

COMPARISON OF SERUM MAGNESIUM LEVEL BETWEEN PRE-ECLAMPTIC AND NORMOTENSIVE PREGNANT PATIENTS

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Abstract

Background: Pre-eclampsia is a leading cause of maternal and perinatal morbidity and mortality worldwide. **Objective:** This study was conducted to compare serum magnesium levels between pre-eclamptic and normotensive pregnant women. **Methodology:** This descriptive cross-sectional study was conducted at the Department of Gynaecology & Obstetrics, Sir Ganga Ram Hospital, Lahore, from November 2024 to June 2025. A total of 355 pregnant women were enrolled using non-probability consecutive sampling. Inclusion criteria were age 18–45 years, gestational age ≥ 28 weeks, singleton pregnancy, and presentation for routine antenatal visits. Women with systemic diseases or on drugs affecting calcium/magnesium metabolism were excluded. Participants were divided into two groups: pre-eclamptic and normotensive. **Results:** Out of the 355 participants, 82 (23.1%) were pre-eclamptic and 273 (76.9%) were normotensive. Mean serum magnesium level was significantly lower in pre-eclamptic women (1.52 ± 0.23 mg/dL) compared to normotensive women (1.84 ± 0.27 mg/dL, $p < 0.001$). Low magnesium (< 1.7 mg/dL) was observed in 69.5% of pre-eclamptic women versus 23.4% of normotensive women. Severity analysis showed that women with severe pre-eclampsia had lower serum magnesium levels (1.44 ± 0.25 mg/dL) compared to those with mild disease (1.58 ± 0.20 mg/dL, $p = 0.02$). **Conclusion:** It is concluded that serum magnesium levels are significantly reduced in pre-eclamptic women compared to normotensive pregnant women, with lower levels linked to greater disease severity and adverse maternal outcomes. Routine monitoring of magnesium during antenatal care may be valuable for early risk detection. Further prospective studies are recommended to explore the preventive role of magnesium supplementation in pre-eclampsia.

INTRODUCTION

Preeclampsia is a condition characterized by a widespread dysfunction of the vascular endothelium and excessive contraction of the blood vessels, both of which typically manifest after the 20th week of gestation and can even persist up to 4–6 weeks postpartum [1]. It is noteworthy that the global prevalence of preeclampsia has been approximated to range between 5% and 14% of all pregnancies. Moreover, in developing countries, the incidence of this disorder has been reported to be as high as 4% to 18%, with hypertensive disorders emerging as the second most prevalent obstetric cause of stillbirths and early neonatal deaths [2]. It is important to understand that the pathophysiology of preeclampsia is likely to involve a complex interplay of various factors originating from both the maternal and fetal realms [3]. Preeclampsia, a condition characterized by an exaggerated inflammatory response and inadequate endothelial activation, is often accompanied by the activation of the coagulation cascade, leading to the formation of microthrombi and subsequent compromised blood flow to vital organs [4]. Numerous clinical studies have shed light on the intricate relationship between the exacerbation of hypertension and alterations in the maternal serum levels of diverse minerals during the course of pregnancy. In the context of developing countries, the impact of preeclampsia has been particularly significant, as the diet of pregnant mothers often lacks the essential minerals and vitamins necessary for optimal health and well-being [5]. The scarcity of these vital nutrients in the diets of expectant mothers in these countries further exacerbates the already challenging situation, potentially contributing to the increased prevalence and severity of preeclampsia [6]. Therefore, addressing the issue of inadequate mineral and vitamin intake among pregnant women in developing countries is of paramount importance in mitigating the burden of preeclampsia and improving maternal and fetal outcomes. Efforts should be focused on implementing interventions that aim to enhance the availability and accessibility of nutrient-rich foods, as well as promoting education and awareness regarding the importance of a balanced and nutritious diet during pregnancy [7]. By addressing these underlying factors, it is possible to reduce the incidence and impact of preeclampsia, ultimately

contributing to better maternal and fetal health outcomes in these resource-limited settings [8].

Poor food intake is a setback to both mother and the baby. Past studies have established a significant reduction in the levels of serum magnesium in pregnant women with pre-eclampsia. This result is consistent with the physiological role of magnesium, that is, being an essential intracellular compound and the key cofactor in activation of many enzymes. Magnesium has a prominent role in blood pressure perceptual regulation, because it can affect the contractility and blood vessel tone. Serum magnesium levels were found significantly lower in the pre-eclampsia expecting women in comparison to the healthy expecting women (1.72 ± 0.38 mg/dl Vs 2.2 ± 0.63 mg/dl, $p < 0.05$) [9]. In another study, serum magnesium was 1.27 ± 0.35 mg/dl in preeclampsia group and 2.09 ± 0.52 mg/dl in control group. Magnesium in serum was significantly low in preeclampsia group as observed in comparison with control group [10]. In another research, the average serum magnesium level was 3.37 ± 2.05 mg/dl in the preeclampsia group, and 2.87 ± 1.38 mg/dl normul pregnant women; the results were not significant different between the preeclampsia and normal pregnant women ($p = 0.153$) [11]. The primary aim of the current study is to see that pre-eclamptic women will be characterized by lower rates of serum magnesium concentrations compared with the control group members. The existing literature is at variance and there is scarcity of local data. In the event of observing some variation in serum magnesium level between found in the pre-eclampsia and the normotensive patients, the strategies can be implemented and early assessment can be relevant.

Objective

1. To determine the frequency of pre-eclampsia in women presenting for antenatal care in a tertiary care hospital.
2. To compare the mean serum magnesium levels between preeclamptic and normotensive pregnant patients.

Methodology

This Descriptive cross-sectional study was conducted at Department of Gynaecology & Obstetrics, Sir

Ganga Ram Hospital, Lahore from November 2024 to June 2025. A total sample size of 355 pregnant women was calculated using a 95% confidence level, 4% margin of error, and an expected prevalence of pre-eclampsia of 18%. Participants were recruited through non-probability consecutive sampling.

Inclusion Criteria

- Pregnant women aged 18–45 years
- Gestational age ≥ 28 weeks, as determined by last menstrual period (LMP)
- Singleton pregnancy
- Women presenting for routine antenatal visits

Exclusion Criteria

- Patients who refused consent
- Women with systemic comorbidities such as asthma, cardiac disease, diabetes mellitus, or renal disease
- Women receiving drugs known to affect serum calcium or magnesium levels

Data Collection Procedure

Approval for the study was obtained from the Institutional Ethical Committee of Fatima Jinnah Medical University (FJMU), Lahore. After obtaining informed consent, 355 patients fulfilling the inclusion and exclusion criteria were enrolled from the obstetrics ward of Gynae Unit I, SGRH, Lahore. Confidentiality and anonymity were strictly maintained, and participants were free to withdraw at any stage. Women were screened for pre-eclampsia based on clinical criteria and were divided into two groups (unequal), i.e., pre-eclamptic patients and normotensive controls, using the lottery method. For laboratory analysis, 5 ml of venous blood was drawn aseptically from the antecubital vein into a metal-free sterile tube without anticoagulant. The samples were coded for identification, allowed to clot at room

temperature for 20–25 minutes, and then transported to the Department of Biochemistry, where serum magnesium levels were estimated using the colorimetric method. Clinical management of patients was carried out in accordance with hospital protocols in consultation with the attending physician. All study information was recorded in a predesigned proforma.

Data Analysis

Data analysis was performed using SPSS version 25. Quantitative variables such as age, gestational age, body mass index (BMI), and serum magnesium levels were expressed as mean $\pm$ standard deviation (SD). Categorical variables such as parity were presented as frequencies and percentages. An independent sample t-test was applied to compare mean serum magnesium levels between the pre-eclamptic and normotensive groups. Effect modifiers including age, gestational age, parity, and BMI were controlled through stratification. Post-stratification, a t-test was applied to assess the significance of differences, with a p-value ≤ 0.05 considered statistically significant.

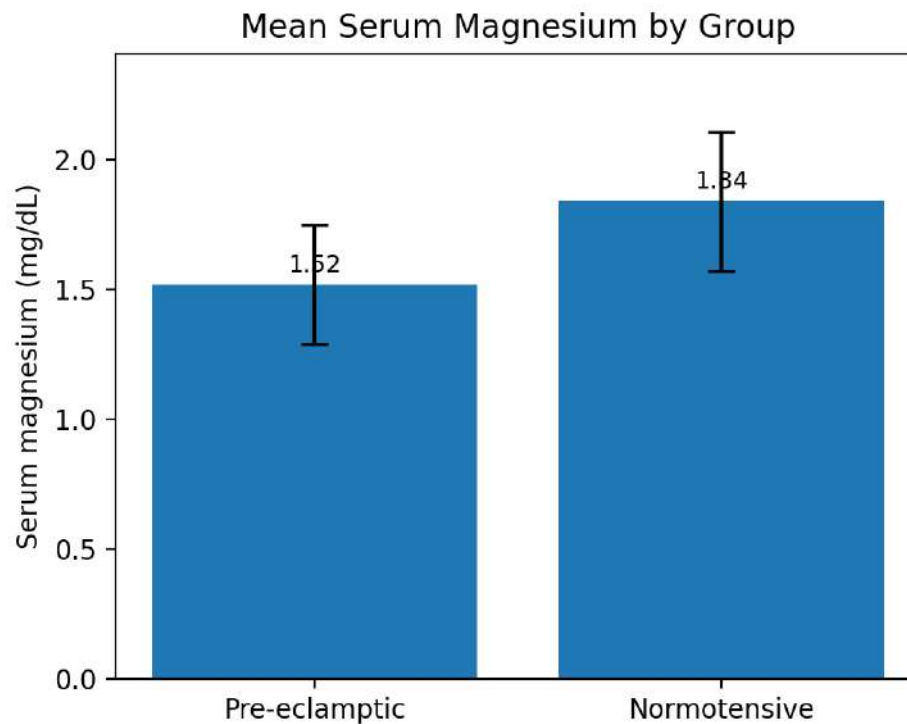
Results

Data were collected from 355 patients. The mean age of pre-eclamptic women was 29.4 ± 5.2 years, slightly higher than that of normotensive women at 27.8 ± 4.9 years. The average gestational age at presentation was also lower among pre-eclamptic patients (33.1 ± 2.9 weeks) compared to normotensive women (34.2 ± 3.1 weeks). Body mass index (BMI) was notably higher in the pre-eclamptic group (29.8 ± 3.6 kg/m²) than in the normotensive group (26.5 ± 3.2 kg/m²). Mean parity was comparable between the groups. Importantly, serum magnesium levels were significantly lower in pre-eclamptic women (1.52 ± 0.23 mg/dL) compared to normotensive women (1.84 ± 0.27 mg/dL).

Table 1. Baseline Demographic and Clinical Characteristics of Study Participants (n = 355)

Variable	Pre-eclamptic (n = 82)	Normotensive (n = 273)	Total (n = 355)
Age (years), mean $\pm$ SD	29.4 ± 5.2	27.8 ± 4.9	28.2 ± 5.0
Gestational age (weeks), mean $\pm$ SD	33.1 ± 2.9	34.2 ± 3.1	34.0 ± 3.0
BMI (kg/m ²), mean $\pm$ SD	29.8 ± 3.6	26.5 ± 3.2	27.2 ± 3.5
Parity, mean $\pm$ SD	2.1 ± 1.3	2.4 ± 1.5	2.3 ± 1.4

Serum Magnesium (mg/dL), mean $\pm$ SD	1.52 $\pm$ 0.23	1.84 $\pm$ 0.27	1.77 $\pm$ 0.28
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Serum Magnesium Levels in Pre-eclamptic vs Normotensive Pregnant Patients

On stratification, younger women (≤ 30 years) had slightly higher magnesium levels (1.68 ± 0.28 mg/dL) compared to those >30 years (1.62 ± 0.26 mg/dL), though the difference was not significant. Women with gestational age >34 weeks had higher magnesium levels (1.72 ± 0.27 mg/dL) than those at 28–34 weeks (1.64 ± 0.25 mg/dL), and this difference reached statistical significance ($p=0.04$). Similarly, women with BMI <25 kg/m² had higher magnesium levels (1.76 ± 0.24 mg/dL) than those with BMI ≥ 25 kg/m² (1.63 ± 0.26 mg/dL), showing a significant association ($p=0.01$).

Table 2. Stratification of Serum Magnesium Levels by Age, Gestational Age, BMI, and Parity

Variable	Category	Mean Magnesium (mg/dL) $\pm$ SD	p-value
Age (years)	≤ 30	1.68 ± 0.28	0.12
	>30	1.62 ± 0.26	
Gestational age (weeks)	28–34	1.64 ± 0.25	0.04
	>34	1.72 ± 0.27	
BMI (kg/m ²)	<25	1.76 ± 0.24	0.01
	≥ 25	1.63 ± 0.26	
Parity	Primigravida	1.65 ± 0.27	0.21
	Multigravida	1.70 ± 0.26	

Among pre-eclamptic patients, 69.5% had low serum magnesium (<1.7 mg/dL), compared to only 23.4% of normotensive women. In contrast, normal magnesium levels were observed in 30.5% of pre-eclamptic patients versus 76.6% of normotensive women.

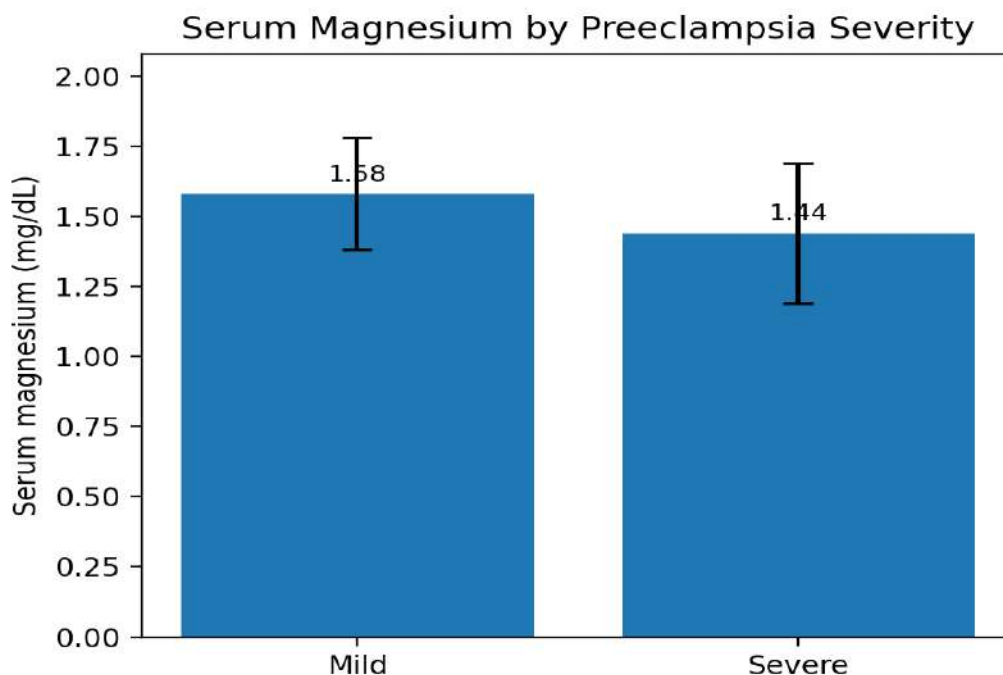
Table 3. Frequency Distribution of Serum Magnesium Levels in Pre-eclamptic and Normotensive Patients

Serum Magnesium Status	Pre-eclamptic (n=82)	Normotensive (n=273)	Total (n=355)	p-value
Low (<1.7 mg/dL)	57 (69.5%)	64 (23.4%)	121 (34.1%)	<0.001
Normal (≥1.7 mg/dL)	25 (30.5%)	209 (76.6%)	234 (65.9%)	

Within the pre-eclamptic group, patients with severe disease had markedly lower magnesium levels (1.44 ± 0.25 mg/dL) compared to those with mild disease (1.58 ± 0.20 mg/dL). The difference was statistically significant ($p=0.02$), indicating that lower magnesium levels correlated with increased disease severity.

Table 4. Association Between Severity of Pre-eclampsia and Serum Magnesium Levels (n=82)

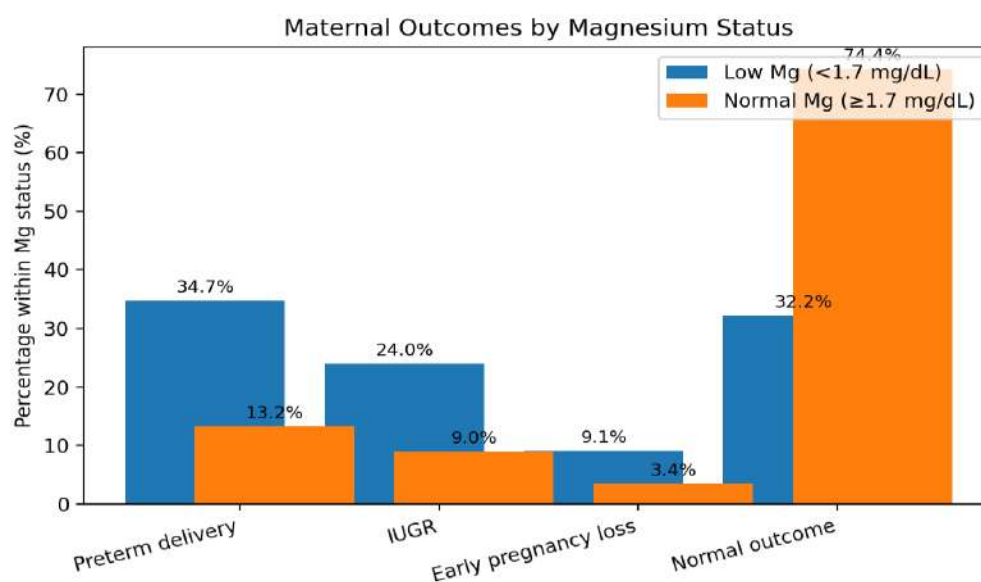
Severity of Pre-eclampsia	n (%)	Mean Magnesium (mg/dL) $\pm$ SD	p-value
Mild	46 (56.1%)	1.58 ± 0.20	0.02
Severe	36 (43.9%)	1.44 ± 0.25	



Preterm delivery occurred in 34.7% of women with low magnesium compared to 13.2% of those with normal magnesium levels ($p<0.001$). Similarly, intrauterine growth restriction (IUGR) was significantly higher in the low magnesium group (24.0% vs 9.0%, $p=0.001$). Early pregnancy loss was also more frequent among women with low magnesium (9.1% vs 3.4%, $p=0.04$). Conversely, normal pregnancy outcomes were observed in 74.4% of women with normal magnesium but only in 32.2% of those with hypomagnesemia ($p<0.001$).

Table 5. Maternal Outcomes in Relation to Serum Magnesium Levels (n=355)

Maternal Outcome	Low Magnesium (<1.7 mg/dL) (n=121)	Normal Magnesium (≥1.7 mg/dL) (n=234)	p-value
Preterm delivery	42 (34.7%)	31 (13.2%)	<0.001
Intrauterine growth restriction (IUGR)	29 (24.0%)	21 (9.0%)	0.001
Early pregnancy loss	11 (9.1%)	8 (3.4%)	0.04
Normal outcome	39 (32.2%)	174 (74.4%)	<0.001



Discussion

In this study, we compared serum magnesium levels between pre-eclamptic and normotensive pregnant women and found that pre-eclamptic patients had significantly lower serum magnesium concentrations. This result confirms the previous idea that hypomagnesemia can be included and refer to the pathogenesis of pre-eclampsia, either as a cause or the end result of maternal metabolism during pregnancy. We found the means serum magnesium to be 1.52 ± 0.23 mg/dL in pre-eclamptic women versus 1.84 ± 0.27 mg/dL in the normotensive women; the difference was statistically significant ($p < 0.001$). Also, about 70 percent of the pre-eclamptic patients were reported to have a low serum magnesium (<1.7 mg/dL) as opposed to 23 percent of the normotensive women. This indicates that hypomagnesemia might be not only correlated with the onset of pre-eclampsia, but it also can implicate prognostic factors [12]. A number of earlier studies are consistent with our findings. In another study, case-control study In India, the serum magnesium level was found significantly lower in pre-eclamptic patients than their normotensive controls and this indicates its potential contribution to vascular responsiveness and blood pressure management [13]. The ability of lower serum magnesium concentration to contribute to the disease mechanism, as evidenced by reduction of vasospasm, endothelial dysfunction and platelet aggregation, as suggested by Nigerian

and Egyptian studies, supports the plausibility of magnesium deficiency in pre-eclampsia, as well [14]. Not all studies have concurred however. Some studies have shown an insignificant variation and it has thus been argued that magnesium deficiency is not a universal characteristic but could be different depending on the population as a result of dietary intake, genetic predisposition and environmental intake. The stratification analysis indicated that hypomagnesemia was more severe in women with higher BMI as well as those who presented earlier than 34 weeks of gestation, however, no significant relationships were identified between the two factors age and parity [15]. These results show that obesity and earlier the onset of pre-eclampsia may enhance magnesium imbalance, which can lead to severity of the disease. In fact we also found that those women with severe pre-eclampsia had lower magnesium levels than those with the mild disease a possible dose response effect. These results are in line with reports that magnesium status can impact the severity of the disease and the consequences of the disease on the mother [16]. The difference between the outcomes in the mothers with low levels of magnesium in their serum was also the fact that they were prone to prepremature births, intrauterine growth retardation (IUGR), premature loss of pregnancy. This indicates the possible clinical value of assessing magnesium in the prenatal setting and particularly in high-risk

women [17]. Use of magnesium sulfate is currently the preventive and corrective measure of eclamptic onset, but our results indicate that detection of hypomagnesemia at solely the baseline level can also be utilized as an early warning indicator to alert more frequent monitoring and subsequent treatment. The strong areas of our study are a relatively large sample size and the utilization of a standardized biochemical technique to be used in quantifying magnesium levels [18]. In addition, stratification in accordance with maternal factors could permit assessment of effect modifiers. There are these limitations in the study, though. This study is cross-sectional and thus is unable to determine causality between hypomagnesemia and pre-eclampsia [19] [20]. Magnesium dietary intake was not measured and this may have affected serum levels. Also, the study was of one tertiary-care hospital, and this may hinder applicability of the study to other populations. Our results despite these limitations add to the growing evidence that the pre-eclampsia has a strong relationship with low serum magnesium and its negative pregnancy outcome. Routine screening of magnesium levels during antenatal care during pregnancy, especially of women with high BMI or early gestational hypertension, could have potential value. Future studies should be prospective studies and randomized controlled trials aimed at defining whether magnesium supplementation may have a preventive or reduction role in the occurrence or effects of pre-eclampsia.

Conclusion

It is concluded that serum magnesium levels are significantly lower in pre-eclamptic pregnant women compared to normotensive controls. This reduction in magnesium concentration is associated with greater disease severity and adverse maternal outcomes such as preterm delivery and intrauterine growth restriction. These findings highlight the potential role of hypomagnesemia in the pathophysiology of pre-eclampsia and suggest that routine monitoring of serum magnesium during antenatal care may be valuable, especially in high-risk women.

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