Section: General Medicine

Original Research Article

A STUDY ON THE SIGNIFICANCE OF SERUM MAGNESIUM LEVELS IN PREGNANCY AND ITS ASSOCIATION WITH PRE-ECLAMPSIA

N Madhu Naveen Reddy[1], Merugu Satya Pratik[2], A Raghuram Bhargavi[3], Karthik Reddy Mamidi[4]

[1]*Associate Professor Department of General Medicine, Malla Reddy Institute of Medical Sciences, India.*
[2]*Associate Professor, Department of General Medicine, Malla Reddy Institute of Medical Sciences, India.*
[3]*Associate Professor, Department of General Medicine, Malla Reddy Institute of Medical Sciences, India.*
[4]*Assistant Professor, Department of General Medicine, Malla Reddy Institute of Medical Sciences, India.*

Received *: 12/11/2025*
Received in revised form *: 27/12/2025*
Accepted *: 15/01/2026*

Corresponding Author:
Dr. Karthik Reddy Mamidi,
Assistant Professor, Department of General Medicine, Malla Reddy Institute of Medical Sciences, India.
Email: karthikreddy234@gmail.com

DOI: 10.70034/ijmedph.2026.1.92

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2026; 16 (1); 521-525

ABSTRACT

Background: Magnesium is a major intracellular divalent cation essential for numerous physiological processes, including neuromuscular conduction, vascular tone regulation, and enzymatic activity. Pregnancy is associated with significant physiological alterations in mineral metabolism, and magnesium deficiency has been implicated in adverse maternal and fetal outcomes, particularly pre-eclampsia. **Objectives:** To study the correlation between serum magnesium levels during pregnancy and the development of pre-eclampsia.

Materials and Methods: A hospital-based cross-sectional study was conducted over a period of 10 months at Mallareddy Institute of Medical Sciences. A total of 100 pregnant women across all three trimesters were enrolled based on predefined inclusion and exclusion criteria. Serum magnesium levels were estimated using the Xylidyl Blue method on a Mindray autoanalyzer. Statistical analysis was performed using descriptive statistics, Chi-square test for proportions, and Student's *t*-test for comparison of means.

Results: The majority of participants were aged 18–25 years (42%). Serum magnesium levels below 1.7 mg/dl were observed in 13%, 22%, and 30% of women in the first, second, and third trimesters respectively. Among women with pre-eclampsia, 75% had serum magnesium levels below 1.7 mg/dl. A progressive decline in magnesium levels was observed with advancing gestation.

Conclusion: Serum magnesium levels decrease progressively during pregnancy and are significantly lower in women with pre-eclampsia. Monitoring magnesium levels during pregnancy may help identify women at increased risk for hypertensive disorders and adverse outcomes.

Keywords: Magnesium, Pregnancy, Pre-eclampsia, Serum Magnesium, Hypertensive Disorders of Pregnancy.

INTRODUCTION

Magnesium is the fourth most abundant cation in the human body and the second most prevalent intracellular divalent cation after potassium. It plays a pivotal role in numerous physiological and biochemical processes, including energy metabolism, protein synthesis, nucleic acid stability, membrane transport, neuromuscular transmission, and regulation of vascular tone. Magnesium acts as a cofactor for more than 300 enzymatic reactions and is essential for maintaining normal nerve and muscle cell electrical activity.[1,2]

The total magnesium content in an adult human body ranges between 20 and 28 grams, with approximately 60% stored in bone, 26% in skeletal muscle, 13% in soft tissues, and less than 1% present in extracellular fluid and blood.[3] Despite this small circulating fraction, serum magnesium levels are tightly regulated within a narrow physiological range of 0.7–

1.0 mmol/L (1.7–2.4 mg/dl). Renal handling of magnesium, particularly reabsorption in the distal convoluted tubule mediated by the transient receptor potential melastatin-6 (TRPM6) epithelial channel, plays a key role in maintaining magnesium homeostasis.[4]

Pregnancy is characterized by profound physiological, metabolic, and hormonal changes that alter mineral metabolism. Factors such as plasma volume expansion, increased renal excretion, transplacental transfer to the fetus, and altered gastrointestinal absorption contribute to changes in maternal magnesium levels. Consequently, pregnant women may be at increased risk of developing magnesium deficiency, especially in the later stages of gestation.[5]

Magnesium has long been recognized for its therapeutic importance in obstetrics. Magnesium sulfate is widely used for the prevention and treatment of eclamptic seizures, management of severe pre-eclampsia, and as a tocolytic agent in preterm labor due to its vasodilatory, anticonvulsant, and uterine relaxant properties. Beyond its therapeutic role, adequate magnesium status during pregnancy has been associated with improved placental perfusion, reduced uterine irritability, and favorable fetal growth outcomes.[6]

Early manifestations of magnesium deficiency in pregnancy are often nonspecific and overlap with common pregnancy-related complaints such as muscle cramps, back pain, constipation, irritability, insomnia, headaches, and fatigue. If unrecognized, severe hypomagnesemia may contribute to serious complications including pre-eclampsia, fetal growth restriction, preterm labor, and fetal demise.

Pre-eclampsia is a multisystem disorder unique to pregnancy, characterized by new-onset hypertension and proteinuria after 20 weeks of gestation, and is associated with endothelial dysfunction, vasospasm, and increased maternal and perinatal morbidity and mortality.[5,6] Several studies have suggested that low serum magnesium levels may contribute to the pathogenesis of pre-eclampsia by enhancing vascular smooth muscle contractility, increasing peripheral resistance, and promoting endothelial dysfunction.[6]

Given the high burden of hypertensive disorders of pregnancy and the potential role of magnesium deficiency in their pathophysiology, evaluating serum magnesium levels during pregnancy may offer valuable insights for early identification of women at risk. This study was therefore undertaken to assess serum magnesium levels across different trimesters of pregnancy and to evaluate their association with the development of pre-eclampsia.

MATERIALS AND METHODS

This was a hospital-based cross-sectional observational study conducted in the Department of Obstetrics and Gynecology at Mallareddy Institute of Medical Sciences, a tertiary care teaching hospital catering to a diverse population. The study was carried out over a duration of 10 months. The study population consisted of pregnant women attending the antenatal outpatient department and inpatient services during their first, second, and third trimesters of pregnancy.

Sample Size

A total of 100 pregnant women were enrolled in the study based on feasibility and availability during the study period.

Inclusion Criteria

Pregnant women fulfilling the following criteria were included:

1. Age ≥18 years
2. Singleton pregnancy
3. Gestational age ranging from first trimester to term
4. Willingness to participate and provide informed consent
5. Regular antenatal follow-up and compliance
6. Planning to deliver at the same institution

Exclusion Criteria

Pregnant women were excluded if they had:

1. Pre-existing medical disorders complicating pregnancy such as chronic hypertension, diabetes mellitus, cardiac disease, renal disease, liver disorders, or congestive cardiac failure
2. Known epilepsy or seizure disorders
3. Multiple gestations
4. Current use of medications affecting magnesium metabolism, including calcium channel blockers, diuretics, or calcium- or magnesium-containing supplements

Methodology

Approval for the study was obtained from the Institutional Scientific Committee and Institutional Ethics Committee prior to commencement. Eligible participants were identified based on inclusion and exclusion criteria. Written informed consent was obtained from all participants after explaining the purpose of the study, procedures involved, and potential risks or inconveniences.

A detailed clinical history was obtained from each participant, including demographic details, obstetric history, past medical history, and relevant antenatal details. This was followed by a thorough general physical examination, systemic examination, and recording of vital parameters such as blood pressure and pulse rate.

Under strict aseptic precautions, approximately 2 ml of venous blood was collected from each participant using a sterile vacutainer. The blood samples were allowed to clot and were centrifuged to separate serum. Serum magnesium levels were estimated using the Xylidyl Blue colorimetric method on a Mindray automated analyzer.

In this method, magnesium reacts with the Xylidyl Blue reagent in an alkaline medium to form a red-colored magnesium–dye complex. The intensity of the color formed is directly proportional to the magnesium concentration in the sample and is measured spectrophotometrically at a wavelength of

600 nm. Quality control procedures were followed as per laboratory standards to ensure accuracy and reproducibility of results.

Ethical Considerations

The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki and adhered to ICH-GCP guidelines. Confidentiality of participant data was maintained throughout the study, and participation was entirely voluntary.

Statistical Analysis

All collected data were entered into a predesigned proforma and subsequently transferred to Microsoft Excel 2010 for analysis. Descriptive statistics were used to summarize demographic and clinical variables and expressed as frequencies and percentages. The Chi-square test was applied to analyze associations between categorical variables, and Student's t-test was used to compare mean serum magnesium levels. A p-value of <0.05 was considered statistically significant.

RESULTS

The total study population included 100 pregnant females visiting OBGY department of MRIMS.

Table 1: Age distribution of study population

AGE GROUP	NO. OF FEMALES	PERCENTAGE
18-25 YEARS	42	42
26-30 YEARS	36	36
>30 YEARS	22	22

The age distribution of the study population is shown in Table 1. The majority of participants belonged to the 18–25 years age group (42%), followed by 26–30 years (36%), while 22% were aged above 30 years. This reflects the predominance of younger reproductive-age women in the study population. Most pregnant women in the study were within the optimal reproductive age group, minimizing age-related confounding factors for pregnancy complications.

Table 2: Comorbidities in study population

COMORBIDITIES	NO. OF FEMALES
HYPOTHYROIDISM	21
PRE-ECLAMPSIA	12
DIABETES MELLITUS	8
OTHERS	4

Out of the total study population, 45% of women had one or more comorbid conditions (Table 2). Hypothyroidism was the most common comorbidity, affecting 21% of participants, followed by pre-eclampsia (12%) and diabetes mellitus (8%). Other conditions constituted 4% of cases. Endocrine and metabolic disorders formed the major burden of comorbidities among pregnant women, with hypertensive disorders being a significant contributor.

Table 3: Magnesium levels in first trimester

Serum Magnesium levels in second trimester	
<1.7 mg/dl	10
>1.7mg/dl	62

Serum magnesium estimation in the first trimester revealed that 10% of women had magnesium levels below 1.7 mg/dl, whereas 62% had levels ≥1.7 mg/dl. [Table 3]

The majority of women maintained normal serum magnesium levels during early pregnancy, suggesting adequate baseline magnesium status in the first trimester.

Table 4: Magnesium levels in second trimester

Serum Magnesium levels in second trimester	
<1.7 mg/dl	18
>1.7mg/dl Serum	68

In the second trimester, 18% of participants exhibited serum magnesium levels <1.7 mg/dl, while 68% had levels ≥1.7 mg/dl (Table 4). A gradual increase in the proportion of women with hypomagnesemia was observed in the second trimester, indicating a declining trend in serum magnesium levels as pregnancy progressed.

Table 5: Magnesium levels in third trimester

Serum Magnesium levels in third trimester	
<1.7 mg/dl	27
>1.7mg/dl	65

Serum magnesium estimation during the third trimester showed that 27% of women had levels below 1.7 mg/dl, while 65% maintained levels within the normal range (Table 5). The highest prevalence of hypomagnesemia was observed in the third trimester, demonstrating a progressive reduction in serum magnesium levels with advancing gestational age.

Table 6: Correlation of serum magnesium levels with preeclampsia patients

Serum Magnesium levels	Pre-eclampsia patients
<1.7 mg/dl	9
>1.7mg/dl	3

Among the 12 women diagnosed with pre-eclampsia, 9 (75%) had serum magnesium levels <1.7 mg/dl, while only 3 (25%) had levels within the normal range (Table 6). A significant proportion of pre-eclamptic women exhibited low serum magnesium levels, suggesting a strong association between hypomagnesemia and the development of pre-eclampsia.

DISCUSSION

Magnesium plays a critical role in maintaining vascular tone, neuromuscular stability, and endothelial function, all of which are central to the physiological adaptations of pregnancy. Alterations in magnesium metabolism during pregnancy have been implicated in adverse maternal and fetal outcomes, particularly hypertensive disorders such as pre-eclampsia. The present study evaluated serum magnesium levels across different trimesters of pregnancy and examined their association with the development of pre-eclampsia.

In the present study, the majority of pregnant women belonged to the 18–25 years age group (42%), followed by 26–30 years (36%). This distribution reflects the common reproductive age group in the Indian population and is comparable with other hospital-based antenatal studies.[7,8] Younger maternal age in the study population minimizes confounding effects of advanced maternal age, which is an independent risk factor for hypertensive disorders of pregnancy. Similar age distributions have been reported in Indian studies evaluating micronutrient status during pregnancy, supporting the representativeness of the study sample.[8]

Approximately 45% of participants had at least one comorbidity, with hypothyroidism being the most prevalent, followed by pre-eclampsia and diabetes mellitus. Endocrine and metabolic disorders are increasingly recognized as common comorbidities in pregnancy due to improved screening and diagnostic practices.

A nationwide cohort analysis published in 2024 reported that endocrine, metabolic, and autoimmune disorders constitute the majority of chronic conditions complicating pregnancy, with an overall prevalence of approximately 8.1%.[5,6,9] In contrast, Indian studies have reported varying prevalence rates, with thyroid disorders being the most common, followed by hypertensive disorders and diabetes mellitus. The higher prevalence of comorbidities observed in the present study may be attributed to referral bias associated with a tertiary care center and increased antenatal surveillance.[10,11]

The present study demonstrated a progressive decline in serum magnesium levels as pregnancy advanced from the first to the third trimester. In the first trimester, only 10% of women exhibited serum magnesium levels below 1.7 mg/dl, whereas this proportion increased to 18% in the second trimester and 27% in the third trimester. This trend suggests that advancing gestation is associated with an increasing risk of hypomagnesemia. These findings are consistent with earlier studies reporting a gestational age–dependent decline in serum magnesium levels.[7,8,12] The physiological basis for this decline includes plasma volume expansion leading to hemodilution, increased renal excretion of magnesium, transplacental transfer to the growing fetus, and increased maternal metabolic demands. Atiba et al. similarly reported significantly lower serum magnesium levels in the second and third trimesters among women who later developed pre-eclampsia, reinforcing the role of magnesium depletion as pregnancy progresses.[9]

In the first trimester, the majority of women in the present study maintained normal serum magnesium levels. However, a small proportion already exhibited hypomagnesemia, which may represent a subgroup at increased risk for adverse outcomes. Čabarkapa et al. demonstrated that lower serum magnesium levels in the first trimester were associated with a higher risk of developing pre-eclampsia later in pregnancy, suggesting that early magnesium deficiency may precede clinical manifestations of hypertensive disorders.[8] The findings of the present study align with this hypothesis, although the cross-sectional design limits the ability to establish temporal causality.[13] Nonetheless, early identification of low magnesium levels may offer an opportunity for preventive interventions.

A key finding of this study was the apparent association between low serum magnesium levels and pre-eclampsia. Among women diagnosed with

pre-eclampsia, 75% had serum magnesium levels below 1.7 mg/dl, compared to a smaller proportion among normotensive pregnant women. This observation supports the hypothesis that hypomagnesemia may contribute to the pathophysiology of pre-eclampsia. Several mechanisms have been proposed to explain this association. Magnesium deficiency is known to increase vascular smooth muscle contractility, enhance peripheral vasoconstriction, and promote endothelial dysfunction. Additionally, low magnesium levels may increase intracellular calcium concentrations, further exacerbating vasospasm and hypertension. Tavana and Hosseinmirzaei reported significantly lower maternal serum magnesium levels in women with pre-eclampsia compared to normotensive controls, findings that closely parallel the results of the present study.[10]

Furthermore, the widespread clinical use of magnesium sulfate in the management of pre-eclampsia and eclampsia underscores the physiological relevance of magnesium in controlling neuromuscular excitability and preventing seizures. Importantly, large clinical trials have demonstrated that magnesium sulfate reduces the risk of eclampsia without increasing long-term maternal morbidity or mortality, highlighting its safety and efficacy.

Overall, the findings of the present study are consistent with both Indian and international literature demonstrating a decline in serum magnesium levels with advancing pregnancy and an association between hypomagnesemia and pre-eclampsia.[13,14,15] These results add to the growing body of evidence supporting the importance of magnesium in maternal cardiovascular adaptation during pregnancy.

Clinical Implications

The observed association between declining serum magnesium levels and pre-eclampsia emphasizes the potential clinical utility of monitoring magnesium status during pregnancy. Routine assessment of serum magnesium, particularly in women with additional risk factors for hypertensive disorders, may facilitate early identification of those at increased risk. Dietary counseling and magnesium supplementation could be considered as preventive strategies, although further randomized controlled trials are needed to establish optimal dosing and timing.

Strengths and Limitations

The strengths of this study include the evaluation of serum magnesium levels across all three trimesters and the inclusion of a well-defined antenatal population. However, the study has certain limitations. Dietary magnesium intake was not assessed, which may have influenced serum magnesium levels. The cross-sectional design limits causal inference, and the relatively small sample size may affect generalizability. Future prospective longitudinal studies with larger sample sizes are warranted to confirm these findings.

CONCLUSION

According to the study it is observed that the levels of magnesium decreased as the individuals progressed from first trimester to third trimester which is inconsistency with the literature the reason attributed being hemodilution. As well as the patients with pre-eclampsia had magnesium in the lower range when compared to the general population.

REFERENCES

1. Fanni D, Gerosa C, Nurchi VM, Manchia M, Saba L, Coghe F, et al. The role of magnesium in pregnancy and in fetal programming of adult diseases. Biol Trace Elem Res. 2021;199(10):3647-3657. doi:10.1007/s12011-020-02487-3
2. Chubanov V, Gudermann T, Schlingmann KP. Essential role for TRPM6 in epithelial magnesium transport and body magnesium homeostasis. Pflugers Arch. 2005;451(1):228-234. doi:10.1007/s00424-005-1480-9
3. Durlach J, Pagès N, Bac P, Bara M, Guiet-Bara A. New data on the importance of gestational magnesium deficiency. Magnes Res. 2004;17(2):116-125.
4. Lundborg L, Ananth CV, Joseph KS, Cnattingius S, Razaz N. Changes in the prevalence of maternal chronic conditions during pregnancy: a nationwide age–period–cohort analysis. BJOG. 2024;131(9):1158-1167. doi:10.1111/1471-0528.17885
5. Malla S, Agiwal V, Chaudhuri S. Multimorbidity among pregnant women in India: national and state-level burden and socio-demographic variations. Prev Med Res Rev. 2024;1(2):115-117. doi:10.4103/PMRR.PMRR_76_23
6. Sukonpan K, Phupong V. Serum calcium and magnesium in normal and pre-eclamptic pregnancy. Arch Gynecol Obstet. 2005;273(1):12-16. doi:10.1007/s00404-005-0020-7
7. Smolarczyk R, Ramejko E, Szymanski W, Wielgos M. Homeostasis of calcium-phosphorus-magnesium in women with pregnancy-induced hypertension. Ginekol Pol. 1996;67(10):488-492.
8. Čabarkapa V, Bogavac M, Jakovljević A, Pezo L, Nikolić A, Belopavlović Z, et al. Serum magnesium level in the first trimester of pregnancy as a predictor of pre-eclampsia: a pilot study. Hypertens Pregnancy. 2018;37(3):144-153. doi:10.1080/10641955.2018.1494189
9. Atiba AS, Akindele RA, Bello NO, Kolawole OO, Fasanu AO. Serum magnesium levels in second and third trimesters of pregnancy in patients that developed pre-eclampsia and fetomaternal outcome. J Obstet Gynaecol. 2019;39(3):360-365. doi:10.1080/01443615.2018.1504215
10. Tavana Z, Hosseinmirzaei S. Comparison of maternal serum magnesium level in pre-eclampsia and normal pregnant women. Iran Red Crescent Med J. 2013;15(12):e10394. doi:10.5812/ircmj.10394
11. Tesfa E, Abebe M, Tadesse M, Berhane N. Association of maternal serum magnesium with pre-eclampsia: a systematic review and meta-analysis. Int Health. 2024;16(1):14-23. doi:10.1093/inthealth/ihab052
12. Xing B, Dai X, Gao G, Liu L, Zhang Y. Magnesium sulfate improves uterine, umbilical and fetal middle cerebral artery blood flow in women with severe pre-eclampsia. Hypertens Pregnancy. 2024;43(1):2404459. doi:10.1080/10641955.2024.2404459
13. Sibai BM. Magnesium sulfate prophylaxis in pre-eclampsia: lessons learned from recent trials. Am J Obstet Gynecol. 2004;190(6):1520-1526. doi:10.1016/j.ajog.2004.01.056
14. Vo TM, Nguyen HV, Pham TT, Tran QT, Le TT. Assessment of serum magnesium levels before and after magnesium sulfate administration in severe pre-eclampsia. Int J Hypertens. 2025;2025:5541651. doi:10.1155/2025/5541651
15. Thomas JM, Shenoy P, Bhat V, Kamath A, Prabhu K. Serum magnesium and nitric oxide levels in early detection of pre-eclampsia and gestational hypertension. Fertil Gynecol Androl. 2025;5(1):e154402. doi:10.5812/fga-154402.