

## Serum calcium level as a marker of pregnancy-induced hypertension

Abdelmarouf H. Mohieldein<sup>1</sup>, Asma A. Dokem<sup>2</sup>, Yousif H M. Osman<sup>3</sup>, Hamza M. A Idris<sup>4</sup>

### Abstract:

**Background:** Regulation of intracellular calcium plays a key role in hypertension. Hypertension has been estimated to complicate 5% of all pregnancies and 11% of first pregnancies. Half of the pregnant women with hypertension have pre-eclampsia. Hypertensive disorders account for up to 40 000 maternal deaths annually.

**Objective:** To compare total serum calcium levels in pregnant women complicated with pre-eclampsia with those in normotensive control.

**Patients and Methods:** This is a case-control hospital based study carried out at Omdurman Maternity Hospital, Khartoum Teaching Hospital, and Khartoum North Teaching Hospital in Khartoum State, Sudan in the period from October 2006 to June 2007. One hundred thirty-five women were enrolled in this study. 90 women with pregnancy - induced hypertension (PIH) admitted after 20<sup>th</sup> week of pregnancy represented the study group. Forty five women with normal pregnancy, at same age; same gestational age were selected as control group.

**Results:** The mean ( $\pm$ SD) serum calcium of the study group was 8.38 $\pm$ 1.04 mg/dl, while that of the control group was 9.04 $\pm$ 1.13mg/dl (P= 0.001).

**Conclusion:** Low level of maternal total calcium may have a role in the development PIH. Therefore calcium consumption in pregnancy should be encouraged. Calcium supplement is recommended for women who live in places of low socioeconomic status as well as for women who prefer to skip milk and milk products due to personal preference.

**Key words:** calcium, pre-eclampsia, calcium supplementation, pregnancy.



### Introduction

The pregnant woman's body provides daily doses of 50 to 330 mg calcium to support the developing fetal skeleton<sup>1</sup>. This high fetal demand for calcium is facilitated by profound physiological interactions between mother and fetus<sup>2</sup>. Early studies of blood calcium levels during pregnancy in humans found a significant decrease in the total serum calcium as pregnancy progressed<sup>3</sup>.

Regulation of intracellular calcium plays a key role in hypertension<sup>4</sup>. Hypertension has been estimated to complicate 5% of all pregnancies and 11% of first pregnancies. Half of the pregnant women with hypertension have pre-eclampsia. Hypertensive disorders account for up to 40 000 maternal deaths annually<sup>5</sup>. Pregnant women who develop severe pre-eclampsia have significant lower dietary calcium intake when compared to normotensive women<sup>6</sup>. Moreover, Calcium supplement has been hypothesized to reduce chances of pregnancy-induced hypertension (PIH) and pre-eclampsia<sup>7,8</sup>.

One of the United Nations' Millennium Development Goals for 2015 is to reduce the mater-

nal mortality ratio by three-quarters<sup>9</sup>. Ninety-nine percent of maternal deaths occur in developing countries<sup>10</sup>, and the World Health Organization encourages investigations in these settings to determine the risk factors of maternal deaths. The maternal mortality ratio was 47.3 per 100,000 live births. The main causes of death were hemorrhage (30.9%), pre-eclampsia/ eclampsia (28.2%), and septic shock (10.9%)<sup>11</sup>.

PIH is a common condition in Sudanese pregnant women as observed by practicing doctors, although to our knowledge there is no published data of its prevalence in Sudan.

### Objective

The objective of this study was to compare the total serum calcium levels in pregnant women complicated with pre-eclampsia with those in normal pregnant women.

### Subjects and Methods

This is a case-control hospital based study carried out at Omdurman Maternity Hospital, Khartoum Teaching Hospital, and Khartoum North Teaching Hospital in Khartoum State, Sudan in the period from October 2006 to June 2007.

One hundred thirty-five women were enrolled in this study. Ninety women with pregnancy - induced hypertension admitted after 20<sup>th</sup> week of pregnancy represented the study group. 45 women with normal pregnancy, at same age; same gestational age were selected as the control group.

1. Associate Prof. Biochemistry Department, Faculty of Medicine, Omdurman Islamic University.

2. Postgraduate student in Biochemistry.

3. Consultant, Assistant Prof. Obse. & Gyn. Faculty of Medicine, University of Science and Technology.

4. Registrar Obse. & Gyn. Omdurman Maternity Hospital, Omdurman, Sudan.

Correspondence to: Dr. Abdelmarouf H. Mohieldein. P.O.Box 11414, Khartoum 11111, Sudan. Email: mabdeldmarouf@hotmail.com. Tel: 0922742409

**Collection of blood samples**

Three ml blood samples were drawn without use of tourniquet from forearm veins of the selected pregnant women. The collected blood was allowed to clot spontaneously in a container, followed by centrifugation at 60 rpm for 2 minutes.

**Procedure for measuring serum calcium**

Serum calcium measurement was performed with enzymatic method<sup>12</sup> using automated spectrophotometer (Biosystems 30, Spain).

**Data collection**

Pregnant women completed pre-coded questionnaires after formal consent. The questionnaires included personal information (age, number of pregnancies, level of education, calcium sources in diet).

**Statistical Data processing**

Data were fed to Statistical Package for Social sciences (SPSS). For differences in level of serum calcium t- test was performed. Level of statistical significance was set at P value < 0.05.

**Results**

1. Age at participants:

The mean age of women in the study group was 27.4±6.1 years; while that in the control group was 24.4±6.6 years (figure 1 and 2).

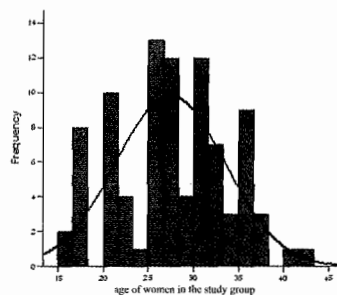


Fig 1. Histogram represented age of women in study group (mean 27.4±6.1 years)

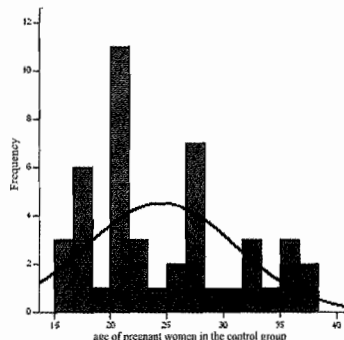


Fig 2. Histogram represented age of women in the control group (24.4±6.6 years).

2. Distribution of residence for pregnant women in study group:

All the pregnant women in the study group live in low socioeconomic areas in Khartoum state (figure 3).

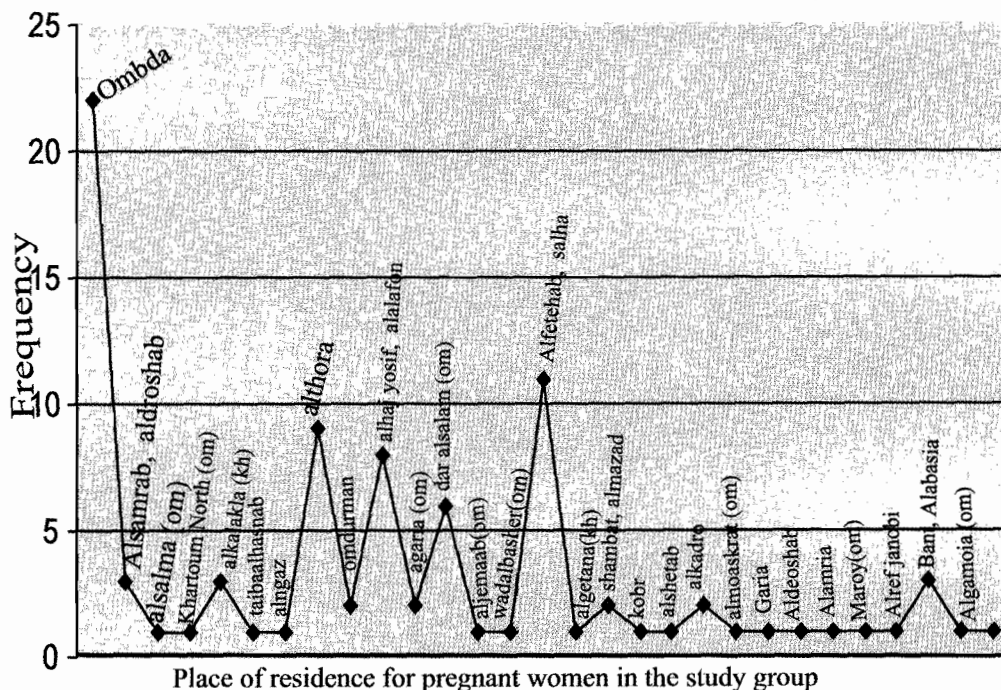


Fig 3. Distribution of residence for pregnant women in study group.

3. level of serum calcium:

The mean serum calcium of the study group was (8.38±1.04 mg %), while the mean serum calcium of the control group was (9.04±1.13mg %). There was a statistically significance difference between the two groups P= 0.001,

4. Drinking milk/having dairy products for the study group participants:

Sixty three (70%) in the study group used to drink milk about one liters /week; while 27(30%) don't drink milk at all. Moreover, 64(60%) of women in study group have dairy products namely cheese (quarter kilogram/week) and yoghurt (approximately one litre /week). Despite this data, the mean serum calcium was low compared to normotensive control.

5. Having calcium tab supplementation for the study group participants

We observed that 83 (92.22%) of the pregnant women with pregnancy-induced hypertension had never had calcium tab supplement.

**Discussion**

Pre-eclampsia; occurs in about 5 % to 10% of all pregnancies. Usually, there are three primary characteristics of this condition, including pregnancy-induced hypertension (PIH), protein in the urine, and oedema<sup>13</sup>. The exact cause of PIH has not been determined. There are many theories, but all that is known for sure is that its mediator originates in the placenta and is believed to be a woman's immunological "reaction" to the fetus and placenta<sup>14,15</sup>.

Calcium is an important component in balanced diet. It is essential for the normal growth and maintenance of bones and teeth, and calcium requirements must be met throughout life<sup>16</sup>.

During full-term pregnancy, the fetus takes approximately 30 g from the mother's calcium, at the expense of the mother's bones if calcium intake is insufficient. In addition, women who consume more calcium during pregnancy may have higher levels of calcium in their breast milk and babies born to women with higher calcium intake may have better bone mineralization and lower blood pressure in later life<sup>17</sup>.

Our study has shown that the mean serum calcium of the study group was (8.38±1.04 mg/dl), while the mean serum calcium of the control group was (9.04±1.13mg/dl). There was a statistically significance difference between the two groups P= 0.001. This result matches

previous data from epidemiological studies which suggests that an inverse relationship between calcium and incidence of pregnancy induced hypertension<sup>18,19</sup>. Our result is not in keeping with that of Trumbo PR et al<sup>20</sup> who reported that the relationship between calcium and risk of pregnancy-induced hypertension and preeclampsia is highly unlikely, inconsistent and inconclusive.

Socioeconomic status may be correlated with calcium intake. Low -income women of reproductive age were more likely to have less than the recommended dietary allowance for calcium. As seen in figure 3, all pregnant women with pregnancy-induced hypertension in this study live in places of low socioeconomic status. 70% of them use to take less than 250 ml milk/day and 60% had dairy products, but were complicated with hypertension.

The effects of dietary calcium on blood pressure regulation appear to be paradoxical, as increasing intracellular calcium increases vascular smooth muscle tone, peripheral vascular resistance, and blood pressure, while increasing dietary calcium exerts the opposite effect. The protective effect of calcium on blood pressure can be explained in part by the influence of calcitrophic hormones on intracellular calcium. 1, 25-dihydroxyvitamin D stimulates calcium influx in a variety of cells, including vascular smooth muscle cells. This effect is rapid, as it is mediated by vitamin D receptor rather than via a classical nuclear-receptor-mediated mechanism. As a consequence, 1,25-dihydroxyvitamin D exerts a repressor effect, serving to promote contraction and increase peripheral vascular resistance. Consequently, low calcium diets, which elicit a 1, 25-dihydroxyvitamin D response, would be expected to increase blood pressure, whereas high calcium diets, by virtue of suppressing 1,25-dihydroxyvitamin D levels, would be expected to reduce vascular smooth muscle cell intracellular calcium, peripheral vascular resistance and blood pressure<sup>4</sup>.

**Conclusion**

Our study suggests that the low level of maternal total calcium may have a role in the development PIH. Therefore, calcium consumption in pregnancy should be encouraged, especially during the second and third trimester of pregnancy. The calcium supplement is recommended for women who live in places of low socioeconomic status as well as for women who prefer to skip milk and milk products due to personal preference.

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