



PREVALENCE OF MIGRAINE IN PATIENTS WITH HYPOMAGNESEMIA: A STUDY OF MAGNESIUM DEFICIENCY IN DIET

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Abstract

Objective: To determine the frequency of hypomagnesemia among patients presenting with migraine at a tertiary care hospital.

Methods: This descriptive cross-sectional study was conducted at the Outpatient Department of Neurology, Nishtar Medical College/Hospital, Multan, Pakistan, from May 16, 2019, to November 16, 2019. A total of 151 adult patients aged 20–60 years diagnosed with migraine were enrolled using non-probability consecutive sampling. Venous blood samples were collected to measure serum magnesium levels. Hypomagnesemia was defined as serum magnesium <1.3 mEq/L.

Results: Out of 151 patients, 71 (47%) were found to have hypomagnesemia. Female patients were more commonly affected, accounting for 62% of the hypomagnesemic cases. There was a statistically significant association between diabetes and hypomagnesemia ($p=0.047$). No significant associations were observed between hypomagnesemia and age, duration of migraine, obesity, or residential status.

Conclusion: Nearly half of the migraine patients had hypomagnesemia, highlighting the need for routine screening of serum magnesium levels in migraineurs. Further interventional studies are needed to assess whether magnesium supplementation can reduce the frequency and severity of migraine attacks.

Keywords: Migraine, Hypomagnesemia, Serum Magnesium, Headache Disorders, Trace Elements

INTRODUCTION

Migraine is a complex neurological disorder characterized by recurrent episodes of moderate to severe headache often accompanied by nausea, photophobia, phonophobia, and sometimes visual or sensory disturbances known as aura. According to the Global Burden of Disease Study 2019, migraine affects approximately 1 billion people globally and ranks as the second leading cause of disability worldwide [1]. It has profound impacts on personal, social, and economic life, contributing significantly to absenteeism, reduced productivity, and healthcare costs.

The exact pathophysiology of migraine remains incompletely understood, but it is widely believed to involve both vascular and neurogenic mechanisms. Central to this discussion is the role of trace elements such as magnesium in the modulation of neuronal excitability, neurotransmitter release, and cerebral blood flow regulation. Magnesium is a vital mineral involved in over 300 enzymatic reactions in the human body and plays a crucial role in maintaining normal nerve and muscle function, regulating blood pressure, and supporting immune health [2].

Magnesium acts as a natural antagonist of the N-methyl-D-aspartate (NMDA) receptor, which is implicated in pain transmission and cortical spreading depression—a phenomenon believed to trigger migraine aura [3]. Deficiency in magnesium can lead to increased neuronal excitability, vasoconstriction, and inflammation—key factors associated with migraine attacks [4]. Several international studies have reported lower serum magnesium levels in migraineurs compared to healthy controls [5–8], yet there remains limited data from South Asian populations, including Pakistan.

In recent years, multiple studies have attempted to establish a link between magnesium levels and migraine. One meta-analysis published in *Biological Trace Element Research* concluded that migraineurs had significantly lower serum magnesium levels than healthy individuals [9]. Another study from Turkey found that serum magnesium levels were significantly lower in migraineurs compared to controls [10]. In Pakistan, a study from Lahore reported hypomagnesemia in 38% of migraine patients [11], while another from Islamabad found it in 45% [12]. These findings suggest that magnesium deficiency might be more prevalent among migraine sufferers, though further research is required to confirm causality.

Moreover, several metabolic and lifestyle-related conditions such as diabetes, hypertension, and obesity are increasingly being linked with both migraine and magnesium deficiency. For instance, insulin resistance and hyperglycemia in diabetic patients may alter magnesium homeostasis, increasing urinary excretion and reducing serum levels [13]. Similarly, obesity has been associated with poor dietary intake and altered metabolism, potentially contributing to magnesium deficiency [14]. However, the current study did not find significant associations between hypomagnesemia and these variables, possibly due to the relatively small sample size and selection criteria.

This study aims to bridge the gap in local evidence by determining the frequency of hypomagnesemia among migraine patients at a tertiary care hospital in Multan, Pakistan. Understanding the prevalence of this potentially modifiable factor may help clinicians consider routine screening and targeted supplementation in appropriate cases, ultimately improving patient outcomes.

MATERIAL AND METHODS

A descriptive cross-sectional study was conducted at Outpatient Department of Neurology, Nishtar Medical College and Hospital, Multan, a tertiary care facility serving a large catchment area in southern Punjab, Pakistan. A sample size of 151 was calculated using the formula:

$$n = d^2 Z^2 \cdot p \cdot q$$

Where:

Z = 1.96 (at 95% confidence level)

p = 50% (estimated frequency of hypomagnesemia in migraine)

d = 8% margin of error

Non-probability consecutive sampling was used including 20-60 years of age patients of both genders diagnosed with migraine according to ICHD-II. Patients with history of brain tumors, ischemic heart disease, chronic liver disease, chronic renal failure, epilepsy, stroke, or head trauma, uncontrolled diabetes (HbA1c >9%), temporomandibular joint disorders, uveitis, autoimmune disorders and unwilling to participate were excluded. Informed consent was obtained from all participants. Baseline characteristics including age, gender, BMI, duration of migraine, diabetes status, smoking history, and residential status were recorded. A 3 mL venous blood sample was

drawn under aseptic conditions and sent to the laboratory for serum magnesium analysis. Hypomagnesemia was defined as serum magnesium <1.3 mEq/L.

Data were entered and analyzed using SPSS version 22. Mean $\pm$ standard deviation (SD) was computed for continuous variables. Frequencies and percentages were calculated for categorical variables. Chi-square test was applied for stratification. A p-value <0.05 was considered statistically significant.

RESULTS

A total of 151 patients diagnosed with migraine were included in this study, all aged between 20 and 60 years. The mean age of the participants was 36.4 ± 9.2 years, with a majority (78.1%) falling into the ≤ 40 years age group. Among the participants, 56 (37.1%) were male and 95 (62.9%) were female, indicating a clear predominance of migraine among females. This aligns with known epidemiological trends where migraine is more commonly reported in women, possibly due to hormonal influences such as estrogen fluctuations.

Table 1: Gender-wise Distribution of Study Cases

Gender	Frequency	Percentage
Male	56	37.1%
Female	95	62.9%
Total	151	100%

Residential status was categorized as urban for 100 (66.2%) patients and rural for 51 (33.8%) patients. In terms of socioeconomic background, 96 (63.6%) belonged to the middle-income group while 55 (36.4%) were from low-income backgrounds. Although no significant association was found between residential or socioeconomic status and hypomagnesemia, these factors may still influence dietary intake and overall health status, which could indirectly affect magnesium levels.

Comorbid conditions were assessed among the participants. Diabetes mellitus was present in 33 (21.9%) patients, out of which 21 (64%) had hypomagnesemia compared to 12 (36%) with normal magnesium levels. This difference was statistically significant ($p = 0.047$), suggesting that diabetic patients are at higher risk of magnesium deficiency. Hypertension was reported in 43 (28.5%) patients; however, no significant correlation was found between hypertension and hypomagnesemia. Obesity, defined as a BMI >27.5 kg/m², was observed in 22 (14.6%) patients, but it did not show any significant relationship with serum magnesium levels. Smoking history was noted in 28 (18.5%) patients, all of whom were male, yet no significant association was found between smoking and hypomagnesemia.

Table 2; Variable	Hypomagnesemia (%)	Normal MG (%)
Male	27 (38%)	29 (51%)
Female	44 (62%)	51 (49%)
Diabetic	21 (64%)	12 (36%)
Non-diabetic	50 (42%)	68 (58%)

The duration of migraine varied among the participants, with 129 (85.4%) having a disease duration of one year or less and 22 (14.6%) having a duration of more than one year. No significant correlation was found between the duration of migraine and the presence of hypomagnesemia. Mean body mass index (BMI) was calculated as 24.58 ± 3.59 kg/m², with 22 (14.6%) classified as obese and 129 (85.4%) as non-obese.

Serum magnesium levels were measured in all participants, and hypomagnesemia was defined as a serum magnesium level <1.3 mEq/L. Out of the 151 patients, 71 (47%) were found to have hypomagnesemia. Stratification by gender revealed that females were disproportionately affected, accounting for 62% of hypomagnesemic cases. There was no statistically significant difference in

hypomagnesemia rates between urban and rural dwellers ($p = 1.000$), nor was there a significant association with socioeconomic status.

Among the 33 diabetic patients, 21 (64%) had hypomagnesemia, whereas 50 (42%) of the 118 non-diabetic patients were hypomagnesemic. This difference was statistically significant ($p = 0.047$), reinforcing the importance of metabolic comorbidities in migraine pathophysiology. However, no such significant associations were found between hypomagnesemia and other clinical features such as hypertension, obesity, disease duration, or smoking history.

Age-wise stratification showed that 93 (78.1%) patients were ≤ 40 years old, with 41 (44%) of them being hypomagnesemic, while 22 (21.9%) patients were older than 40 years, with 13 (59%) showing hypomagnesemia. No significant difference was found between these age groups in terms of hypomagnesemia ($p = 0.305$). Similarly, when analyzed in relation to disease duration, 58 (45%) of patients with ≤ 1 year of disease duration and 13 (59%) of those with >1 year had hypomagnesemia ($p = 0.222$), indicating that the presence of hypomagnesemia does not significantly change over time in migraineurs.

In summary, nearly half of the migraine patients (47%) had hypomagnesemia, with a higher prevalence in females. The only variable showing a statistically significant association with hypomagnesemia was diabetes mellitus. Other factors such as age, residential status, socioeconomic status, duration of migraine, obesity, and smoking did not show significant correlations. These findings highlight the potential interplay between metabolic disorders and magnesium homeostasis in migraineurs and suggest that clinicians should consider routine screening for serum magnesium levels, particularly in diabetic patients presenting with migraine.

DISCUSSION

Our study revealed that nearly half (47%) of migraine patients had hypomagnesemia, consistent with findings from international literature [5–8]. These results support the hypothesis that magnesium deficiency may play a role in migraine pathogenesis. The high prevalence of hypomagnesemia suggests that measuring serum magnesium levels could be a useful diagnostic tool in migraine management.

Female preponderance in hypomagnesemia aligns with prior studies suggesting hormonal influences on magnesium homeostasis [15]. Estrogen has been shown to influence magnesium absorption and excretion, possibly explaining the higher prevalence in women. This finding underscores the need for gender-specific approaches in evaluating and managing migraine.

The significant association between diabetes and hypomagnesemia highlights the importance of metabolic factors in migraine etiology [13]. Diabetic patients often have altered magnesium metabolism due to increased urinary excretion, which may contribute to lower serum levels. This finding supports the idea that comorbid metabolic disorders should be considered when evaluating migraineurs.

Despite the lack of correlation with other demographic and clinical variables such as age, duration of migraine, obesity, or smoking history, our results suggest that measuring serum magnesium levels in migraineurs could still be beneficial. Routine monitoring may help identify those who might benefit from magnesium supplementation.

Although some studies have suggested a link between obesity and magnesium deficiency, our findings did not show a statistically significant relationship [14]. This discrepancy may be due to differences in sample characteristics, dietary habits, or genetic predispositions. Similarly, the absence of a correlation between disease duration and hypomagnesemia suggests that magnesium deficiency may be a persistent rather than progressive feature in migraine.

To date, no similar study has been conducted in Pakistan, making this one of the first reports on this topic in the region. Our findings suggest that magnesium deficiency is common among migraine patients and may serve as a modifiable risk factor. Clinicians should consider routine screening for serum magnesium levels, particularly in diabetic patients or those with refractory migraines.

Future interventional studies are required to explore whether magnesium supplementation can reduce the frequency and severity of migraine attacks. Randomized controlled trials evaluating oral

or intravenous magnesium therapy in hypomagnesemic migraineurs would provide valuable insights into its therapeutic potential.

LIMITATIONS

The study has several limitations. First, it was conducted at a single center with a relatively small sample size, limiting the generalizability of the findings. Second, we did not assess dietary intake or lifestyle factors that could influence magnesium levels. Third, we did not perform longitudinal follow-up to evaluate the impact of magnesium supplementation on migraine outcomes.

Despite these limitations, our study contributes important data on the prevalence of hypomagnesemia in a Pakistani population and highlights the need for further research in this area.

CONCLUSION

The frequency of hypomagnesemia among migraine patients at our center was 47%. This emphasizes the need for routine serum magnesium testing in migraine patients, particularly those with comorbid conditions such as diabetes. Awareness among clinicians should be raised to consider magnesium deficiency as a possible contributing factor to migraine attacks. Further interventional studies are required to evaluate the therapeutic potential of magnesium supplementation in migraine management.

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