Journal of Cardiovascular Disease Research
ISSN: 0975-3583,0976-2833 VOL 16, ISSUE 7, 2025

Serum Calcium and Magnesium Levels and Their Prognostic Significance in Newly Detected Essential Hypertensive Patients: A Descriptive Observational Study.

Dr. G Channamma[1], Dr. Syed Furquan Ali[2]
Professor[1], Postgraduate[2]
Department of General Medicine
Mahadevappa Rampure Medical College, Kalaburagi

Abstract

Background:
Essential hypertension is a multifactorial disease that continues to challenge public health systems specifically serum calcium and magnesium may play a role in blood pressure regulation and hypertension progression. Evidence suggests that electrolyte imbalances

Objective:
To study the levels of serum calcium and serum magnesium and their prognostic significance in newly detected essential hypertensive patients.

Methods:
This descriptive cross-sectional study involved 120 newly diagnosed essential hypertension patients aged 18 years and above, attending outpatient and inpatient services at Basaveshwar Teaching & General Hospital. Exclusion criteria included comorbid conditions such as diabetes, CKD, and secondary hypertension. Investigations included serum calcium, magnesium, fundoscopy, ECG, 2D ECHO, and USG abdomen. Blood pressure was categorized as per IGH-IV 2023 guidelines. Statistical analysis was performed using SPSS version 25, with chi-square, ANOVA, and Pearson correlation tests.

Results:

Mean age was 56.35 ± 15.18 years; 54.2% were male. Around 95.8% had low serum calcium (<8.7 mg/dL) and 39.2% had low serum magnesium (<1.8 mg/dL). The study observed significant negative correlation between serum calcium and SBP ($r = -0.189$, $p<0.05$) and DBP ($r = -0.181$, $p<0.05$). There was no statistically significant correlation observed between serum magnesium and BP.

Conclusion:
Hypocalcaemia is significantly associated with elevated blood pressure in newly diagnosed essential hypertensive patients. Serum calcium may serve as a prognostic biomarker. Serum magnesium levels, although frequently low, were not significantly correlated with BP.

Keywords: Hypertension, Serum Calcium, Serum Magnesium, Prognostic Marker, Blood Pressure, Cardiovascular Risk.

Introduction

Hypertension is a global public health concern, contributing to increased risks of stroke, myocardial infarction, heart failure, chronic kidney disease, and premature death. The World Health Organization (WHO) estimates that approximately **1.28 billion adults aged 30–79 years** globally are affected by hypertension, with nearly **46% remaining undiagnosed**[1]. In India, the **National Family Health Survey (NFHS-5)** reported that **24% of men and 21% of women aged 15 years and above** suffer from hypertension[2]. Alarmingly, only **7.9% of men and 13.4% of women** with hypertension in India have their blood pressure adequately controlled[2].

This condition is often referred to as the "silent killer" due to its asymptomatic nature and its capacity to cause irreversible damage to vital organs such as the heart, brain, and kidneys. Emerging studies emphasize that hypertension pathogenesis is multifactorial, including environmental, genetic, and nutritional contributors, such as micronutrient imbalances.

Micronutrients, particularly calcium and magnesium, have garnered research attention due to their roles in vascular smooth muscle contraction, endothelial function, and hormonal regulation. Calcium modulates excitation-contraction coupling in vascular smooth muscles, while magnesium acts as a physiological calcium antagonist and supports nitric oxide synthesis[3]. Deficiency in either may contribute to increased vascular resistance, sodium retention, and sympathetic overactivity[4]. Hence, their serum levels may not only influence blood pressure but also serve as early prognostic markers in essential hypertension.

Materials and Methods

Study Design: Descriptive Observational study
Study Site: Department of General Medicine, Basaveshwar Teaching & General Hospital
Study Duration: May 2023 – December 2024
Sample Size: 120 patients

Inclusion Criteria:

- Age ≥18 years
- Newly diagnosed essential hypertension

Exclusion Criteria:

- Secondary hypertension
- Diabetes mellitus
- Chronic kidney disease
- Ischemic heart disease
- History of stroke, CCF, or current diuretic use

Data Collection:

- Detailed history and clinical examination
- BP measurement using standardized mercury sphygmomanometer (IGH-IV 2023 classification)
- Serum calcium and magnesium analysis using automated analysers
- Fundoscopy, ECG, 2D ECHO, and USG abdomen

Statistical Analysis: SPSS v25. Chi-square, ANOVA, and Pearson's correlation. $p < 0.05$ considered statistically significant.

Results

Table 1: Socio-demographic Characteristics

Parameter	Result
Mean Age	56.35 ± 15.18 years
Male: Female	65:55
Sedentary Lifestyle	76.7%
Smokers	25%
Alcohol Users	27.5%
Family History of HTN	68%

Table 2: Blood Pressure and Classification

BP Classification (IGH-IV)	Frequency	Percentage
Stage 1 Hypertension	89	74.1%
Stage 2 Hypertension	31	25.8%

Table 3: Serum Biochemistry

Parameter	**Mean ± SD**	**% Below Normal**
Serum Calcium	8.11 ± 0.47	95.8%
Serum Magnesium	1.78 ± 0.27	39.2%

Table 4: Fundus and 2D Echo Findings

Investigation	**Abnormal Findings**	**% Affected**
Fundus	Hypertensive Retinopathy	72.5%
2D ECHO	Left Ventricular Hypertrophy	55.8%
	Diastolic Dysfunction	18.3%

Correlation Analysis:

- Serum Calcium vs SBP: **r = -0.189**, $p < 0.05$
- Serum Calcium vs DBP: **r = -0.181**, $p < 0.05$
- Serum Magnesium: No significant correlation with either SBP or DBP

Figures:

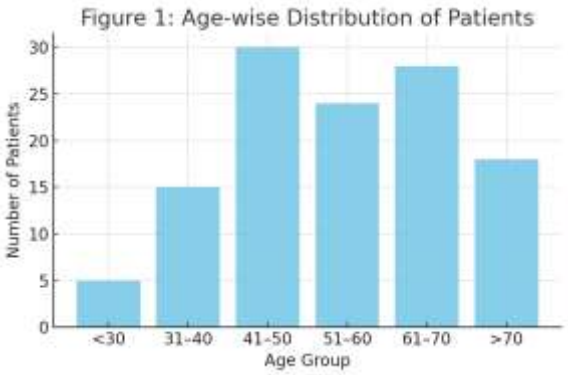

Figure 1: Age-wise Distribution of Patients
Most common age group: 41–60 years

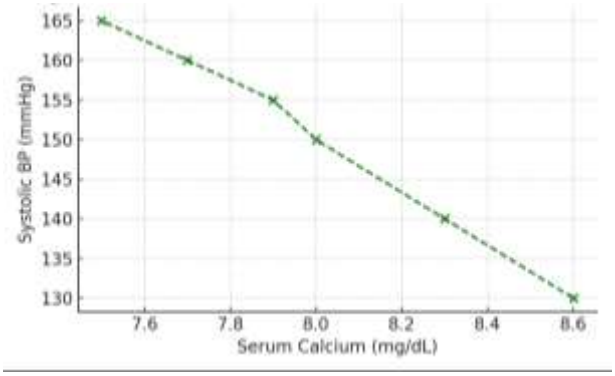

Figure 2: Correlation Between Serum Calcium and BP
A significant negative correlation observed between serum calcium and both systolic and diastolic pressures.

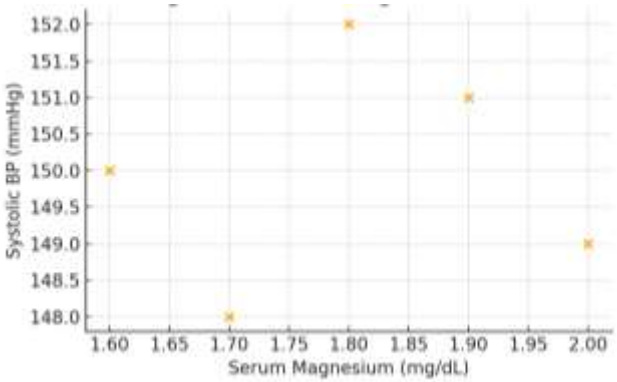

Figure 3: Serum Magnesium vs Blood Pressure
No significant trend or correlation.

Discussion

Our findings indicate a significant inverse relationship between serum calcium levels and both systolic and diastolic blood pressure in newly diagnosed essential hypertensive patients. Hypocalcaemia may promote vasoconstriction via increased peripheral vascular resistance, mediated through enhanced intracellular calcium influx in vascular smooth muscle cells. Furthermore, calcium deficiency is known to activate the renin-angiotensin-aldosterone system (RAAS) and elevate parathyroid hormone levels, contributing to volume expansion and sympathetic stimulation all of which favour the development and maintenance of elevated blood pressure[5].

In the present study, 95.8% of participants had serum calcium levels below 8.7 mg/dL. This high prevalence is consistent with findings from Singh et al. who observed a similar trend of reduced serum calcium in newly detected hypertensives in their observational study[6]. Manickam et al. also reported a statistically significant decrease in serum calcium in hypertensive patients compared to normotensives[7]. These associations underscore the potential role of hypocalcaemia as an early biochemical marker of essential hypertension.

Although 39.2% of our participants had serum magnesium levels below the normal threshold (<1.8 mg/dL), we found no statistically significant correlation with blood pressure values. This is in line with studies by Rekha et al. and Abhishek et al., which also reported inconsistent or non-significant correlations between serum magnesium and BP [8,9]. One possible explanation lies in the nature of serum magnesium measurement—it accounts for only ~1% of total body magnesium and does not accurately reflect intracellular or biologically active ionic magnesium, which may be more relevant to vascular tone regulation.

Interestingly, despite recent diagnosis, our study participants already exhibited signs of early end-organ damage. Hypertensive retinopathy was observed in over 72% of patients, and left ventricular hypertrophy (LVH) was present in 55.8%. These findings emphasize the importance of early biochemical profiling and highlight that vascular and cardiac remodelling may begin insidiously, even before clinical symptoms emerge. Bawiskar et al. also noted that patients with lower calcium levels showed higher grades of hypertensive retinopathy and more pronounced echocardiographic abnormalities[6], further supporting the prognostic implications of these biochemical markers.

Our study thus adds to the growing body of literature advocating the integration of serum calcium measurement in the routine evaluation of newly diagnosed hypertensive patients. Although serum magnesium alone may not serve as a consistent predictor, it may still hold clinical value when interpreted alongside other intracellular parameters or in combination with calcium levels.

Conclusion

- Hypocalcaemia is prevalent in newly diagnosed hypertensives and significantly correlates with BP values.
- Serum calcium may serve as a low-cost prognostic marker.
- Magnesium's role remains uncertain and needs further investigation through intracellular and longitudinal studies.
- Early screening of serum calcium could improve hypertension risk stratification.

Declarations

Conflict of Interest: None declared

Source of Funding: None

Ethical Approval: Institutional Ethics Committee approval obtained (MRMC/IEC/2023/011)

References:

1. World Health Organization. Hypertension. Geneva: WHO; 2023. Available at: https://www.who.int/news-room/fact-sheets/detail/hypertension
2. Ministry of Health and Family Welfare. National Family Health Survey – 5. International Institute for Population Sciences (IIPS); 2021.
3. Ji H, Kim A, Ebinger JE, et al. Sex differences in blood pressure trajectories. *JAMA Cardiol*. 2020;5(3):255–261.
4. Singh DP, Singh P, Acharya S, et al. Serum calcium and magnesium levels in essential hypertension. *Innov J Med Health Sci*. 2023;3:76–82.
5. Resnick LM. The role of calcium in hypertension pathophysiology. *Am J Hypertens*. 1989;2(6):429–435.
6. Bawiskar DP, Shimpi RS, Jadhav AB, et al. Role of serum calcium and albumin-corrected calcium as prognostic markers in acute hypertensive emergencies. *J Assoc Physicians India*. 2022;70(4):11–15.
7. Manickam K. Serum calcium in newly diagnosed essential hypertensives. *IAIM*. 2020;7(10):35–41.

8. Rekha S, Murugiah J, Rajaseharan SR. Correlation of serum magnesium levels with BP in normotensives and hypertensives. *Natl J Physiol Pharm Pharmacol*. 2019;9(10):1017–1020.
9. Abhishek K, Singh BP. Estimation of serum calcium level in essential hypertension. *J Cardiovasc Dis Res*. 2022;12(1):207–214.