In the name of God

Shiraz E-Medical Journal
Vol. 6, No. 1 & 2, January and April 2005

http://semj.sums.ac.ir/vol6/jan2005/capreg.htm

Does Pregnancy actually affect serum calcium and inorganic phosphate levels?

Ikaraoha Chidiebere Ikechukwu*, Usoro Chinyere A.O**
Igwe Chidi Uzoma‡, Nwobu Gilbert O‡, Mokogwu Azukaego Thomas Hughs*
Okwara John Ekenedirichukwu Ж, Ukaegbu Queeneth O‡.

* Dept. of Chemical Pathology, School of Clinical Medicine, Igbinedion University, Okada, Edo State, Nigeria. ** Department of Chemical Pathology, College of Medicine, University of Calabar, Nigeria. ‡ Dept. Of Medical Laboratory Sciences, College Of Medicine, Ambrose Alli University, Ekpoma, Nigeria. Ж Department of Chemical Pathology, College Medicine, University of Ibadan, Ibadan, Nigeria.

Correspondence: C. I. Ikaraoha, Deptartment of Chemical Pathology, School of Clinical Medicine, College of Health Sciences, Igbinedion University Okada, Edo State,Nigeria. Tel.+234(803) 350-5200, E mail: iykeikaraoha@yahoo.com

Abstract:
The serum level of calcium and inorganic phosphate in pregnancy is less well defined among Black – Nigerians, than among Caucasians. This case – control study assessed the relation of serum calcium and inorganic phosphate concentrations to pregnancy in Nigerian women. Blood samples were collected by venepuncture technique from 128 pregnant women during their first, second and third trimesters. A total of 72 non – pregnant women were recruited as controls. Serum calcium and inorganic phosphate levels were determined.
Pregnant women had significantly lower serum levels of calcium and inorganic phosphate compared to controls ($P<0.000$ and $P<0.001$) respectively. There was a statistically significant progressive decrease in serum calcium and inorganic phosphate concentration from first trimester to third trimester ($P<0.000$ and $P<0.001$) respectively. Serum calcium and inorganic phosphate may be reduced during pregnancy due to inadequate dietary intake. The decrease in serum calcium and inorganic phosphate levels parallels increase in gestational age. This may result from mineral transfer from mother to developing fetus.

Key Words: Calcium, Inorganic phosphate, Nigeria, Pregnancy, Trimester.

Introduction:

There are contrasting views on the effect of gestational age on serum calcium and inorganic phosphate levels[1,2]. Calcium and inorganic phosphate are macronutrients, and are very essential for bone formation in fetus. In pregnancy, the very high circulatory concentrations of estrogen and progesterone alter the concentration of many substances in the maternal blood[3].khastigir and Studd[4] have noted that there is an increased demand for calcium and inorganic phosphate for fetal development during pregnancy. A direct linear relationship has been established between daily dietary intake of calcium and serum calcium concentration[5]. The menstrual cycle is associated with

hormonal and physiological changes in the female body. Reports on serum calcium level in pregnancy are unclear. There is inadequate information on the effect of pregnancy on Black–Nigerian women. Hence this study was designed to examine and address this gap in knowledge.

Materials and Methods:

Study Area: Calabar is the Capital of Cross Rivers State, which is among the 36 states in Nigeria. It is located in the Eastern Nigeria, and has one teaching hospital, one general hospital and several private hospitals.

Subjects: Two hundred women in first trimester pregnancy attending antenatal clinic at University of Calabar Teaching Hospital and two private hospitals were randomly selected for this study. Only 128 subjects were effectively followed up till third trimester. Majority of the subjects were indigenous to Calabar and its environs. Seventy-two (72) nulliparous non-pregnant women were selected as controls, after being subjected to pregnancy test to ensure that they were not pregnant. Both pregnant and non- pregnant groups were age – matched (20 –30 years). Questionnaire forms were used to evaluate the dietary intake and socio-economic status of the subjects.

Collection of Blood Samples: By venopuncture technique, fasting blood samples was collected from each pregnant subject during her first, second and third trimester. Blood samples were also collected from the control group. All samples were blindly coded. Serum samples were separated into aliquots and were analyzed for calcium and inorganic phosphate within 24 hours of storage at – 40^{o}C.

Method: Serum calcium and inorganic phosphate were determined using the CPC photometric method of Gitelman[6] and photometric method of Gamst et.al.,[7] respectively, employing chemical kits supplied by Human (Human Diagnostica, Germany). Humatrol quality control sample (Human Diagnostica, Germany) was used for quality assessment. The control was included in each batch of the analysis.

Statistical Analysis: The data collated was analyzed using SAS software (Cary, North Carolina)8. The students' t – test and Analysis of variance (ANOVA) were used to determine the level of significance. Inter and intra – group comparison were made. Values were taken to be significant when $P< 0.05$.

Results:

Table 1,2 and 3 show the results obtained from this study.

Pregnant women Vs controls: The mean serum levels of calcium and inorganic phosphate in pregnant women were significantly lower than in non – pregnant women ($P< 0.000$ and $P<0.001$) respectively (Table 1).

First, second Vs third trimester: There was statistically significant progressive decrease in mean serum calcium and inorganic phosphate levels in first, second and third trimester ($P<0.000$ and $P<0.001$) respectively (Table 2).

Dietary intake and socio-economic status: Only 3.9% of the pregnant women took calcium/phosphorus supplements. Non of the Low class subjects took calcium/phosphorus supplements. About 90.6% of the total pregnant women eat local vegetables on daily bases. There was low intake of dairy diets in the low class. Also 47.6% used multivitamins/iron supplements.

Table 1: Serum Calcium and Inorganic Phosphate Levels in Pregnant women and controls.

	Pregnant Women	control	t	p
Serum Calcium (mmol/L)	1.53± 0.53	2.20± 0.3	6.48	<0.000
Serum Inorganic phosphate (mmol/L)	1.04± 0.14	1.26± 0.13	5.53	<0.001

	n = 128	n = 72		

Values are mean ± SD.

Table 2: Serum Calcium and Inorganic Phosphate Levels in First Trimester, Second Trimester and Third Trimester pregnancy.

	First Trimester	Second Trimester	Third Trimester	F	P
Serum Calcium (mmol/L)	1.86±0.46	1.75±0.39	1.09±0.39	11.36	<0.000
Serum Inorganic Phosphate (mmol/L)	1.22±0.20	1.02±0.20	0.83±0.24	7.87	<0.001
	n = 128	n = 128	n = 128		

Values are mean ± SD

Table 3: Dietary intake and socio-economic status

	High class n(%)	Middle class n(%)	Low class n(%)	Total n(%)
Dairy products	12(9.4)	19(14.8)	18(14.1)	49(38.3)
Local vegetables	11(8.6)	25(119.%)	80(62.5)	116(90.6)
Calcium/phosphate Supplement	2(11.6)	3(2.3)	0(0.0)	5(3.9)
Multivitamins/Iron Supplements	12(9.4)	22(117.1)	27(21.1)	61(47.6)
n(%)	14(10.9)	28(21.9)	86(67.2)	128(100.0)

Discussion:

Serum calcium and inorganic phosphate concentrations may vary depending on the physiological, biochemical and pathological variations[3]. In the present study, there was significant decrease in serum calcium and inorganic phosphate levels in pregnant women, when compared with the non – pregnant women. This may be as a result of their utilization for fetal growth [4,9,10]. Significant decreases in serum calcium and inorganic phosphate levels with increase in gestational age was observed in this study. The decrease in serum calcium and inorganic phosphate levels was highly significant in the third trimester, when compared to the first and second trimester respectively. Olatunbosun et.al.,[2] had earlier observed a significant reduction in serum concentrations of inorganic phosphate and magnesium during the third trimester.

The significant reduction we observed in serum total calcium and inorganic phosphate in the present study could be as a result of mineral transfer from maternal circulation to the developing fetus. About 80% of the transfer occurs during the third trimester[11]. Muller et.al.,[12] also noted that calcium level increases in the fetus with increase in gestational age[1]. However our observation in this study contrast with a previous report that maternal serum calcium does not vary with increase in gestational age[1], and that there is increase in serum calcium in pregnant women compared to non – pregnant controls[13]. It should be noted that the previous observations were made in first world (advanced) countries. Assessment of dietary intake in this study by questionnaire revealed that only 38.3% of the pregnant women eat dairy products (rich in calcium /phosphorus) regularly, while barely 3.9% use calcium/phosphorus supplements. Oguntola and Akinyele [15] had earlier reported a low dietary intake of calcium (compared to the recommended daily allowance) by Nigerian adolescents during the third trimester.

Also, data collation in the present study show that majority (90.6%) of the pregnant women eat the local vegetables on regular bases. In Calabar and its environs,

indigenous pregnant women indulge in culture oriented habitual dietary intake of their local vegetables like cucumber, spinach, water-leaf and ukazi leaves (used for afan soup preparation). These vegetables contain a lot of oxalates and fibres[14]. Oxalates form insoluble calcium oxalates with dietary calcium which are eventually excreted in the faeces[14]. There is a direct linear relationship between dietary intake of calcium and its serum concentration[5]. This explains the low serum calcium level observed in pregnant women in this present study. This corroborates an earlier report that as the gestational age increases, pregnant teenagers in Northern Nigeria appear to become calcium deficient, without the expected increases in serum parathyroid hormone levels[16]. This suggests that the low level of serum calcium and inorganic phosphate reported in the present study is not as a result of hormonal (parathyroid hormone) effects. But may be basically due to inadequate dietary intake, poor absorption and transfer from maternal circulation to the developing fetus.

From this study, it could be concluded that serum calcium and inorganic phosphate levels might be reduced during pregnancy because of insufficient dietary intake. The decrease is directly proportional to increase in gestational age.

References:

1) Standley CA, Whitly JE, Mason BA, Cotton DB: Serum Ionized Magnesium Levels in Normal and Preclamptic Gestation. Obstet. Gynecol. 1997; 89: 24-7

2) Olatunbosun DA, Adeniyi FA, Adadevoh BK: Serum Calcium, Phosphorus and Magnesium Levels in pregnant and non–pregnant Nigerians. Br. J Obstet Gynaecol 1975, 82: 568 – 71.

3) Mayne P: Calcium, Phosphate and Magnesium Metabolism in: Clinical Chemistry in Diagnosis and Treatment ELSB 6th Ed. Bath Press Co. 1996; UK, Great Britian pp 179 – 188, 144

4) Khastigir G, Studd JWW: Pregnancy Associted Osteoporosis. Br J Obstet Gynaecol 1994; 101: 836 – 838

5) Easthan RD. Calcium. In: Biochemical values in clinic Medicine. 7th Ed. John wright Sons 1985; Bristol pp 66 – 70, 281 – 284.

6) Gitelman H. Anal: Biochem 1967; 20:521.

7) Gamst O, Try K: Scand J. Clin. Lab. Invest. 1980; 40:483 – 486.

8) SAS: Institute, SAS Language guide, release 6.0 Cary, NC: SAS Institute, 1988.

9) Bidlalk WR: Interrelationship of food, Nutrition, Diet and Health. J Am Coll. Nutr 1996; 15: 422 – 433.

10) Khastgir G, studd JWW, King H, Addulk H, Jones J, Carter G, Alaghsand JZ: Changes in Bone Densisty and Biochemical Markers of Bone Turnover in Pregnancy Associated Osteoporsis. Br J Obstet Gynaecol 1996; 103: 716 – 718

11) Reddy GS, Norman AW: Regulation of vitamin D Metabolism in Normal Human Pregnancy. Obstet Gynaecol 1983; 88: 170 – 173

12) Muller F, Dommergueques M, Bussieres L, Loutat JS, Loirat C, Oury JF, Angrain Y, Hegerter P, Niaudet P: Development of Human Renal function. Clin Chem. 1996; 42: 1855 – 60.

13) Paderson EB, Johneson P, Kristensen S, Rasmussen AB, Emmertsen K, Moller J, Lauritsen JG, Wohlert M: Calcium, Parathyroid hormone and Calcitonin in normal pregnancy and precldampsia. Gynecol Obstet Invest. 1984; 18: 156 –64

14) Chatterjea MN, Shine R: Metabolism of Mineral and Trace elements: Textbook of medical Biochemistry. 5th (Ed.) Jaypee Brothers medical Published Ltd., New Delhi. 2002; 531-532.

15) Oguntola CR, Akinyele IO: Food and Nutrient Intakes by Pregnant Nigerian Adolescents during the Third trimester. Nutrition 2002; 18:673-9.

16) Sanchez PA, Idisa A, Bobzom DN, Airede A, Hollis BM, Liston DE, Jone DD, Dassgupta A, Glew RH: Calcium and Vitamin D status of pregnant teenagers in Maiduguri, Nigeria. J. Natl Med. Assoc. 1997; 89: 805-11.