ORIGINAL ARTICLE

Serum copper and zinc levels in preeclamptic Nigerian women

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ABSTRACT

Background: The exact etiology of preeclampsia remains unknown even though several studies have been done. Some studies have shown that supplementation of zinc (Zn) and copper could ameliorate the effects of preeclampsia while other studies did not establish the beneficial role of these elements in preeclampsia. The objective of this study was to compare the Zn and copper levels in the serum of Nigerian women with or without preeclampsia. **Materials and Methods:** In this study, serum Zn and copper levels were determined using atomic absorption spectrometry in 54 patients and 48 healthy normotensive pregnant women. The mean, standard deviation, Student's *t*-test, and Pearson correlation were employed. **Results:** Serum Zn was significantly lower in patients than controls (8.27 ± 0.60 vs. 12.16 ± 1.83 μmol/l. P <0.001) (*t*-test). Serum copper was also significantly lower in patients than controls (8.14 ± 1.80 vs. 16.62 ± 3.17 μmol/l, P < 0.001). **Conclusion:** There was a significant reduction in the levels of Zn and copper in patients with preeclampsia. Dietary supplementation of these trace elements may help to prevent preeclampsia.

Key words: Atomic absorption spectrometry, copper and zinc, preeclampsia

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INTRODUCTION

Hypertension associated with pregnancy is the most common medical risk for maternal morbidity and mortality.[1] The greatest impact is associated with the pregnancy–specific syndrome, preeclampsia.[2] Preclampsia is the occurrence of hypertension and proteinuria in a pregnant woman after 20 weeks of gestation.[3] The deficiency of trace elements such as zinc (Zn), copper, magnesium have been implicated in various reproductive events like infertility, congenital anomalies, preeclampsia, low birth weight, and stillbirth.[4,5] Therefore, this study was done to compare the levels of Zn and copper in preeclamptic and non- and pre-clamptic women in Nnewi with a view to providing a preliminary data regarding copper and Zn supplementation in pregnancy in our area.

MATERIALS AND METHODS

This was a case–control study designed to determine the serum levels of copper and Zn in pregnant women with preeclampsia.

Inclusion criteria were women diagnosed with preeclampsia after 20 weeks of pregnancy. The controls were pregnant women in the same age range seen after 20 weeks of pregnancy but not diagnosed with preeclampsia.

Exclusion criteria included patients on any form of Copper and Zinc drugs, patients with medical complications such as diabetes mellitus, renal failure, and heart diseases. A well-designed questionnaire administered by researchers was used to sample the patients and the controls.

A sterile needle and syringe were used to draw blood from the cubital vein, and the blood was put into plain tubes. The blood was allowed to clot undisturbed. Serum was separated by centrifugation for 10 min at 4000 rpm and stored at – 20°C until time of analysis. Copper and Zn levels were determined by atomic absorption spectrophotometry.

Access this article online	
Quick Response Code:	Website: www.nigeriamedj.com
	DOI: 10.4103/0300-1652.184071

How to cite this article: Onyema AO, Onah CE, Iheukwumere BC, Udo JN, Atuegbu CC, Nosakhare NO. Serum copper and zinc levels in preeclamptic Nigerian women. Niger Med J 2016;57:182-4.

The principle is based on the dissolution of the elements (from the flame) from its chemical bonds. This is then placed in unexcited or ground state (neutral atom). Thus, the neutral atom is at a low energy in which it is capable of being absorbing radiation at a very narrow bandwidth corresponding to its own line spectrum. The amount of radiant energy absorbed is proportional to the concentration of copper and Zn in the serum.

Statistical analysis

The Statistical Package for Social Sciences version 17 (SPSS, Inc., 2008, Chicago) was used for the analysis. Values obtained from the study were expressed as mean and standard deviations. Independent *t*-test was used to determine the difference between continuous variables while the degree of correlation between variables was measured using Pearson correlation coefficient. The level of significance was set at $P < 0.05$.

RESULTS

Of the total 102 pregnant women, 48 were non- and pre-eclamptic while 54 were preeclamptic. The mean age of the patients were 27 ± 7.02 years whereas that of the control was 29 ± 5.35 years. Most of the patients and controls were of 0 and 1 parity. It was noted that among the patients that had preeclampsia (54 women), those <20 years contributed the highest number compared to other ages 15 (27.8%). It was also shown that 33 (61.1%) were nulliparous, greatest number attended secondary education 37 (68.5%) These are shown in Table 1. As shown in Table 2, there was a significant inverse negative correlation between the serum levels of Copper, Zinc and both systolic and diastolic blood pressure. There was an inverse relationship between copper and Zn and diastolic blood pressure ($r = -0.808$, $P < 0.01$), $r = -0.749$, $P < 0.01$, respectively.

Table 1: Sociodemographic factors

Variables	Non- and pre-eclamptic (%)	Preeclamptic (%)
Age		
<20	2 (4.2)	15 (27.8)
20-25	12 (25.0)	8 (14.8)
26-30	17 (35.4)	13 (24.1)
31-35	11 (22.9)	11 (20.4)
36-40	6 (12.5)	6 (911.1)
>40	0 (0.0)	1 (1.9)
Parity		
Nullipara	18 (37.5)	33 (61.1)
Para 1	19 (39.6)	7 (13.6)
Multipara	8 (16.7)	9 (16.7)
Grandmultipara	3 (6.3)	5 (99.3)
Educational status		
No formal education	0 (0.0)	5 (9.3)
Primary	5 (10.4)	1 (1.9)
Secondary	24 (50.0)	37 (68.5)
Tertiary	19 (939.6)	11 (20.4)

Table 2: Levels of biochemical parameters in preeclamptic and non- and pre-eclamptic women

Parameters	Mean±SD		*t*	*P*
	Patients age (*n*=54)	Control (*n*=48)		
Age	27±7.02	29±5.35	1.326	0.188
BMI (kg/m²)	29.29±6.01	27.80±4.34	−1.415	0.160
SBP (mmHg)	174.63±27.45	113.30±19.17	−13.19	<0.001
DBP (mmHg)	111.48±13.65	71.67±9.07	−17.51	<0.001
Copper (µmol/)	16.62±3.17	8.14±1.80	16.34	<0.001
Zinc (µmol/l)	12.26±1.83	8.27±0.60	11.44	<0.001

SD – Standard deviation; BMI – Body mass index; SDP – Systolic blood pressure; DBP – Diastolic blood pressure

DISCUSSION

The result obtained from this study showed no statistically significant difference between maternal age and preeclampsia ($P = 0.188$). This was similar to the findings of Asraf *et al.*,[6] but it was, however, different from the findings of Macdonald-Wallis *et al.*[7] Such difference may be due to the specificity of each population and hospital of the attendant patients.

There was also a significant difference between nulliparity and preeclampsia ($P = 0.02$), this supported the finding by Odegård e*t al.*[8], who noted that the risk of preeclampsia was increased by nulliparity and hypertension. This may be explained by the immunologic theory of preeclampsia which was of the view that inadequate blocking antibodies to the paternal antigens increase the incidence of preeclampsia in nullipara.

Lack of formal education has been noted to increase the risk of preeclampsia by a factor of 4.[6] In our study, women who had at most secondary education were noted to have a higher incidence of preeclampsia, this may be explained by the fact that this group formed the bulk of participants, up to 68.5%.

We observed a significant decrease in the serum level of Zn in preeclamptic women when compared to the non- and pre-eclamptic women. This suggests a possible involvement of Zn, in the development and pathogenesis of preeclampsia. Our data agree with Mahomed *et al.*[4] and Akinloye *et al.* [9,] who also noted reduced levels of Zn in women with preeclampsia.

Zn is an important trace element in metabolism, growth, development, and reproduction. It is a constituent of many enzymes. This element plays important roles in nucleic acid metabolism and protein synthesis, as well as membrane structure and function.[10] Zn deficiency has been associated with complications of pregnancy part of which is preeclampsia.[11]

Zn is passively transferred from mother to fetus across the placenta, and there is also decreased Zn binding capacity of

maternal blood during pregnancy, which facilitates efficient transfer of Zn from mother to fetus.[12] During pregnancy, there is a decline in circulating Zn and this increases as the pregnancy progresses possibly due to decrease in Zn binding and increased transfer of Zn from the mother to the foetus.[12]

Zn is essential for proper growth of fetus and the fall in Zn during pregnancy could also be a physiological response to expanded maternal blood volume.[13] It was reported that an increased incidence of preeclampsia in Zn-deficient regions was corrected by Zn supplementation in those regions.[14]

Our study also noted the significant difference between the serum copper levels in preeclamptic and non- and pre-eclamptic women. This finding corroborated the finding of Ugwuja[15] and findings from the earlier workers involved in both epidemiological study[16] and experimental study.[17]

Copper has been shown to be involved in the function of several cuproenzymes that are pertinent for life. Copper is a component of ceruloplasmin and superoxide dismutase, which are notable antioxidants. This has made some workers conclude that copper deficiency may increase the risk of cardiovascular diseases.[18]

Careulopasmin containing copper catalyzes the conversion of Iron from the ferric to the ferrous form, and thus is essential in the absorption of Iron in the gastrointestinal system. It also plays a role in the mobilization of Iron from its tissue stores.[19]

CONCLUSION

Our study showed a significant reduction in the levels of copper and Zn in preeclamptic women when compared with non- and pre-eclamptic women. Dietary supplementation of these trace elements may help to prevent preeclampsia.

Acknowledgments

We would like to thank all who were involved in the collection, preservation, and processing of the samples.

Financial support and sponsorship:

Nil.

Conflicts of interest

There are no conflicts of interest.

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