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A prospective study of some micronutrients in socioeconomic group of women with their progressive pregnancy

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Abstract

Background and Aim: Pregnancy is a very dynamic physiologic condition in which the female mammals undergo several hemodynamic, biochemical and hematological modifications. Hence the present research was designed with an intention to evaluate the biochemical status of six parameters such as Calcium, hemoglobin, phosphorus, bilirubin, ALP and iron levels across the three trimesters of pregnancy. Methods: Samples from a total of 90 pregnant patients from the Out Patient Department were collected for the study. The serum was analysed for calcium, phosphorus, alkaline phosphatase, iron, bilirubin and hemoglobin analysis was done on the spot at the OPD by using Sahli's hemoglobinometer and hence readings were obtained from record. Results: The mean age of pregnant women in first, second and third trimesters were found 2.67±0.47, 5.02±0.75, and 7.6±0.81 respectively. No significant changes were observed in calcium level in all the trimester. The phosphorus level was decreased (p=0.00002) and hemoglobin level was increased (p=0.005) in second trimester in our study population. The bilirubin level was significantly decreased in second and third trimester (p=0.02). The iron content was significantly increased (p=0.0001) in second trimester. The alkaline phosphatase concentration in significantly increased (p=0.008) in second and third trimester. Conclusion: Evidences suggested that low hemoglobin levels and anaemia can together cause still birth, preterm birth and lead to low birth weight. Calcium depletion in the mother can lead to osteoporosis in the near future. Also increased or decreased levels of various parameters in pregnancy across the three trimesters can cause multiple complications both pre- and post-labor.

Keywords: Pregnancy, biochemical parameter, hemoglobin, calcium, trimester, iron, bilirubin

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1. Introduction

Pregnancy is the carrying of one or more foetuses by female mammals, humans, inside their bodies. Pregnancy is typically broken into three periods, or each of about three months [1]. Pregnancy is a very dynamic physiologic condition in which the female mammals undergo several hemodynamic, biochemical and hematological modifications, mainly related to the adjustments of the genital system, the metabolic changes, and the fetal growth [2]. These changes during pregnancy occur as part of the physiological adaptation of the body to this condition. All the physiologic changes must be well known in order to promptly recognize abnormalities that could impair the health of the pregnant female, of the fetus, or both [3]. Among the wide variety of physiologic changes, the knowledge of the normal biochemical blood changes, as markers of organs activity and efficiency, are required [2,3].

Pregnancy is a time of increased need for calcium and magnesium. Insufficient calcium supply during pregnancy and lactation could result in maternal bone loss [4]. During gestation the average fetus requires about 30 g of

calcium, 20 g of phosphorus, and 0.8 g of magnesium to mineralize its skeleton and maintain normal physiological processes [5]. It is commonly stated that during pregnancy, the physiological fall in haemoglobin concentration (Hb) is approximately 5 g/L [6]. The pregnancy related fall in the haemoglobin concentration across gestation is in the main due to the increase in plasma volume exceeding the increase in red cell mass [7]. During pregnancy, more iron is needed primarily to supply the growing fetus and placenta and to increase the maternal red cell mass [8].

An understanding of these changes is important for the management of the health of pregnant women, as pathological deviations are not able to be distinguished from normal physiological alterations until an adverse outcome occurs. Therefore, the assessment of maternal blood parameters is essential to the management of the health of pregnant women by all obstetricians [9-11].

Hence the present research was designed with an intention to evaluate the biochemical status of six parameters such as Calcium, hemoglobin, phosphorus, bilirubin, ALP and iron levels across the three trimesters of pregnancy.

2. Materials and Methods

Samples from a total of 90 pregnant patients (30 of each trimester) from the Out Patient Department of the Department of Gynaecology and Obstetrics, Lokmanya Tilak Municipal General Hospital, Sion, Mumbai were collected for this study

The whole blood samples collected in plain were subjected to estimation of study parameter. The analysis of hemoglobin done immediately using Sahli's hemoglobinometer [12]. Rest of the blood was allowed to clot, serum was separated by centrifugation and used for analysis of calcium, phosphorus, iron, bilirubin, and alkaline phosphatase. The estimation of serum calcium is done by using *o*-cresolphthalein complexone method [13]. The concentration of phosphorus in serum was measured calorimetrically by using Fiske-subbarow method [14]. Analysis of serum iron was done by Ferrozine method in which reagent reduces iron to ferrous state. The reduced iron reacts with ferrozine reagent to faint pink color complex measured calorimetrically at 560 nm [15]. The bilirubin concentration was measured by using Evelyn and Malloy method [16]. The serum alkaline phosphatase activity was assessed using King and Arm Stronge method [17].

Biostatistical analysis

The results were collated and analyzed statistically, Mean and standard deviations were calculated for all parameters for patients as we as for control groups. ANOVA (Analysis of Variance) was carried out for statistical analysis and the p' value of significance was calculated.

3. Results

The blood samples were collected from 90 pregnant patients, 30 of each trimester. The mean age of pregnant women in first, second and third trimesters were found 2.67±0.47, 5.02±0.75, and 7.6±0.81 respectively. The detailed biochemical parameter in first, second and third trimester is depicted in table 1. F statistic was applied for deciding to support or reject the null hypothesis. In F test results, both F value and F critical value was calculated. The F critical value is a specific value which compared with F-value. In present study, the calculated F value in a test is larger than F critical value, and hence we can reject the null hypothesis.

No significant changes were observed in calcium level in all the trimester. The phosphorus level was decreased (p=0.00002) and hemoglobin level was increased (p=0.005) in second trimester in our study population. The bilirubin level was significantly decreased in second and third trimester (p=0.02). The graphical presentation is depicted in figure 1.

The iron content was significantly increased (p=0.0001) in second trimester. The alkaline phosphatase concentration in significantly increased (p=0.008) in second and third trimester. The graphical presentation of iron content and alkaline phosphatase concentration is depicted in figure 2.

Table 1: Biochemical parameters in first, second and third trimester

Parameter	First trimester	Second trimester	Third trimester	F_{crit}	F	P value
Calcium (mg%)	8.95±0.13	8.94±0.36	9.04±0.44	3.09	0.33	0.7 (ns)
Phosphorus (mg%)	4.02±0.31	3.17±0.38	3.60±0.75		11.83	0.00002*
Alkaline phosphatase (IU/L)	161.17±49.21	242.27±152.19	247.82±135.86		4.97	0.008*
Haemoglobin (g%)	9.50±0.51	10.02±0.33	9.86±0.44		5.46	0.005*
Iron (mg %)	113.39±39.89	143.41±39.30	100.35±42.09		9.64	0.0001*
Bilirubin (mg %)	0.76±0.06	0.65±0.08	0.57±0.06		4.03	0.02*

All values expressed as Mean Standard deviation, Sample size n=30 in each trimester

If F> F_{crit} data is significant; * represents significant results; p<0.05 represents level of significance

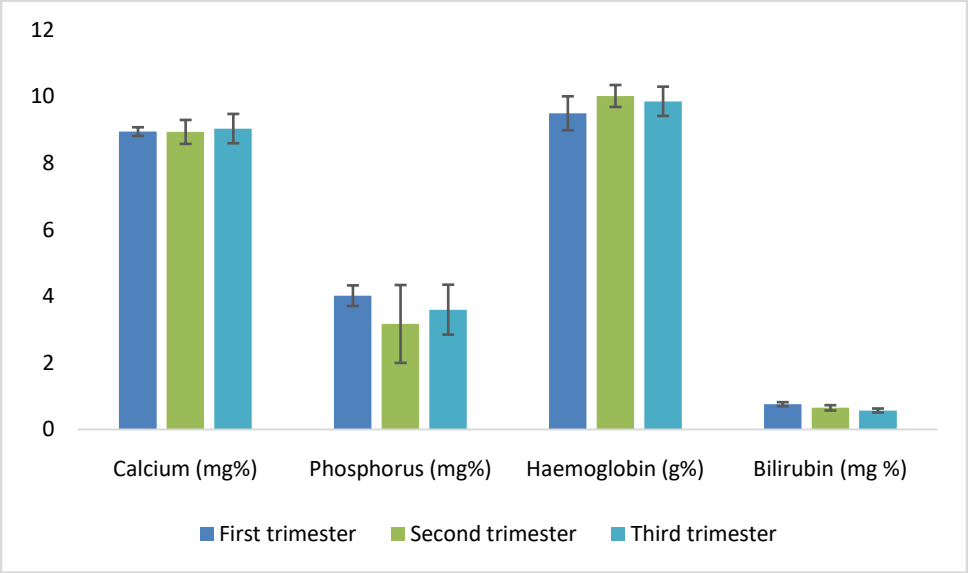

Figure 1: Graphical presentation of level of Calcium, phosphorus, haemoglobin and bilirubin in all trimester

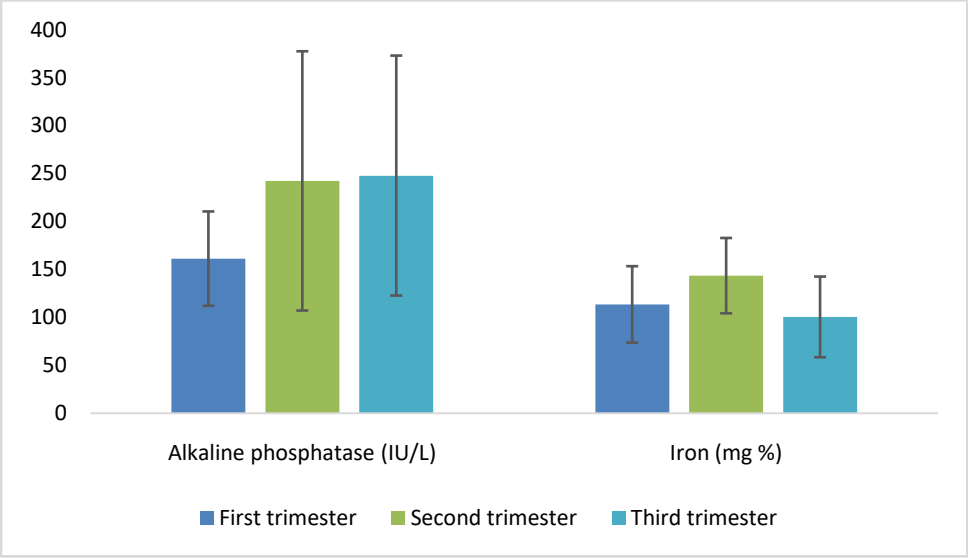

Figure 1: Graphical presentation of level of alkaline phosphatase and iron in all trimester

4. Discussion

During gestation the average fetus requires about 30 g of calcium, 20 g of phosphorus, and 0.8 g of magnesium to mineralize its skeleton and maintain normal physiological processes. Calcium provided from the maternal decidua aids in fertilization of the egg and implantation of the blastocyst; from that point onward the rate of transfer from mother to offspring increases substantially. About 80% of the calcium and phosphate present in the fetal skeleton at the end of gestation crossed the placenta during the third trimester and is mostly derived from the maternal diet during pregnancy. Intestinal calcium and phosphate absorption doubles during pregnancy, driven by 1,25-dihydroxyvitamin D (calcitriol) and other factors, and this appears to be the main adaptation through which women meet the mineral demands of pregnancy [5].

During pregnancy, the very high circulatory concentrations of estrogen and progesterone alter the concentration of many substances in the maternal blood [18]. Maternal blood calcium and phosphate level found to vary in different trimesters [19-21]. Lower maternal serum calcium level was found to be associated with pregnancy induced hypertension and pre-eclampsia, and calcium supplementation was suggested to circumvent the plausible conditions [22,23]. Lower bone calcium and phosphate is associated with increased risk of maternal bones fracture. Data are lacking regarding the serum calcium status of pregnant women in different trimesters.

However, Akhter et el [24] and Sultana *et al* [25] have measured serum calcium level in third trimester. They have demonstrated lower serum calcium level during pregnancy. In the present study no significant changes were

observed in calcium level in all the trimester. While phosphorus level was decreased (p=0.00002) in second trimester and increased in third trimester. It was hypothesized that serum phosphate level falls during pregnancy due to low intake, hypoalbuminemia and increase demand for fetal growth [26].

Red blood cells are primarily formed in the bone marrow, and their production is highly affected by pregnancy. Anemia is a disease condition in which the red blood cell concentration was lower than the recommended point, a hemoglobin concentration lower than 11.6 g/dl (gram per deciliter) in the first trimester, 9.7 g/dl in the second trimester, and 9.5 g/dl in the third trimester labelled as anemia for pregnant women [27,28].

In present study, the hemoglobin concentration was found 9.50±0.51, 10.02±0.33, 9.86±0.44 in first, second and third trimester respectively. Iron is essential for the production of hemoglobin, which functions in the delivery of oxygen from the lungs to the tissues of the body, and for the synthesis of iron enzymes, which are required to utilize oxygen for the production of cellular energy [29].

In present study the iron contents were found 113.39±39.89, 143.41±39.30 and 100.35±42.09 in first, second and third trimester respectively. It was also revealed that in second trimester the level of iron was increased and hence the hemoglobin concentration also increased.

Alkaline phosphatase is known to be produced by syncytiotrophoblasts in the placenta and its levels are normally increased in pregnancy. During pregnancy alkaline phosphatase is known to gradually increase, reaching a peak in the third trimester that is around twice its pregestational value [30]. Similar observation was found in the present study that is 161.17±49.21, 242.27±152.19 and 247.82±135.86 in first, second and third trimester respectively. During a normal pregnancy in liver function test alkaline phosphatase activity increases due to added placental secretion. The aminotransferase concentrations (alanine and aspartate), bilirubin, and gamma-glutamyltranspeptidase (GGT) and prothrombin time all remain normal throughout pregnancy. Their increase in pregnancy is always pathological, and should be further investigated [31]. In present study the concentration of bilirubin was 0.76±0.06, 0.65±0.08 and 0.57±0.06 in first, second and third trimester respectively.

5. Conclusion

During pregnancy, serum calcium and whole blood hemoglobin levels decreased, serum phosphorus and bilirubin levels remain constant and serum ALP and iron increased. Evidences suggested that low hemoglobin levels and anaemia can together cause still birth, preterm birth and lead to low birth weight. Calcium depletion in the mother can lead to osteoporosis in the near future. Also increased or decreased levels of various parameters in pregnancy across the three trimesters can cause multiple complications both pre- and post-labor. Therefore, in pregnancy, serum calcium and iron levels need to be monitored carefully and appropriate treatment and medication need to be taken along with a balanced and nutritious diet in order to prevent complications in pregnancy.

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