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## RESEARCH ARTICLE

# COMPARATIVE STUDY OF SERUM CALCIUM IN PREGNANCY ASSOCIATED HYPERTENSION AND NORMAL PREGNANCY-A PROSPECTIVE STUDY

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**ABSTRACT**

***Background:*** Gestational hypertension, also referred to as pregnancy-induced hypertension, is a condition where pregnant women develop high blood pressure after the 20th week of pregnancy without showing proteinuria. During pregnancy, a high need for calcium can reduce calcium secretion in breast milk, leading to decreased bone mineralization for both the mother and the baby. Pregnancy-specific multisystem disorder (PIH) is characterized by edema, high blood pressure, and is a component of preeclampsia and eclampsia. Preeclampsia is a more severe form of PIH that also involves proteinuria and can cause organ damage. Eclampsia is a rare but serious complication of preeclampsia that involves seizures. Regular prenatal care is important to monitor and manage any potential pregnancy-related complications. ***Methods:*** We conducted a one-year prospective observational study involving 100 pregnant women who were admitted to the antenatal ward at the Government Medical College in Srinagar, Jammu and Kashmir. To be included in the study group, women had to be over the age of 20 with a singleton pregnancy and more than 20 weeks pregnant. They also had to have been diagnosed with pre-eclampsia, which was defined as having a blood pressure of ≥140/90mmHg on two separate occasions six hours apart, proteinuria of more than 300mg in 24-hour urine or 1+ dipstick in 2 midstream urine samples collected four hours apart, with or without edema, and at more than 20 weeks of gestational age. The control group consisted of women between the ages of 20 and 40 with a singleton pregnancy, more than 20 weeks of gestational age, a blood pressure of ≤130/80 mmHg, and who were either primi- or multigravidas. ***Results:*** The study compared the characteristics of cases and controls. The mean age of cases was 26.015 years with a standard deviation of 4.51 years, while the mean age of controls was 26.450 years with a standard deviation of 4.82 years. The mean gestational age of cases was 34.230 weeks with a standard deviation of 3.02 weeks, and the mean gestational age of controls was 33.120 weeks with a standard deviation of 3.59 weeks. Among cases, 60% were primiparous and 40% were multiparous, while among controls, 55% were primiparous and 45% were multiparous. The mean systolic blood pressure of cases was 150 mm/Hg with a standard deviation of 7.124 mm/Hg, and the range was between 135 mm/Hg and 165 mm/Hg. The median systolic blood pressure of cases was 151 mm/Hg. The mean systolic blood pressure of controls was 120 mm/Hg with a standard deviation of 10.20 mm/Hg, and the range was between 115 mm/Hg and 130 mm/Hg. The median systolic blood pressure of controls was 120 mm/Hg. The mean diastolic blood pressure of cases was 98.9 mm/Hg with a standard deviation of 6.03 mm/Hg, and the range was between 90 mm/Hg and 110 mm/Hg. The median diastolic blood pressure of cases was 100 mm/Hg. The mean diastolic blood pressure of controls was 75.90 mm/Hg with a standard deviation of 4.45 mm/Hg, and the range was between 60 mm/Hg and 80 mm/Hg. The median diastolic blood pressure of controls was 76 mm/Hg. The mean serum calcium level of cases was 8.53 mg/dL with a standard deviation of 0.450 mg/dL, and it ranged between 8-9.6 mg/dL. The median serum calcium level of cases was 8.550 mg/dL. The mean serum calcium level of controls was 9.30 mg/dL with a standard deviation of 0.5350 mg/dL, and it ranged between 8.4-10.6 mg/dL. The median serum calcium level of controls was 9.050 mg/dL. The study showed that cases had lower mean serum calcium levels compared to controls. ***Conclusion:*** The study did not explicitly state a conclusion. However, based on the data presented, regular monitoring of serum calcium levels in pregnant women may be beneficial in diagnosing and managing any issues that arise. This could potentially help to prevent maternal morbidity and mortality and lead to better outcomes in pregnancy.



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# INTRODUCTION

Pregnancy-induced hypertension (PIH) or gestational hypertension occurs when a pregnant woman experiences newly diagnosed hypertension after 20 weeks of gestation without proteinuria. To diagnose PIH, the woman's blood pressure should be more than 140/90 mm of Hg on at least two occasions six hours apart[1]. Hypertensive disorders are the second most common medical disorder in pregnancy and contribute significantly to maternal mortality and morbidity, along with infection and hemorrhage[2]. PIH is a multisystem disorder specific to pregnancy that presents with edema and elevated blood pressure and is a component of preeclampsia and eclampsia[3]. Preeclampsia is common in pregnancy and is highly correlated with maternal and perinatal morbidity and mortality[4]. In developed countries, early diagnosis, prevention, and treatment have made hypertensive disorders non-serious, but developing countries such as India still report high incidence rates of PIH[5]. During pregnancy, the mother undergoes various physiological changes, including cardiovascular and renal function changes, to accommodate the changing needs of the mother and fetus. The requirement for calcium during pregnancy is very high, and its deficiency can lead to demineralization of the maternal skeleton, stunted fetal growth, reduced mineralization of fetal bones, and a decrease in calcium secretion in breast milk[6]. Approximately 25-30 g of calcium is transferred from the mother to the fetal skeleton by the end of pregnancy, starting at a rate of 2-3 mg/day in the first trimester and increasing to 250 mg/day by the end of the third trimester[7]. Calcium loss in breast milk during lactation is around 200-240 mg/day, causing the mother to lose 3-5% of maternal skeletal calcium content[8,9]. Initial studies on calcium in pregnancy suggested that high calcium intake could reduce the incidence of PIH, but the actual reason for this could not be established[10]. There are not many studies on the role of serum calcium levels in pregnancy among the Indian population. Therefore, the present study aims to assess the levels of calcium in normal pregnant women and those with pregnancy-associated hypertension.

# METHODS

In this study, we observed 100 pregnant women and divided them into two groups. The first group consisted of 50 women with normal pregnancies, and the second group included 50 women with pregnancy-associated hypertension. We collected data from these women over a period of one year, with ethical clearance obtained from the institution's ethical committee. To be included in the study group, patients had to be over the age of 20, have a singleton pregnancy, be at more than 20 weeks gestational age, and meet the diagnostic criteria for pre-eclampsia, which includes a blood pressure of 140/90mmHg on two separate occasions six hours apart, proteinuria of more than 300mg in 24 hour urine or 1+dipstick in 2 midstream urine samples collected 4 hours apart, and the presence of edema. In the control group, patients had to be between the ages of 20-40 years, have a singleton pregnancy, be at more than 20 weeks gestational age, and have a blood pressure of ≤ 130/80 mmHg. Patients with multiple gestations, gestational age less than 20 weeks, and associated co-morbidities like gestational diabetes mellitus, chronic hypertension, heart disease, and renal disease were excluded from the study.

**Data analysis:** Statistical analysis of the data was carried out with the help of SSPS software version 20.0. $p<0.05$ was considered significant.

# RESULTS

**Age distribution:** The average age of the participants in the study group is 26.015 years with a standard deviation of 4.51 years. The median age of the study group is 26 years, with an age range between 20 and 40 years.

The average age of the participants in the control group is 26.450 years with a standard deviation of 4.82 years. The median age of the control group is also 26 years with an age range between 20 and 40 years. The statistical analysis using Student t-test indicates that there is no significant difference in age between the two groups, with a p-value greater than 0.05. Table no. 1

**Table 1. Age distribution of study participants**

| S.no | Age (years) | cases | control |
|---|---|---|---|
| 1 | mean | 26.015 | 26.450 |
| 2 | median | 26.0 | 26.0 |
| 3 | Std.deviation | 4.51 | 4.82 |
| 4 | minimum | 20.0 | 40.0 |
| 5 | Maximum | 40.0 | 40.0 |

**Gestational Age of the participants:** The average gestational age of the pregnancy-associated hypertension group is 34.230 weeks with a standard deviation of 3.02 weeks, and a median gestational age of 35 weeks. The range of gestational age in this group is between 26 and 40 weeks. The control group has an average gestational age of 33.120 weeks with a standard deviation of 3.59 weeks, and a median gestational age of 33.250 weeks. The range of gestational age in the control group is between 24 and 40 weeks. Table no. 2.

**Table 2. Gestational age of the participants**

| S.no | Gestational age(weeks) | cases | controls |
|---|---|---|---|
| 1 | Mean | 34.230 | 33.120 |
| 2 | Median | 35.00 | 33.250 |
| 3 | Std. deviation | 3.02 | 3.59 |
| 4 | Minimum | 26 | 40 |
| 5 | maximum | 24 | 40 |

**Parity of the participants:** In cases, 60% of them were primi while 40% of them were multiparous. In controls, 55% of them were primi while 45% of them were multiparous shown in table 3.

**Table 3. Parity of the participants**

| S.no | parity | Cases (n %) | Control (n %) |
|---|---|---|---|
| 1 | multi | 40 | 45 |
| 2 | primi | 60 | 55 |
| | total | 100 | 100 |

**Systolic BP of the participants:** The mean systolic BP of cases is 150 mm/hg (S.D=7.124 mm/Hg). The range was between 135 mm/Hg and 165 mm/Hg. The median systolic BP of cases is 151mm/Hg. The mean systolic BP of controls is 120mm/hg (S.D=10.20 mm/Hg). The range was between 115 mm/Hg and 130 mm/Hg. The median systolic BP of controls is 120 mm/Hg shown in table 4.

**Table 4: systolic BP of the participants**

| S.no | Systolic BP | Cases | Controls |
|---|---|---|---|
| 1 | Mean | 150.750 | 120.225 |
| 2 | Median | 151.00 | 120.00 |
| 3 | Std. deviation | 7.124 | 10.20 |
| 4 | Minimum | 135.0 | 115.0 |
| 5 | maximum | 165.0 | 130.0 |

**Diastolic BP of the participants:** The mean diastolic BP of cases is 98.9 mm/hg (S.D=6.03 mm/Hg). The range was between 90 mm/Hg and 110 mm/Hg. The median diastolic BP of cases is 100 mm/Hg.
The mean diastolic BP of controls is 75.90mm/hg (S.D=4.45 mm/Hg). The range was between 60 mm/Hg and 80 mm/Hg. The median diastolic BP of controls is 76 mm/Hg.shown in table 5.

**Table 5. Diastolic BP of participants**

| S.no | Diastolic BP | cases | controls |
|---|---|---|---|
| 1 | mean | 98.94 | 75.90 |
| 2 | median | 100 | 76.00 |
| 3 | Std.Deviation | 6.03 | 4.45 |
| 4 | Range | 90-110 | 60-80 |

**Serum calcium levels:** The mean serum calcium level of cases is 8.53 mg/dl (S.D=0.450 mg/dl). The median serum calcium level of cases is 8.550 mg/dl. It ranges between 8-9.6 mg/dl. The mean serum calcium level of controls is 9.30mg/dl (S.D=0.5350 mg/dl). The median serum calcium level of controls is 9.050 mg/dl. It ranges between 8.4-10.6 mg/dl. Mean serum calcium levels between cases and controls shows that the mean serum calcium is lower in cases. The difference is statistically highly significant ($p<0.005$).shown in table 6

**Table 6. Serum calcium of participants**

| S.no | Serum calcium (mg/dl) | cases | controls |
|---|---|---|---|
| 1 | Mean | 8.53 | 9.30 |
| 2 | Median | 8.550 | 9.050 |
| 3 | Std.Deviation | .0450 | .5350 |
| 4 | Range | 8-9.6 | 8.4-10.6 |

# DISCUSSION

Pregnancy induced hypertension, also known as gestational hypertension, is characterized by high blood pressure that occurs after 20 weeks of pregnancy and is not accompanied by proteinuria. During pregnancy, the maternal system undergoes complex physiological adaptations to support the growing fetus. Adequate calcium levels are crucial during pregnancy as its deficiency can cause various complications[11].The way that calcium is processed in vascular smooth muscle cells is significantly altered in preeclampsia, a condition that can arise during pregnancy. During pregnancy, the concentration of calcium inside cells increases, and this effect is exaggerated in women with preeclampsia due to a significant increase in membranous calcium content. Calcium has various mechanisms that can lower blood pressure, including stimulating the release of parathyroid hormone and renin from the kidneys. This leads to an increase in intracellular calcium concentration, particularly in vascular smooth muscle cells, causing vasoconstriction[12]. When serum calcium is low, the production of other vasoactive agents such as nitric oxide, prostacyclines, and angiotensin is affected. Additionally, calcium can also modulate oxidative stress, contributing to the development of preeclampsia[13]. Abnormal placenta development in preeclampsia leads to decreased activation, increased catabolism, and impaired placental uptake of vitamin D, which results in inadequate calcium absorption, decreased serum calcium levels, and a secondary rise in parathyroid hormone. Our study showed that the average level of serum calcium was considerably lower in cases compared to the control group. Furthermore, we observed a negative correlation between serum calcium and both systolic and diastolic blood pressure in patients with pregnancy-induced hypertension (PIH). These results indicate a significant link between a lack of this mineral and the development and advancement of PIH[14].Our findings are similar to many former studies by Onyegbule *et al*,[15] Sultana *et al*,[16] and Moholkar *et al*.[17] In contrast, some researchers did not demonstrate significant difference between the two groups.[18,19]The differences in the results of various studies could be attributed to factors such as genetic variations among the study population, differences in sample collection methods, sample storage and processing, and variations in the analytical methods used. Based on our study, we can conclude that there is a significant association between hypocalcemia and PIH, and that serum calcium may play a role in the development of PIH.

# CONCLUSION

The study suggests that monitoring serum calcium levels may be beneficial for early detection and management of PIH, which could ultimately lead to better maternal outcomes in pregnancy. Therefore, the regular monitoring of serum calcium levels may be a useful tool in preventing maternal morbidity and mortality associated with PIH.

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