Serum levels of calcium and magnesium in pre-eclamptic-eclamptic patients in a tertiary institution

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ABSTRACT

We report the exceptional case of an intrauterine fetal death Objective: the aim of this study was to determine the serum levels of calcium and magnesium in patients with pre-eclampsia/eclampsia and compare with those with normal pregnancies. Materials and methods: venous blood samples were collected from 48 patients with pre-eclampsia, 30 patients with eclampsia, and 78 normal pregnant women. All the subjects were either in the third trimester or within the puerperium. The blood samples were analysed for calcium and magnesium using a colorimeter analyser. The data were analysed using SPSS 17. Results: The serum calcium in the pre-eclamptic and eclamptic patients were significantly lower than in normal pregnant women (2.05±0.4mmol/l, 1.9±0.2mmol/l vs. 2.6±0.4mmol/l, p<0.000). Unlike serum calcium, serum magnesium was lower in the patients with either pre-eclampsia or eclampsia compared with normal pregnant women but the difference was not statistically significant. Conclusion: this study revealed that serum calcium and magnesium in preeclampsia/eclampsia are lower compared to normal pregnancy. It was also revealed in this study that serum calcium and magnesium are lower in patients with eclampsia compared to patients with pre-eclampsia. These findings support the hypothesis that hypocalcaemia and hypomagnesaemia may play a role in the pathogenesis of pre-eclampsia-eclampsia.

Keywords: Serum, Calcium, Magnesium, Pre-eclampsia, Eclampsia, Pregnancy, Blood pressure.

SOMMARIO

lo scopo di questo studio era di fattori che determinano i livelli sierici di calcio e magnesio in pazienti con pre-eclampsia / eclampsia e appare con Quelli con gravidanze normali. Materiali e metodi: campioni di sangue venoso sono stati prelevati da 48 pazienti con preeclampsia, 30 pazienti con eclampsia, e 78 donne in gravidanza normale. Tutti i soggetti erano o nel terzo trimestre o All'interno del puerperio. I campioni di sangue sono stati analizzata per il calcio e magnesio utilizzando un analizzatore colorimetro. I dati sono stati analizzata utilizzando SPSS 17. Risultati: Il calcio sierico nei pazienti pre-eclampsia e eclampsia erano significativamente più bassi rispetto alle donne in gravidanza normale (2,5 ± 0.4mmol / l, 1,9 ± 0.2mmol / l vs 2.6 ± 0.4mmol / l, p <0.000). A differenza di calcio sierico, del magnesio nel siero è stata inferiore nei pazienti con o pre-eclampsia o eclampsia Rispetto alle donne in gravidanza normali, ma la differenza non era statisticamente significativa. Conclusioni: questo studio ha rivelato che il calcio sierico e magnesio in preeclampsia / eclampsia sono Rispetto inferiore alla gravidanza normale. E 'stato rivelato in questo also studio che il calcio sierico e magnesio sono più bassi nei pazienti con eclampsia Rispetto ai pazienti con pre-eclampsia. Questi risultati supportano l'ipotesi che l'ipocalcemia e ipomagnesiemia possono giocare un ruolo nella patogenesi della preeclampsia-eclampsia.

INTRODUCTION

Hypertension is a common medical condition during pregnancy and about 10% of women will have their blood pressure recorded as above normal at some point during the antenatal period before delivery.1 It is estimated to complicate about 5% of all pregnancies and 11% of first pregnancies[(2)].

Pre-eclampsia is defined as hypertension and significant proteinuria beginning during the second half of gestation in a previously normotensive and non-proteinuric pregnant woman[(2,3)]. It complicates 4-8% of all pregnancies[(4,5)]. Eclampsia on the other hand, is the new onset of grand mal seizures occurring during or up to 6weeks after pregnancy that do not have another identifiable cause[(6,7)]. It could also be defined as the development of convulsions and/or unexplained coma during pregnancy or postpartum in patients with signs and symptoms of pre-eclampsia.8 Incidence of eclampsia in developed countries ranges from 5-7 cases per 10,000 deliveries9, quite unlike in developing countries where Nigeria belongs, where the prevalence ranges from 2-16.7%[(10-12)].

Pre-eclampsia and eclampsia are not distinct disorders but the manifestation of the spectrum of clinical symptoms of the same condition.9 Once eclampsia occurs the risk to mother and baby is substantial. WHO estimates that the incidence of pre-eclampsia is seven times higher in the low and middle–income countries than in high-income countries, and the risk of a woman in a low-income country dying of pre-eclampsia/ eclampsia is three hundred times that of a woman in a high-income country[(6,13)]

Pre-eclampsia has remained a significant public health threat in both developed and developing countries(9). WHO had estimated its incidence to be 7 times higher in developing countries than in developed countries and a

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woman in a developing country is 300 times more likely to die from pre-eclampsia and eclampsia[6,13]. Globally, pre-eclampsia and eclampsia account for 10-15% of maternal deaths[14]. Unlike in the developed countries where pre-eclampsia and eclampsia are associated with near-miss rather than maternal death, death usually results from eclampsia in the developing countries[15]. The high maternal morbidity and mortality in the developing countries is due to barrage of factors that include delays (Types I,II, and III), unbooked status of patients, high parity, and multiple convulsions before admission[9,16,17]. It can also lead to significant foetal morbidity and mortality, including an increased incidence of placental abruption, intrauterine growth restriction, and preterm delivery[14]

To date, the aetiology of pre-eclampsia has remained poorly understood but it has been documented that pre-eclampsia is polygenetic and is caused by a combination of maternal and foetal genes with influence of environmental factors.18 Pathogenesis of eclamptic convulsions has also remained source of controversy[8].

The overall risk of seizure is approximately 1% in developed countries8 and 2.3% in developing countries6 and can occur at virtually any time in pregnancy up to within the first 48 hours of delivery, though it has been reported as late as 23 days postpartum[19]. The reported frequency of antepartum eclampsia ranged from 38-53%, intrapartum eclampsia ranged from 18-30%, while postpartum eclampsia had ranged from 11-44% respectively[6,8].

Pre-eclampsia and eclampsia are not distinct disorders but the manifestation of the spectrum of clinical symptoms of the same condition.9 Pre-eclampsia complicates about 4-8% of all pregnancies[4,5] while the incidence of eclampsia in Nigeria ranges from 2-16.7% unlike in developed countries where its incidence ranges from 5-7 cases per 10,000 deliveries[9]. Pre-eclampsia could be mild or severe. It is mild when the blood pressure is >140/90mmHg but <160/110mmHg associated with proteinuria of >0.3-3g/24hr without associated symptoms but when there is a sustained blood pressure that is ≥160/110mmHg measured twice, at least 6hours apart with evidence of other end organ damage it is described as been severe[14]. Pre-eclampsia could also be classified as being early or late depending on whether it is occurring prior to 34 weeks or not[14]. There is significant maternal-foetal morbidity associated with pre-eclampsia especially when the onset is below 32 weeks[14,19-21].

Focus is currently on ways to prevent pre-eclampsia based on the different theories surrounding the aetiology of pre-eclampsia, micronutrient supplements have been investigated as potential preventive ways[22,23]. Hypocalcaemia has been reported in essential hypertension in human and experimental models of hypertension in animals, and has been implicated in the pathogenesis of elevated blood pressure[24]. There is evidence that low serum calcium may also be associated with increased neuromuscular irritability and seizures[25]. Interestingly, neuromuscular excitability, vasoconstriction, elevated blood pressure, and increased vascular sensitivity to pressor agents are also characteristic of magnesium depletion[27,28]. The results from many clinical studies show the relationship between the aggravation of hypertensive complications and change in concentration of various ions especially calcium and magnesium in the serum of pre-eclamptic and eclamptic mothers[5,22,26-28]. On the physiological basis, calcium plays an important role in muscle contraction, a decrease in extracellular calcium concentration increases the excitability of nerve and muscle cells and conversely an increase in extracellular calcium concentration stabilizes the membrane by decreasing excitability[5,29]. The reduction in serum calcium and increased intracellular calcium can cause an elevation of blood pressure in pre-eclampsia[6]. Hypomagnesaemia also increases hypertensive tendencies by increasing angiotensin II action, decreasing levels of vasodilatory prostaglandins (PGs), increasing levels of vasoconstrictive PGs and growth factors, increasing vascular smooth muscle cytosolic calcium and impairing insulin release, thereby producing insulin resistance and alteration of lipid profile[30].

MATERIALS AND METHODS

The Scientific and Ethical committee of the Ahmadu Bello University Hospital, Zaria, Kaduna State of Nigeria approved the study protocol, and an informed written consent was obtained from each participant before recruitment. The study population consisted of 156 pregnant women in the third trimester of pregnancy that presented to the antenatal clinic, delivery suite, and the postnatal ward of the hospital. Out of the 156 pregnant women 78 served as the control; while 48 had pre-eclampsia and 30 had eclampsia.

The consecutive patients who met the inclusive criteria were selected as they presented at the set out locations in the hospital using the convenient sampling method.

For the purpose of this study significant hypertension and proteinuria were as defined by the International Society for the Study of Hypertension in Pregnancy (ISSHP), which are blood pressure of ≥140/90mmHg and proteinuria of ≥2+ respectively. Korotkoff phase V was used to designate the diastolic blood pressure. Pregnant women with either a diagnosis of pre-eclampsia or eclampsia in the third trimester or postpartum that were not on calcium supplement and had not been commenced on magnesium sulphate therapy were included in the study while those with chronic medical illness like diabetes mellitus and renal disease, multiple gestation were excluded.

At presentation at the clinics, ward, or delivery suite the blood pressure of each subject was taken in the supine position with a left lateral tilt using an Accoson table-top mercury sphygmomanometer that had the appropriate size cuff with the arm at the level of the heart. After taking the blood pressure the mid-stream urine sample was obtained and tested with combi-9 urinalysis strip for proteinuria.

Height was measured with each subject standing barefooted on a standard Seca Stadiometer. The height was read from under the head piece on the calibrated metre of the stadiometer to the nearest 0.1cm. Weight was measured using a calibrated weighing scale (Camry digital weighing scale) without shoes and subjects wearing light clothes; weight was read to the nearest 0.1kg. All these were done at presentation for those who were conscious while the measurements of those that presented in a state of unconsciousness were taken after they had regained consciousness.

The socio-economic status (SES) of each of the subjects was assessed using the husband's occupation and the subject's educational attainment as proposed by Olusanya et al.[31].

10ml of venous blood specimen was collected by venepuncture with sterile 10ml syringe with 21G disposable hypodermic needle from the ante-cubital vein without a tourniquet from each subject after the skin over the site had been swabbed clean with methylated spirit-soaked cotton wool and allowed to dry.

Laboratory procedure: Each of the blood samples collected was transferred into a plain specimen bottle containing no anticoagulant and allowed to clot for 30 minutes. It was then centrifuged with Hettich centrifuge machine at 4000 rpm for 10 minutes to separate the serum from the cells. The serum aliquots were harvested with a clean Pasteur pipette into a plain bottle and immediately stored at -200C in Haier Thermocool deep freezer until the time of analysis. The frozen samples were allowed to thaw at room temperature before analysis. Albumin was analysed for in the sera of the subjects so as to factor out the real level of calcium, however, it was observed that all the subjects had normal albumin level so there was no need to calculate for any factor. Serum calcium was measured by colorimetric method. This is based on the principle that calcium reacts with o-cresolphthalein complexone in an alkaline medium to give a blue coloured complex. Magnesium which interferes with the reaction is bound out of solution by 8-hydroxyquinoline. The absorbance of the standard and that of the complex were read with Spectro-V16 spectrophotometer at a wavelength of 650nm specified by the manufacturer of the kit used in this study. The calcium concentration was calculated by the formula:

$$\text{Calcium conc. (mmol/l)} = \frac{\textbf{Absorption of sample}}{\textbf{Absorption of standard}} \text{ X Concentration of standard}$$

Magnesium was measured with Calmagite-EGTA-Colorimetric. Magnesium forms a purple coloured complex when it reacts with calmagite in alkaline solution. The interference by calcium is prevented by the use of EGTA (ethylene glycol tetraacetic acid). The intensity of the colour formed is proportional to the magnesium concentration in the sample. Reagent sample mixture was then incubated for 5minutes at room temperature. The absorbance of the standard and the sample was measured against reagent blank at a specific wavelength of 520nm using Spectro-V16 spectrophotometer. Magnesium concentration was calculated as follows;

$$\text{Magnesium conc. (mmol/l)} = \frac{\textbf{Absorption of sample}}{\textbf{Absorption of standard}} \text{ X Concentration of standard}$$

For the purpose of this study the normal reference values of serum calcium (2.1-2.6mmol/l) and magnesium (0.66-1.03mmol/l) for the Chemical Pathology laboratory of ABUTH were used.

The data obtained were analyzed using SPSS version 17 for windows. The mean values of serum level of calcium and magnesium obtained from patients with pre-eclampsia and eclampsia who met the set out criteria were compared with those of the controls using ANOVA. The values of the mean of serum level of calcium and magnesium of patients with pre-eclampsia were compared with eclamptic patients using the student t-test to see if there was any significant statistical relationship. A multivariate analysis between these results and the sociodemographic variables of the subjects was done using Chi square. Correlation analysis was also carried out between the systolic and diastolic blood pressures and levels of calcium and magnesium of the subjects. A p-value of equal to or less than 0.05 was considered to be statistically significant.

RESULTS

The total number of Parturients that were cared for during the period of this study was 1,074 out of which 156 subjects met the set out inclusion criteria; out of these 156 subjects 78 of them had pre-eclampsia/eclampsia (i.e. 48 pre-eclamptics and 30 eclamptics) and they served as the test group while the remaining 78 subjects that served as control were normal pregnant women. These two groups were matched for age, gestational age, and parity.

Table 1 below highlights the sociodemographic variables and the clinical parameters of the subjects studied. Mean age, mean gestational age, and parity between the pre-eclamptic/eclamptic and control groups were not statistically different. There was significant statistical difference between the mean systolic and diastolic blood pressure of the test group and the mean systolic and diastolic blood pressure of the control group as shown in the table 1 below. The differences in the mean weight and height of the patients with pre-eclampsia/eclampsia and control were not statistically significant.

Table1
Sociodemographic variables and the clinical parameters of the subjects

	Pre-eclampsia/Eclampsia N = 78	**Control** N = 78	**P Value**
Demographic status			
Age (years)	26.5 ± 6	27.4 ± 6	0.370*
G.A (weeks)	34.3 ± 3	34.0 ± 3	0.556*
Postpartum	6 (7.7%)	5 (6.4%)	
Parity			
Primigravidae	42 (54.8%)	43 (55.1%)	
Multipara	26 (33.3%)	26 (33.3%)	0.968*
Grandmultipara	10 (12.8%)	9 (11.5%)	
Booking status			
booked	51 (65.4%)	76 (97.4%)	0.000**
unbooked	27 (34.6%)	2 (0.26%)	
Socioeconomic status			
Upper	15 (19.2%)	42 (53.8%)	
Middle	22 (28.2%)	28 (35.9%)	0.000**
Lower	41 (52.6%)	8 (10.3%)	
Clinical status			
SBP(mmHg)	171 ± 26	111 ± 11	0.000**
DBP(mmHg)	110 ± 16	67 ± 9	0.000**
Height(m)	1.57 ±0.06	1.59 ± 0.05	0.076*
Weight(kg)	74.6 ± 15	71.4 ± 13	0.155*
BMI(kg/m^2)	30.2 ± 0.05	28.2 ± 4.8	0.010**

**significant at p-value <0.05, *not significant at p-value >0.05

Table 2 below compares the mean serum calcium and magnesium of the patients with eclampsia, pre-eclampsia, and control using ANOVA. There is a significant statistical difference in the p-values of the different trace elements studied. **Table 3** below shows the difference in the mean serum calcium and magnesium in the pre-eclamptic and eclamptic patients. The mean values were lower in the eclamptic patients, however, there was no significant statistical difference when their means were compared using the student T-test.

Table 4 shows the Chi-square values of the cross-tabulation of the serum calcium against the status of the subjects studied and their sociodemographic characteristics. Statistical significance was observed between serum calcium level and the status of the subjects studied; their booking status as well as their social class. **Table 5** also shows the Chi-square values of the cross-tabulation of the serum magnesium against the status of the subjects studied and their sociodemographic characteristics. Statistical significance was only observed between serum magnesium level and the age group of the subjects.

As shown in **tables 6** and **7** below, calcium and magnesium showed negative correlation with systolic and diastolic blood pressure values in the test and control groups, however, the correlation was not statistically significant.

Table 2
Comparing the mean serum levels of calcium and magnesium of patients with pre-eclampsia, eclampsia, and control with ANOVA

Laboratory Data	Pre-Eclamptic	Eclamptic	Control	
	N=48	N=30	N=78	p-value
Mean serum calcium (mmol/l)	2.05±0.4	1.9±0.2	2.6±0.4	0.000**
Mean serum magnesium (mmol/l)	0.82±0.03	0.82±0.07	0.86±0.07	0.004**

At 95% CI, **significant at P-value <0.05

Table 3
Comparing the mean serum levels of calcium and magnesium of pre-eclamptic patients with eclamptic patients using the student's t-test

Laboratory Data	Pre-Eclamptic	Eclamptic	
	N=48	N=30	p-value
Mean serum calcium(mmol/l)	2.05±0.4	1.9±0.2	0.076**
Mean serum magnesium (mmol/l)	0.82±0.03	0.82±0.07	0.944**

At 95% CI, *not significant at P-value >0.05

Table 4
Cross-tabulation of level of calcium with status of subjects and their sociodemographic characters using Chi square

	Level of calcium						
	<2.1 mmol/l		2.1-2.6 mmol/l		>2.6 mmol/l		p-value
	test	**control**	**test**	**control**	**test**	**control**	
Subjects' status							
Test group	51	-	26	-	1	-	0.000**
Control group	-	8	-	28	-	42	
Age(years)							
<20	4	0	6	1	1	8	
20-24	13	3	6	3	0	10	
25-29	18	1	7	14	0	12	0.373*
30-34	9	1	4	8	0	7	
35-39	6	2	2	1	0	5	
≥40	1	1	1	1	1	0	
Gestational age(weeks)							
≥28	4	0	1	4	0	2	
29-33	16	2	9	8	0	10	
34-38	20	3	12	11	1	21	0.636*
≥39	7	3	2	5	0	3	
Postpartum	4	0	2	1	0	6	
Parity							
Primigravida	26	0	15	11	1	21	
Multipara	20	2	6	14	0	17	0.477*
Grandmultipara	5	3	5	3	0	4	
Booking status							
Booked	30	7	20	27	1	42	0.000**
Unbooked	21	1	6	1	0	0	
Social class							
Upper	9	4	6	16	0	22	
Middle	18	3	3	9	1	16	0.001**
Lower	24	1	17	3	0	4	

**significant at P-value <0.05, *not significant at P-value >0.05

Table 5
Cross-tabulation of level of magnesium with status of subjects and their sociodemographic characters using Chi square

	Level of magnesium						
	<0.66mmol/l		0.06-1.03mmol/l		>1.03mmol/l		p-value
	test	**control**	**test**	**control**	**test**	**control**	
Subjects' status							
Test group	1	-	76	-	1	-	0.188*
Control group	-	0	-	74	-	4	
Age(years)							
<20	0	0	11	9	0	0	
20-24	0	0	18	16	1	0	
25-29	0	0	25	24	0	3	0.000**
30-34	0	0	13	15	0	1	
35-39	0	0	8	8	0	0	
≥40	1	0	1	2	0	0	
Gestational age(weeks)							
≥28	0	0	5	5	0	0	
29-33	0	0	24	17	1	2	
34-38	1	0	32	31	0	2	0.717*
≥39	0	0	9	14	0	0	
Postpartum	0	0	0	7	0	0	
Parity							
Primigravida	0	0	42	32	0	4	
Multipara	1	0	24	33	1	0	0.477*
Grandmultipara	0	0	10	9	0	0	
Booking status							
Booked	1	0	50	72	0	4	0.889*
Unbooked	0	0	26	2	1	0	
Social class							
Upper	0	0	15	39	0	3	
Middle	0	0	22	27	0	1	0.493*
Lower	1	0	39	8	1	0	

**significant at P-value <0.05, *not significant at P-value >0.05

Table 6
Correlation of serum calcium and magnesium with systolic and diastolic blood pressures in the test group

		Calcium	Magnesium
Systolic blood pressure	Pearson correlation	-0.119	-0.075
	Sig. (2.tailed)	0.300*	0.515*
	N	78	78
Diastolic blood pressure	Pearson correlation	-0.103	-0.107
	Sig. (2.tailed)	0.371*	0.351*
	N	78	78

*correlation not significant at the 0.01 level (2-tailed) with P-value >0.05

Table 7

Correlation of serum calcium and magnesium with systolic and diastolic blood pressures in the control group

		Calcium	Magnesium
Systolic blood pressure	Pearson correlation	-0.135	-0.113
	Sig. (2.tailed)	0.239*	0.324*
	N	78	78
Diastolic blood pressure	Pearson correlation	-0.069	-0.208
	Sig. (2.tailed)	0.550*	0.068*
	N	78	78

*correlation not significant at the 0.01 level (2-tailed) with P-value >0.05

DISCUSSION

This study observed a statistically significant lower serum calcium and magnesium levels in patients with pre-eclampsia—eclampsia compared to normal pregnant women. These findings may suggest a possible involvement of hypocalcaemia and hypomagnesaemia in the aetiopathogenesis of pre-eclampsia-eclampsia. The findings in this study agree with the findings reported by other investigators: Sukopan et al[5] in Thailand, Idogun et al[19] in Benin, Nigeria, and Akinloye et al[26] in Oshogbo, Nigeria. However, in contrary to the findings in this study Odigie et al[32] in Lagos, Nigeria and Golmohammad lou et al[33] in Iran did not find any significant difference in the serum calcium and magnesium of pre-eclamptic women when compared with normal pregnant women.

This study also revealed that the serum levels of calcium and magnesium were lower in the patients with eclampsia compared with levels in the pre-eclamptic patients though the differences were not statistically significant. This difference in the levels of these micronutrients may be due to the disease progression from pre-eclampsia to eclampsia since it is a known fact that pre-eclampsia is a progressive disease.

Again, this study also revealed that the serum calcium in the pre-eclampsia/eclampsia group was below the lower limit of normal reference range for this centre; however, the mean serum magnesium was within normal range. On the other hand, the mean values of both these two micronutrients in the control group were within normal range. It was also found out in this study that majority of the patients in the pre-eclampsia/eclampsia group were in the low socioeconomic class, and when the sociodemographic variables of the subjects were compared with their disease status; the booking status and the socioeconomic class showed a significant relationship. These findings are consistent with the findings by Omole-Ohonsi et al[12] in Kano, Nigeria in their study of risk factors for pre-eclampsia in 2008. Kano is about 150km from Zaria with similar geographical ethnic characteristics. The implication of these findings could be that their dietary intake of calcium-rich food had been inadequate. Though the natural trend of homeostatic mechanism tends to maintain calcium level but still the presence of lower level of serum calcium in pre-eclamptic/eclamptic women may indicate the chronicity of micronutrients deficiency which may be a causative factor for the occurrence of pre-eclampsia/eclampsia in these patients. Various possible explanations have been proposed by different investigators to explore the link between nutritional deficiency and pre-eclampsia/eclampsia[34] though research findings from literature have suggested that there is a relationship between nutritional status of calcium and the onset of progression of pre-eclampsia[23,34,35]. While the cause of pre-eclampsia/eclampsia remains elusive to scientific knowledge, calcium and magnesium deficiencies are thought to be implicated[7,36]. Decreased serum calcium levels lead to an increase in the parathyroid hormone levels, thereby increasing the intracellular calcium levels, which leads to an increase in the vascular smooth muscle contraction and thus an increase in the blood pressure. Reduced serum magnesium also increases hypertensive tendencies by increasing the vasoconstrictor effect of angiotensin II and nor-adrenaline[30]. Since calcium and magnesium are two intracellular ions that play very important roles in cellular metabolisms and they compete with each other, high magnesium concentrations inhibit the release of acetylcholine (Ach) while high calcium concentrations enhance the release of Ach from the pre-synaptic nerve

terminal[37]. During cellular injury, there is influx of calcium ions into the cell leading to increased intracellular ions and loss of calcium homeostasis[37]. In pre-eclampsia/eclampsia there is widespread vasospasm, ischemia, and cellular hypoxia leading to reversible endothelial injury[37]. Since magnesium antagonises the effect of calcium, in order to counteract intracellular calcium migration there is also an influx of magnesium into the cells. This could explain why both calcium and magnesium were reduced in the patients studied. This also forms the basis for the use of magnesium sulphate in the prevention and control of convulsion in pre-eclampsia/ eclampsia.

When serum calcium level was compared with the status of the subjects studied and their sociodemographic characteristics it was observed that a statistically significant relationship existed with the booking status of the subjects and their socioeconomic class with p-values being 0.000 and 0.001respectively. Low literacy level and lack of economic power could have contributed to their attitude to non-booking at antenatal period and thereby resulting in their inability to have enlightenment on benefits that could be derived from eating calcium-rich food, purchasing same, and other benefits of antenatal care. However findings in other studies with respect to magnesium have been conflicting, with some findings showing significantly lower serum magnesium in patients with pre-eclampsia/eclampsia while others did not find any difference at al[5,22,26,32,33].

In this study inverse correlation of serum calcium and magnesium with SBP and DBP in the test and control groups was observed though the correlation was not significant, this finding may suggest a relationship between the deficiency of these trace elements and the risk of pre-eclampsia/eclampsia. This finding is consistent with the findings by Akinloye et al[26] and Akhtar et al[35] but in contrary to the findings in the aforementioned studies the correlation was not significant this may probably due to differences in geographical locations of the patients studied.

Limitations of this study included the fact that the dietary analysis of the participants was not done there their calcium and magnesium baselines were not known before the study, and the anthropometric parameters of those who presented in a state of unconsciousness were only measured after they had regained consciousness.

CONCLUSION

This study established that serum calcium and magnesium are significantly lower in patients with pre-eclampsia/eclampsia compared to normal pregnant women. It was also established in this study that the serum levels of calcium and magnesium in patients with eclampsia were less compared to the level in pre-eclamptic patients. This finding supports the fact that pre-eclampsia is a progressive disease. This study also established that among all the sociodemographic variables of the subjects studied, only their booking status and socioeconomic class showed a statistically significant relationship with the serum calcium. There is a negative correlation between systolic and diastolic blood pressures and serum calcium and magnesium in both pre-eclampsia/eclampsia and control groups.

REFERENCES

1) Duley L, Henderson-Smart DJ, Walker GJA. **Interventions for preventing pre-eclampsia and its consequences: generic protocol (Protocol).** The Cochrane Library. 2009(2):1-14

2) Hofmeyr GJ, Duley L, Atallah A. **Dietary calcium supplementation for prevention of pre-eclampsia and related problems: a systemic review and commentary.** Br. J. Obstet Gynaecol 2007;114:933-943

3) Pregnancy Hypertension. In: Cunningham FG, Leveno KJ, Bloom SL, Hauth JC, Rouse DJ, Spong CY (Eds). **Williams Obstetrics 23rd Edition**, McGraw-Hills companies 2010; 706-756.

4) Miller DI. Hypertension in pregnancy. In: Decherney A.H, Nathan L, Goodwin T.M and Laufer N. (Eds) **Current Diagnosis and Treatment Obstetrics and Gynaecology**, 10th edition, McGraw-Hill Medical Publishing Division 2007; 321.

5) Sukonpan K, Phupong V. S**erum calcium and serum magnesium in normal and pre-eclamptic pregnancy.** Arch Gynaecol Obstet 2005; 273:12-16.

6) Engender Health. **BALANCING THE SCALES. Expanding treatment for pregnant women with life-threatening hypertensive conditions in developing countries. A report on Barriers and solutions to Treat Pre-eclampsia and Eclampsia.** New York: Engender Health; 2007

7) Sibai MB, Villar MA, Bray E. **Magnesium supplementation during pregnancy: a double-blind study.** Br. J. Obstet Gynaecol. 1988; 950:120-5.

8) Sibai BM. **Diagnosis, Prevention, and Management of Eclampsia**. Obstet Gynecol 2005; 105:402-10

9) Osungbade KO, Ige OK. **Public Health Perspectives of Pre-eclampsia in Developing Countries: Implication for Health system strengthening**. Journal of Pregnancy

[Review]. 2011; 2011:1-6
10) Population Council Nigeria. "**Administering Magnesium Sulphate to Treat severe Pre-eclampsia and Eclampsia**, 2009.Available at http://.popcouncil.org/script/tellafriend.asp.
11) Olopade FE, Lawoyin TO. **Maternal Mortality in a Nigerian Hospital.** Afr J Biomed Research, 2008;11(3):276-273
12) Omole-Ohonsi A, Ashimi AO. **Pre-eclampsia: a study of risk factors.** Nigerian Medical Practitioner 2008; 53(6):99-102
13) Gaym A, Barley P, Pearson L, Admasu K, Gebrehiwot Y. **Disease burden due to Pre-eclampsia/ eclampsia and Ethiopian health system's response.** Int J Gynecol Obstet; 2011;115:112-116
14) Turner JA. **Diagnosis and management of pre-eclampsia: an update.** Int J Women's Health, 2010;2:327-337
15) Duley L. **The global impact of Pre-eclampsia and Eclampsia**. Semin Perinatol, 2009;33:130-137
16) Agida ET, Adeka BI, Jibril KA. **Pregnancy outcome in Eclamptics at the University of Abuja Teaching Hospital, Gwagwalada, Abuja: A 3year review**. Nigerian J of Clinical Practice 2010;13(4):394-398
17) Agan TU, Archibong EL, Ekabua JE, Ekanem EL, Abeshi SE et al. **Trends in maternal mortality at the University of Calabar Teaching Hospital,** Nigeria, 1999-2009. Int J Women Health 2010;2:249-254
18) Williams PJ, Pipkin FB. T**he genetics of Pre-eclampsia and other hypertensive disorders of pregnancy.** Best Practice and Research Clin Obstet Gynaecol 2011;25:405-417
19) Chames MC, Livingston JC, Invester TS, Barton JR, Sibai BM. **Late postpartum eclampsia: a preventable disease?** Am J Obstet Gynecol 2002;186:1174-7
20) Ganzevoort W, Rep A, Bonsel GJ et al. **Dynamics and incidence patterns of maternal complications in early onset hypertension of pregnancy.** Br. J. Obstet Gynaecol 2007;114:741-750
21) Ganzevoort W, Sibai BM. T**emporizing versus interventionist management (Preterm and at term).** Best Practice & Research Clinical Obstet Gynaecol 2011; 25:463-476
22) Idogun ES, Imarengiaye CO, Momoh SM. **Extracellular Calcium and Magnesium in Pre-eclampsia and Eclampsia.** African Journal of Reproductive Health 2007;11(2):89-94
23) Kumar A, Devi DG, Batra S, Singh C, Shukla DK. **Calcium Supplementation for the prevention of pre-eclampsia.** Int. J Gynecol Obstet 2009;104:32-36
24) Duckitt K, Harington D. **Risk factors for Pre-eclampsia at antenatal booking: Systematic review of controlled studies.** BMJ 2005; 330(7491):565.
25) Resnick LM, Barbagallo M, Dominguez LT. **Cellular-free Magnesium Depletion in Brain and Muscle of Normal and Pre-eclamptic pregnancy.** Journal of the American Heart Association 2004; 44:322-326.
26) Akinloye O, Oyewole OJ, Oguntibeju OO. **Evaluation of trace elements in pregnant women with pre-eclampsia.** Afr J Biotech. 2010;9(32):5196-5202
27) Altura B, Altura B. **Magnesium ions and contraction of Vascular Smooth Muscles: relationship to some vascular diseases.** Fed. Pro.1981; 40:2672-2679.
28) Resnik L, Gupta RK, Laragh JH. **Intracellular free Magnesium erythrocytes of essential hypertension: relation to blood pressure and serum divalent Cations.** Proc. Nat Acad Sci USA 1984; 81:6511-6515
29) **American Heart Association Guidelines for cardiopulmonary resuscitation and Emergency cardiovascular care**. American Heart Association Inc 2005; 112: iv-12-iv-125
30) Abbort LG, Rude RK. **Clinical manifestations of magnesium deficiency.** Miner Electrolyte Metab 1993, 19:314-322
31) Olusanya O, Okpere EE, Ezimokhai M. **The importance of socioeconomic class in voluntary fertility in a developing country.** W Afr J Med 1985;4:205-12
32) Odigie IP, Anorlu RI, Adesiyun AE, Odum CU. **Serum Ionized magnesium levels in Normal and Pre-eclamptic women in Lagos, Nigeria.** Nig Qt J Hosp Med. 2004;14(2):178-180
33) Golmohammad lou S, Amrabi A, Yazdian M, Pashapour N. **Evaluation of serum Calcium, Magnesium, Copper, and Zinc levels in Women with Pre-eclampsia.** Iran J Med Sci December 2008; 33(4):231-234
34) Hofmeyr GJ, Lawrie TA, Atallah ÀN, Duley L. **Calcium supplementation during pregnancy for preventing hypertensive disorders and related problems (Review).** The Cochrane Library. 2011, Issue 2. Available at http://www.thecochranelibrary.com
35) Akhtar S, Begum S, Ferdousi S. **Calcium and Zinc Deficiency In Preeclamptic Women.** J Bangladesh Sco. Phsiol. 2011, 6(2):94-99
36) Sibai BM. **Prevention of Pre-eclampsia: A big disappointment.** Am J Obstet Gynecol 1998;179:1275-8
37) Fawett WJ, Haxby EJ, Male DA. **Magnesium: physiology and pharmacology.** Br J Anaesth 1999;83:302-20