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Original Research Article

Comparative study of serum calcium in pre-eclamptic and normotensive pregnant women at Federal Teaching Hospital Katsina

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ABSTRACT

Background: Studies have linked calcium to the aetiopathogenesis and prevention of preeclampsia, however, the precise mechanism involved is unclear therefore this study aimed to determine the relation between serum calcium and preeclampsia among normotensive pregnant women.
Methods: The study was a cross-section descriptive design that included 88 pregnant women with singleton fetuses all at gestational ages above 20 weeks. Socio-demographic and obstetric data were obtained using a structured self-administered questionnaire. Urinary protein estimation was detected using the dipstick measurement of clean catch midstream urine specimens and blood samples were collected for serum calcium. Statistical analysis was done using SPSS version 21.
Results: The majority of the participants 20 (45.5%) age range was between 15-44 years and the majority were also primigravida 31 (70.5%). Serum calcium level was significantly low among the study group 1.97±0.49 compared to the control 2.22±0.12. There was a significantly high systolic BP (162.11±18.01) and diastolic (104.88±16.69) among the study group with significant proteinuria.
Conclusions: This finding suggested that serum calcium could be used as a marker for preeclampsia and based on the findings of this study, serial measurements of serum calcium among women who are at risk for pre-eclampsia may be used to predict the onset and severity of preeclampsia.

Keywords: Normotensive women, Pregnancy, Serum calcium, Pre-eclamptic women

INTRODUCTION

Preeclampsia is a progressive, multisystem, and multifactorial pregnancy-specific disorder.[1] According to the World Health Organization report, it is the leading cause of maternal and fetal morbidity and mortality, particularly in developing countries.[2] Incidence of preeclampsia has been estimated at 5-14% of pregnancies worldwide, 4-18% in developing countries with an increasing trend.[3,4] It has been found that preeclampsia has more impact in developing countries where pregnant women have been reported to consume diets with lesser amounts of essential minerals and vitamins.[5] During pregnancy, inadequate nutrition might be harmful not only to the mother but also to the growing fetus.[5] The pathophysiology of preeclampsia likely involves maternal-fetal physiological perturbations.[6] The pregnant woman's body provides daily doses of 50 to 330 mg of calcium to support the developing fetal skeleton.[7] This high fetal demand for calcium is facilitated by the profound physiological interaction between mother and fetus. This additional calcium is normally provided by an increase in maternal intestinal calcium absorption. There may not be a necessary increase in dietary calcium intake.[8]

Although the exact etiology is unknown, the pathophysiological mechanism is characterized by the failure of the trophoblastic invasion of the spiral arteries,

leading to maladaptation of maternal spiral arterioles, which may be associated with increased vascular resistance of the uterine artery and a decreased perfusion of the placenta.[9,10] The implicated vascular resistance and under-perfusion of the placenta, may lead to the release of antiangiogenic factors into the maternal circulation and alter maternal systemic endothelial function to cause hypertension and other manifestations of the disease. Other contributory factors include obesity, diabetes, calcium deficiency, maternal age, and job stress.[11,12] Several studies have linked calcium to the aetiopathogenesis and prevention of preeclampsia, however, the precise mechanism involved is unclear.[13-15] Normal serum total calcium is 2.2-2.6 mmol/l (8.6-10.3 mg/dl).[16] Thus values less than 2.2 mmol/l (<8.6 mg/dl) indicate low serum calcium.[17]

While some studies showed that preeclamptic pregnant women have lower levels of serum calcium compared with normotensive pregnant women.[17-19] Other studies have shown that serum calcium seems not to differ in preeclamptic women compared to normal pregnant women.[20,21] Calcium is known to cause vasoconstriction by decreasing prostacyclin production and by increasing the vasoconstriction effect of angiotensin II and noradrenaline in the blood vessel wall.[22,23] Considering the physiological importance of calcium, it appears that alterations in these nutrients during pregnancy may be a risk and/or predisposing factor to preeclampsia. Hence the need for further investigations on the role of calcium in preeclampsia etiology.

There is a paucity of studies on the relationship between serum calcium and pre-eclampsia in Nigeria and none from Katsina state thus, the present study was designed to investigate the possible relationship between serum calcium and pre-eclampsia aetiopathogenesis among pregnant Nigerian women in Federal Medical Centre Katsina.

METHODS

This study was carried out at the department of obstetrics and gynecology of the Federal Teaching Hospital Katsina, Katsina state, northwestern Nigeria. The hospital is a tertiary health facility that provides health service delivery to citizens of the state, neighboring states as well as neighboring communities from Niger Republic.

Study population

The study included 88 preeclamptic pregnant women with singleton fetuses all at gestational ages above 20 weeks who were not on calcium or other supplements and normotensive pregnant women (controls) attending the antenatal clinic.

Study design

The study was a comparative cross-sectional design.

Procedure

Socio-demographic and obstetric data were obtained using a structured self-administered questionnaire. Clinical examinations were carried out on each consented participant which include blood pressure measurement, anthropometric data, body mass index etc. Urinary protein estimation was detected using the dipstick measurement of clean catch midstream urine specimens and blood samples were collected for biochemical assay (serum calcium) and analyzed using the spectrophotometric method. Normal total serum calcium is 2.2- 2.60 mmol/l (8.10-10.4 mg/dl).[24]

Data analysis

Statistical analysis was performed using SPSS version 21. Differences between mean values were determined using the Student's t-test, at $p<0.05$ for statistically significant differences.

RESULTS

A total of 88 respondents were involved in the study. Forty-four were pregnant women with eclampsia and severe preeclampsia, while forty-four also were age-matched control pregnant women without preeclampsia or eclampsia. The majority of the subjects were Hausa/Fulani ±(90%) while other tribes constitute 10% of the study population, the age range of the study group and control were between 15-44 years and 20 (45.5%) were between 14-20 years of age, 9 (20.5%) were 21-30 years, 7 (15.9%) are between 27-33 years of age, 6 (13.6%) are between 33-38 years of age and 2 (4.5%) were between 39-44 years (Table 1).

Table 1: Socio-demographic characteristics.

Variables	Pregnant women (%) N=44	Control (%) N=44
Age		
15-20	20 (45.5)	20 (45.5)
21-26	9 (20.5)	10 (22.7)
27-32	7 (15.9)	7 (15.9)
33-38	6 (13.6)	6 (13.6)
39-44	2 (4.5)	1 (2.3)
Education		
Primary	14 (31.8)	3 (6.8)
Secondary	16 (36.4)	27 (61.4)
Tertiary	10 (22.7)	12 (27.3)
No education	4 (9.1)	2 (4.5)
Occupation		
Employed	6 (13.6)	11 (25)
Unemployed	38 (86.4)	33 (75)
Tribe		
Hausa/Fulani	40 (90)	40 (90)
Other	4 (4)	4 (4)

From Table 2 weight and BMI of the study group were significantly higher than the control group. The result also shows a significantly high systolic BP (162.11±18.01) and diastolic (104.88±16.69) among the study group while systolic blood pressure among the control was (111.59±10.33) and diastolic was (77.36±9.05). There was significant proteinuria among the study group with only (4.5%) +1 urine protein in the control group while the remaining 42 (95.5%) have undetected protein in their urine.

Table 2: Anthropometric and vital sign parameters of respondents.

Parameters	Study group M±2SD	Control	P value
Weight (kg)	69.21±16.38	65.35±13.67	<0.001
Height (m)	1.60±0.75	1.60±0.5	0.63
BMI	31.74±5.8	25.74±5.33	<0.001
Systolic bp	162.11±18.01	111.59±10.33	<0.001
Diastolic	104.88±16.69	71.36±9.05	<0.001
Urinary protein			
3+	22 (50%)	0	
2+	22 (50%)	0	
1+	0	2 (4.5%)	
Nil	0	42 (95.5%)	

Table 3: Obstetric history and serum calcium level of respondents.

Parameters	Study group	Control	P value
Primigravida	31 (70.5%)	29 (65.9%)	
Parity			
1-2	5	8	
≥3	8	3	
No. of chirdren alive			
1-2	6	3	
≥3	7	8/87	
Number of pregnant women with low calcium	19 (43%)	3 (6.8%)	0.01
Average mean of calcium	1.97+-0.49	2.22+-0.12	<0.01
Gestational age	34.57+-3.35	35.68+-4.00	0.65

Table 3 depict the obstetric and serum calcium level of the study group and control group, there was no significant difference between the gestation age of the study group and control. However, the majority of the study group and control were primigravida 31 (70.5%), and 29 (65.9%) respectively. Serum level of calcium was significantly low among the study group 1.97±0.49 as compared to the control group 2.22±0.12 and this shows a very high percentage of people with low calcium among the study group 19 (43%) while only 3 (6.8%) have low serum calcium among healthy pregnant control women.

DISCUSSION

Pre-eclampsia has been known as a disease of theories and several theories have been implicated in its aetiopathogenesis. The study involved a total of eighty-eight participants accounting for a hundred percent response rate which are 44 cases of pregnant women with pre-eclampsia and 44 normotensive women. The majority of the participants in the study group were primigravidae, the control also had the majority of primigravidae this is because during the study patient were matched for age and parity, which explains why we had more primigravida as well in the control group. preeclampsia has been known to be commoner in primigravida.

Moreso, the weight and BMI of the study group were significantly higher than the control group and a significant difference was noted between the study group and control groups, this is similar to other studies.[25,26] These studies have shown that maternal obesity predisposes a woman to develop preeclampsia, and a relationship between increasing BMI and the risk of developing preeclampsia is well established. It is also seen that maternal high BMI is related to adverse maternal pregnancy outcomes such as preeclampsia, and eclampsia. Our finding is different from a study in which the normotensive pregnant women had a higher BMI.[20]

Mean systolic blood pressure (162.11±18.01 mmHg) and mean diastolic blood pressure (104.88±16.69 mmHg) in the study group were higher than the control group (111.59±10.33 mmHg) and (71.36±9.05 mmHg)

respectively, the difference in mean systolic and mean diastolic blood pressure in the two groups were statistically significant. This is similar to the findings by Agu et al and Sethi et al.[17,27]

Our study demonstrated a relationship between hypocalcaemia and pre-eclampsia. In our study the mean serum calcium in pre-eclamptic women was significantly lower at (1.97±0.49 mg/dl) as compared to the serum calcium level in normotensive women which was (2.22±0.12 mg/dl), there was a statistically significant difference in the level of serum calcium in the study and control groups which was <0.01. This is similar to what has been observed in other studies such as that by Agu and Okeudo in which hypocalcemia was correlated with preeclampsia.[17] Numerous other studies have also shown a similar pattern.[8,11,22,27] This finding is in contrast to other studies which have not demonstrated a relationship between hypocalcemia and preeclampsia. Ugwaja et al found in their study that there was no significant difference in the mean serum calcium in both pre-eclamptic and normotensive pregnant women.[20]

The finding of our study demonstrated a relationship between low serum calcium and the development of preeclampsia which confirmed the hypothesis that hypocalcaemia may be an etiological factor in the development of pre-eclampsia. Serum calcium is very important for metabolism at the cellular level and vital for muscle contraction, cell death and neuronal activity, making it very essential in pregnancy.

CONCLUSION

This finding suggests that serum calcium could be used as a marker for preeclampsia and based on the findings of this study, serial measurements of serum calcium among women who are at risk for pre-eclampsia may be used to predict the onset and severity of preeclampsia. Early detection and treatment of hypocalcemia may give beneficial health effects in pregnancy-induced hypertension and preeclampsia. The study highlights the need to monitor serum calcium during the antenatal period. It is hoped that this finding will contribute to the knowledge of the role of serum calcium in the pathogenesis of pre-eclampsia and possibly develop a protocol for routine serum calcium measurement and supplementation of calcium for women with hypocalcemia in pregnancy.

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