postpartum haemorrhage, antepartum haemorrhage and maternal deaths^[5].

Women with pregnancy in developing countries have been reported to take diets that are low in minerals and vitamins, leading to complications in pregnancy including preeclampsia^[6]. An inadequate dietary intake might be harmful for the mother and for the growing fetus.

The pathogenesis of adverse pregnancy outcomes has been shown to be associated with oxidative stress. Micronutrients such as zinc, copper, magnesium, manganese and selenium are involved in the antioxidant defense mechanism in the body as cofactors of enzymes^[7,8].

There are various studies conducted on the status of the micronutrients in pregnancy, especially in preeclampsia with varying conclusions. This study was conducted to understand the importance of the same in preeclampsia and normal pregnancy.

Materials and Methods

The study is a cross-sectional study and involved 120 pregnant cases attending antenatal clinic at SRMMCH & RC. They were divided into two groups, 60 preeclampsia patients and 60 normal pregnancy. The sample size was designed using the formula $4pq/d^2$ with the guidance of the statistician.

Pregnant women with preeclampsia aged 20 - 35 years were taken as controls with normal pregnancy as controls of the same age group.

Patients with history of chronic hypertension, cardiovascular disease, diabetes, multiple gestations, malnourishment and renal disorders were excluded from the study.

Informed consent was obtained from individuals and 2 ml of venous blood sample were collected and estimated in Beckman Coulter AU480 Auto-analyzer for copper and zinc by their respective methods.

Table 1: Parameters with methods of estimation

Parameter	Method
Copper	Turbidimetry method
Zinc	Turbidimetry method

Results

The study included 60 pregnant women, divided into two groups A and B. The study parameters were analyzed with the Statistical Product and Service Solutions (SPSS) 22 software.

Table 2: Parameters in Group A (Normal pregnancy)

Parameters	Mean	Standard Deviation
SBP (mm Hg)	108.7	9.8
Copper ($\mu\text{g}/\text{dl}$)	106.9	18.9
Zinc ($\mu\text{g}/\text{dl}$)	70.6	11.8
Copper/Zinc	1.5	1.6

Table 3: Group B (Preeclampsia)

Parameters	Mean	Standard Deviation
SBP (mm Hg)	154.4	15.1
Copper ($\mu\text{g}/\text{dl}$)	44.9	20.8
Zinc ($\mu\text{g}/\text{dl}$)	24.3	15.7
Copper/Zinc	1.8	1.3

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
SBP	A	B	45.7	2.32	< 0.001	41.10	50.30
Copper	A	B	-62.0	5.13	< 0.001	-72.27	-51.73
Zinc	A	B	-46.3	3.59	< 0.001	-53.48	-39.12
Copper/Zinc	A	B	0.3	0.27	0.2619	-0.23	0.83

Table 5: Comparison of Copper/Zinc and SBP within groups A and B

Copper/Zinc	SBP	Mean Difference (A-B)	Std. Error	Significance P	95% Confidence Interval	
					Lower bound	Upper bound
Group A	Group A	107.2	1.28	< 0.001	104.66	109.73
Group B	Group B	152.6	1.96	< 0.001	148.72	156.47

Discussion

The parameters, Copper and Zinc play an important role as antioxidants being a part of antioxidant enzymes. This property gains even more importance in pregnancy as there is an increase in complications. From our study, it was found that there was an indirect correlation with the Group B when compared to those in Group A. This shows that there was a decrease in the levels of both Copper and Zinc among the subjects in Group B than among the controls in Group A with higher significance $p < 0.001$. This was in accordance to the study conducted by Negi R, Al-Jameil N and Sarwar NS who concluded that there was a decrease in copper and zinc concentrations among pregnancy with preeclampsia when compared to the normal pregnancy significantly [8-10].

In contrast with the study conducted by Rathore S and Lou GS which showed no significant changes in copper and zinc concentrations among pregnancy with preeclampsia [11,12].

The Copper/Zinc ratio was not of much difference when compared between the groups as both the parameters were decreased in Group B, leading to a negligible change in the ratio than in Group A [Table 4]. This inference was not in accordance to the study conducted by Bader A.A. among normal pregnant women without any complications where the Copper/zinc ratio was found to be increased because of the increase in copper and decrease of zinc, especially in 35 and 36 weeks of gestation [13]. Whereas the study conducted by Mistry HD showed an increase in copper and unaltered zinc levels in preeclampsia [7].

It was also found that there was a direct correlation between the Copper/Zinc ratio and the SBP when compared between the groups A and B. Copper/zinc ratio was decreasing with respect to the increase in the SBP with a significance of $p < 0.001$. This helps us conclude that the microminerals namely, copper and zinc are found to be indirectly correlated to the SBP and are decreased with higher SBP.

Conclusion

Our study concluded that, there are decreased copper and zinc levels among pregnancy with preeclampsia. This inturn helps us to understand the roles of these micronutrients as potent antioxidants. Low serum levels of maternal copper and zinc are related to preeclampsia and may be associated with the pathogenesis of preeclampsia and to have a causative role in this disorder.

Hence, it is advisable that all pregnant women should be screened for the microminerals like copper and zinc in the first trimester itself to prevent any complications in the perinatal period.

Limitations of the Study

A smaller number of population limits the study to come to a major conclusion.

Ethical Standards

The study was conducted in central lab, Biochemistry department collaborated with Department of Obsterics and Gynecology at SRM Medical College Hospital and Research Centre, Kattankulathur, SRMIST. The study approved by the Institutional Ethical Committee. An informed consent was taken from the participants in the study group and control group.

Acknowledgments

The authors would like to thank the staff of SRM Medical College Hospital and Research Centre, Kattankulathur and the participants for their great support.

Conflicts of interest: None.

Funding: Self.

References

1. WHO, UNFPA, UNICEF, WORLD BANK; *Complications in pregnancy and child birth. A guide for midwives and doctors S36-S37*. WHO 2000
2. Bergström S. 'Perinatal health' In: Lankinen KS, Bergström S, Makela PH, Peltoma M editors. Health and Disease in

- Developing Countries. 1st ed. London, Oxford: Macmillan Education LTD; 1994:294
3. Palacios C and Pena-Rosas JP. Calcium supplementation during pregnancy for preventing hypertensive disorders and related problems. WHO RHL Commentary.
 4. Harma M, Harma M and Kocyigit. A correlation between maternal plasma homocysteine and zinc levels in preeclamptic women. *Biol Trace Elem Res.* 2005;104:97-105.
 5. Black, R. E., R. Laxminarayan, M. Temmerman, and N. Walker, editors. 2016. Reproductive, Maternal, Newborn, and Child Health. Disease Control Priorities, third edition, volume 2. Washington, DC: World Bank.
 6. Pregnancy. *American Journal of Obstetrics and Gynecology* 1990; 163: 1691 - 712.
 7. Mistry HD, Gill CA, Kurlak LO, Seed PT, Hesketh JE, MeÅplan C, et al. SCOPE Consortium. "Association between Maternal Micronutrient Status, Oxidative Stress, and Common Genetic Variants in Antioxidant Enzymes at 15 Weeks' Gestation in Nulliparous Women Who Subsequently Develop Preeclampsia." *Free Radical Biology & Medicine* 2015; 78: 147±155.
 8. Negi R, Pande D, Karki K, Kumar A, Khanna RS, Khanna HD. Trace elements and antioxidant enzymes associated with oxidative stress in the pre-eclamptic/eclamptic mothers during fetal circulation. *Clin Nutr* 2012; 31:946±50.
 9. Al-Jameil N, Tabassum H, Al-Mayouf H, Aljohar HI, Alenzi ND, Hijazy SM, et al. Analysis of serum trace elements-copper, manganese and zinc in preeclamptic pregnant women by inductively coupled plasma optical emission spectrometry: a prospective case controlled study in Riyadh, Saudi Arabia. *Int J Clin Exp Pathol* 2014; 7:1900±10.
 10. Sarwar MS, Ahmed S, Ullah MS, Kabir H, Rahman GK, Hasnat A, et al. Comparative study of serum zinc, copper, manganese, and iron in preeclamptic pregnant women. *Biol Trace Elem Res* 2013; 154:14±20.
 11. Rathore S.; Gupta A.; Batra H.S.; Rathore R. Comparative study of trace elements and serum ceruloplasmin level in normal and pre-eclamptic pregnancies with their cord blood. *Biomed. Res.*, 2011, 22, 207-10.
 12. Lou GS, Amirabi 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.
 13. Bader A.A.; Hussain T.; Mosawi M.A.; Otaibi M.; Abul H.; Khalifa D.; Dashti H. Serum zinc and copper concentrations in pregnant women from Kuwait. *J. Trace. Elem. Exp. Med.*, 1997, 10, 209-215.