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EVALUATING THE IMPACT OF MAGNESIUM CONSUMPTION ON BLOOD PRESSURE REGULATION IN HYPERTENSIVE INDIVIDUALS

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ABSTRACT

Background: Despite adequate salt restriction and medicine, a considerable minority of hypertension patients are unable to maintain normal blood pressure. Magnesium has been shown in several trials to reduce blood pressure, although there is little information on Indian topics.

Aim: to investigate the function of magnesium consumption on blood pressure regulation in Indian patients, utilizing 24-hour urine magnesium excretion as a surrogate marker for magnesium intake, as well as the effect of magnesium-rich flaxseed on blood pressure.

Methods: The current study examined 80 participants with essential hypertension and inadequate blood pressure management while adhering to JNC-8 BP targets. The remaining 80 participants with essential hypertension and satisfactory blood pressure management acted as controls. 24-hour urine samples were collected from controls and patients, and urinary Mg/Cr (magnesium-creatinine) ratios were determined. The Mg/Cr ratio was evaluated in two groups. In a subgroup of 46 patients, 3 tablespoons of roasted whole flaxseeds were administered daily for four weeks, and the significance of mean blood pressure change before and after intervention was examined.

Results: The Mg/Cr ratio in good-BP control participants was considerably greater than in poor-BP control subjects (p=0.02). In another sample of participants who consumed 3 Tbsp flax seeds daily, mean systolic and diastolic blood pressure fell [p=0.005 and 0.01 respectively].

Conclusion: Hypertensive patients with good blood pressure control had greater amounts of 24-hour urine magnesium excretion than those with poor blood pressure control. Flaxseeds were administered to hypertensive patients.

Keywords: hypertension, magnesium, magnesium deficiency, flaxseeds.

INTRODUCTION

Hypertension is a chronic and widely widespread lifestyle illness known as the silent killer because it causes asymptomatic myocardial infarction and stroke in afflicted individuals. Hypertension is currently the most common chronic condition in India, with lakhs of people dying from it each year.

Given blood pressure's complicated etiology, visual management is typically challenging, resulting in significant mortality and morbidity. The primary treatment technique for hypertension is pharmacological. However, scientific evidence shows that lifestyle changes can help manage blood pressure. The National Heart, Lung, and Blood Institute (NHLBI) evaluated the DASH diet for controlling hypertension, which informed WHO recommendations.

The DASH diet recognizes the importance of minerals like potassium and sodium in managing blood pressure. Magnesium, another element that is less usually associated with hypertension, is a key intracellular mineral. Magnesium intake is determined by the magnesium content of foods and drinking water. Approximately 30-40% of dietary magnesium is absorbed by the ileum and jejunum. The primary regulators of magnesium absorption are parathyroid hormone and 1-25 dihydroxy vitamin D. The kidney contributes to magnesium homeostasis, and urine magnesium excretion is normally associated with net interstitial absorption and is around 100mg/day. Since the early 1900s, several research have looked at the impact of magnesium on cardiovascular health.[3]

Despite the abundance of magnesium in food sources such as pumpkin seeds, flaxseeds, green leafy vegetables, legumes, nuts, cereals, and drinking water, magnesium shortage has been observed internationally. Subclinical magnesium deficit is an asymptomatic deficiency caused by a prolonged low magnesium food consumption. It is very common in today's society as a result of dietary changes and the usage of water purifiers and softeners, among other things. Such magnesium shortage goes undiscovered for years, resulting in poor cardiovascular health and the emergence of a variety of chronic inflammatory disorders. Existing literature has found substantial differences in Mg levels in hypertensive persons compared to the general population.[4]

WHO data has also reported that the Mg/Cr ratio has an inverse significant association with TC (total cholesterol), DBP (diastolic blood pressure), SBP (systolic blood pressure), and BMI (body mass index) and that 24-hour urinary Mg/Cr ratio is associated with lower risk of cardiovascular diseases including hypercholesterolemia, hypertension, obesity, TC (total cholesterol), and BMI (body mass index).5 Hence, the present study aimed to assess the correlation between blood

Furthermore, a sample of participants received 3 Tsp flaxseed supplementation daily for 4 weeks since flaxseeds contain high magnesium levels, and after 4 weeks, 24-hour urine magnesium and blood pressure were revisited to evaluate changes in magnesium excretion and BP.

The current study aimed to analyze and compare 24-hour urine magnesium excretion in hypertensive participants with poor and good blood pressure management, as well as to investigate the relationship between 24-hour urinary magnesium excretion and blood pressure after consuming 3 Tsp of flaxseeds for four weeks.

MATERIALS AND METHODS

The current prospective assessment research aimed to measure and compare 24-hour urine magnesium excretion in hypertensive adults with poor and satisfactory blood pressure management assessing the correlation of 24-hour urinary magnesium excretion and blood pressure after 3 Tsp intake of flaxseeds for 4 weeks. The research subjects were from the Institute's Outpatient Department. All individuals provided verbal and written informed permission before participating.

The research evaluated patients with essential hypertension between the ages of 30 and 80 who visited the Institute's Outpatient Department throughout the designated study period. The study excluded subjects who were taking diuretics, as these drugs reduce magnesium urine excretion and assessing urinary magnesium excretion is not a reliable marker for magnesium intake, as well as those who were morbidly obese, critically ill, had chronic kidney disease, or were taking a proton pump

inhibitor, which reduced gastrointestinal magnesium absorption. Following final inclusion, individuals were informed about the study's aims, length, and technique of urine collection.

Demographic information was collected for all subjects, and they were given 5-liter airtight cans prefilled with 20% dilute HCl as a preservative, as well as instructions for a 24-hour urine collection approach that included voiding the first pee in the morning and collecting all urine until the same time the next day. Urine magnesium and creatinine were estimated at the Institute's biochemistry lab using a fully automatic chemical analyser, with urine creatinine and magnesium measured using Jaffe's Alkaline Picrate technique and the Calmagite dye binding method, respectively.

The blood pressure readings were taken using an auscultatory approach using a mercury sphygmomanometer. A total of four readings were obtained, with two taken on distinct days. Blood pressure was measured in accordance with JNC-8 recommendations.[6]

After completing the first part of the body, 46 subjects were taken from the original 160 depending on their willingness for further participation and counselling for magnesium-rich diet benefits. Subjects were instructed to consume 3 tablespoons of flax seeds daily for four weeks.

Flax seed was supplemented with 3Tsp of whole and roasted flaxseed sachets, each weighing 120mg. After four weeks, their blood pressure was re-measured, as was a 2-hour urine sample. The mean BO in 46 patients before and after dietary flax seed intake was compared to assess blood pressure changes following the intervention.

The collected data were statistically evaluated using SPSS software version 24.0 for descriptive measures, Student t-test, ANOVA (analysis of variance), Mann-Whitney U test, and Chi-square test. The data were presented in the form of mean and standard deviation, as well as frequency and percentage. A p-value of <0.05 was considered.

RESULTS

The current prospective assessment study aimed to assess and compare 24-hour urinary magnesium excretion in hypertensive subjects with poor and good blood pressure control, as well as to determine the relationship between 24-hour urinary magnesium excretion and blood pressure after consuming 3 Tsp of flaxseeds for four weeks. The current prospective assessment study aimed to assess and compare 24-hour urinary magnesium excretion in hypertensive subjects with poor and good blood pressure control, as well as to determine the relationship between 24-hour urinary magnesium excretion and blood pressure after consuming 3 Tsp of flaxseeds for four weeks. The research subjects ranged in age from 36 to 78 years old and were separated into two groups: cases and controls. The cases were 80 patients with essential hypertension, while the controls were subjects without it.

According to the JNC-8 guidelines for hypertensive blood pressure control, subjects aged 18-59 years with no major comorbidity and those aged 18-59 years with major comorbidity had a goal blood pressure of 140/90mmHg. Good control was defined as a mean blood pressure of <140/90mmHg, while poor control was defined as mean blood pressure of ≥140/90mmHg. The second group of participants was aged >60 years with diabetes/CKD and age ≥ years without diabetes/CKD. Good and poor control was determined for mean blood pressure <150/90mmHg and ≥150/90mmHg (Table 1).

When the demographic data of research subjects were analyzed, it was discovered that the mean age in the control group was substantially greater than in the case group (p=0.01). The male-to-female ratio was statistically equivalent between control and case groups (p=0.226).

The mean SBP in controls and cases was 131.3±8.82 and 151.9±9.35mmHg, whereas the mean DBP was 81.43±6.04 and 93.20±8.12mmHg, respectively. There were 42.5% of participants from controls and 52.5% of subjects from diabetes cases, which was not statistically significant (p = 0.35). The urine magnesium/creatinine (Mg/Cr) ratio was 77.03 mg/gm in controls and 56.47 mg/gm in patients (Table 2).

The study found a substantial drop in mean blood pressure (SBP) from 141.11±10.8mmHg to 134.20±11.48mmHg following 4 weeks of increased magnesium consumption (p=0.005), compared to before the intervention. The mean DBP before intervention was 87.63±9.17mmHg, which fell considerably to 84.63±8.15mmHg (p=0.01). The mean Mg/Cr ratio before intervention was 45.96±15.03 mg/gm which significantly increased to 112.71±53.15 mg/gm with p<0.00001 (Table 3).

DISCUSSION

The current prospective assessment study aimed to assess and compare 24-hour urinary magnesium excretion in hypertensive subjects with poor and good blood pressure control, as well as to investigate the relationship between 24-hour urinary magnesium excretion and blood pressure after consuming 3 Tsp of flaxseeds for 4 weeks. The research subjects ranged in age from 36 to 78 years old and were separated into two groups: cases and controls. Cases were 80 people with essential hypertension, while controls were subjects without it. These findings were consistent with earlier studies conducted by Swaminathan M7 in 2003 and Houston M8 in 2011, both of which examined a similar distribution of patients and individuals with hypertension from age groups similar to the current research.

The study followed JNC-8 guidelines for BP control in hypertensives. Subjects aged 18-59 years with no major comorbidity and those aged 18-59 years with major comorbidity had goal blood pressure of 140/90mmHg. Good control was defined as BP <140/90mmHg and poor control as BP ≥140/90mmHg. The second group of participants were aged >60 years with diabetes/CKD and age ≥ years without diabetes/CKD. Good and poor control were assessed for mean blood pressure <150/90mmHg and ≥150/90mmHg. These findings were congruent with those of Patni N et al9 in 2022 and Yamori Y et al10 in 2015, both of whom used JNC-8 recommendations for hypertension evaluation in their investigations, as seen in the current study's results.

When the demographic data of research subjects were assessed, it was discovered that the mean age in the control group was substantially greater than in the case group (p=0.01). The male-to-female ratio was statistically equivalent between control and case groups (p=0.226). The mean SBP in controls and cases was 131.3±8.82 and 151.9±9.35 mmHg, respectively, whereas the mean DBP was 81.43±6.04 and 93.20±8.12 mmHg. There were 42.5% of participants from controls and 52.5% from diabetic cases, which was not statistically significant (p=0.35).

The urine Mg/Cr (magnesium/creatinine) ratio was 77.03 mg/gm in controls and 56.47 mg/gm in cases. These findings were consistent with the findings of Chidambaram N et al11 in 2014 and Seo JW12 in 2008, in which the authors evaluated participants with hypertension and demographic data similar to the current research.

The Mg/Cr ratio and mean blood pressure of study individuals were compared before and after 4 weeks of increased magnesium food intake. The mean SBP was 141.11±10.8mmHg before intervention and fell considerably to 134.20±11.48mmHg after intervention (p=0.005). Before intervention, the mean DBP was 87.63±9.17mmHg, but it fell dramatically to 84.63±8.15mmHg (p=0.01). Before intervention, the mean Mg/Cr ratio was 45.96±15.03 mg/gm, but it dramatically rose to 112.71±53.15 mg/gm (p<0.00001).

These findings were consistent with earlier research by Colussi NA et al13 in 2024 and Schwalfenberg GK[14] in 2017, who noted a comparison of Mg/Cr ratio and mean blood pressure before and after 4 weeks of flax seed intake, which was comparable to the current study.

CONCLUSIONS

With its limitations, the current study shows that hypertensive people with good blood pressure management had greater amounts of 24-hour urine magnesium excretion than those with poor blood pressure control. Flaxseeds can be used as an addition to medication therapy in hypertensive patients to enhance blood pressure management.

REFERENCES

1. Banjanin N, Belojevic G. Changes of blood pressure and hemodynamic parameters after oral magnesium supplementation in patients with essential hypertension—An intervention study. Nutrients 2018;10:581.
2. Sacks FM, Svetkey LP, Vollmer WM, et al. Effects on blood pressure of reduced dietary sodium and the dietary approaches to stop hypertension (DASH) diet. N Engl J Med 2001;344:3–10.
3. Goyal C, Andrabi SAS. Hypertension: The Silent Killer. Indian Council of Medical Research and Department of Health Research - Ministry of Health & Family Welfare, Government of India. New Delhi. 2018. Available from: https://www.icmr.nic.in/sites/default/files/press_realease_files/Hypertension.pdf.
4. Vongpatanasin W, Peri-Okonny P, Velasco A, et al. Effects of potassium magnesium citrate supplementation on 24-hour ambulatory blood pressure and oxidative stress marker in prehypertensive and hypertensive subjects. Am J Cardiol 2016;118:849–53.
5. Challa HJ, Tadi P, Uppaluri KR. DASH diet (Dietary Approaches to Stop Hypertension). In: StatPearls. Treasure Island (FL): StatPearls Publishing; 2019. Available from: https://www.ncbi.nlm.nih.gov/ books/NBK482514/
6. Page MR. The JNC 8 hypertension guidelines: An in-depth guide. Am J Manag Care 2014;20.
7. Swaminathan R. Magnesium metabolism and its disorders. Clin Biochem Rev 2003;24:47–66.
8. Houston M. The role of magnesium in hypertension and cardiovascular disease. J Clin Hypertens (Greenwich) 2011;13:843– 7.
9. Patni N, Fatima M, Lamis A, et al. Magnesium and hypertension: Decoding novel anti-hypertensives. Cureus 2022;14:e25839.
10. Yamori Y, Sagara M, Mizushima S, et al. An inverse association between magnesium in 24-h urine and cardiovascular risk factors in middle-aged subjects in 50 CARDIAC Study populations. Hypertension Research 2015;38:219–25.
11. Chidambaram N, Sethupathy S, Saravanan N, et al. Relationship of sodium and magnesium intakes to hypertension proven by 24-hour urinalysis in a South Indian population. J Clin Hypertens (Greenwich) 2014;16:581–6.
12. Seo JW, Park TJ. Magnesium metabolism. Electrolyte Blood Press 2008;6:86–95.
13. Colussi NA, Todaro JS, Rodríguez JP, et al. Dietary supplementation with integral chia and flax flours ameliorates systemic inflammation. Medicina (B Aires) 2024;84:206–20.
14. Schwalfenberg GK, Genuis SJ. The importance of magnesium in clinical healthcare. Scientifica (Cairo) 2017:2017:4179326.

	Goal BP (SBP/DBP)	Good control	Poor control
Age 18-59 with no major comorbidity	Mean BP <140/90mmHg	If mean BP <140/90mmHg	If mean BP ≥140/90mmHg
Age 18-59 with major comorbidity			
Age ≥60 with diabetes/CKD	Mean BP <150/90mmHG	If mean BP <150/90mmHg	If mean BP ≥150/90mmHg
Age ≥60 without diabetes/CKD			

Table 1: JNC-8 guidelines for BP control in hypertensives

Groups	Controls (Good BP control) (n=80)	Cases (Poor BP control) (n=80)	p-value
Mean age (years)	58±8.7	54.1±10.6	**0.01**
Male: female ratio	3:5	1:3	0.226
Mean SBP (mmHg)	131.3±8.82	151.9±9.35	**-**
Mean DBP (mmHg)	81.43±6.04	93.20±8.12	**-**
% having diabetes	42.5	52.5	0.35
Urinary magnesium/creatinine ratio (mg/gm)	77.03	56.47	**0.02**

Table 2: Demographic data of study subjects

	Before intervention	After intervention	p-values
Mean SBP (mmHg)	141.11±10.8	134.20±11.48	**0.005**
Mean DBP (mmHg)	87.63±9.17	84.63±8.15	**0.01**
Mean Mg/Cr ratio (mg/gm)	45.96±15.03	112.71±53.15	**<0.00001**

Table 3: Comparison of Mg/Cr ratio and mean blood pressure before and after 4 weeks of increased dietary intake of magnesium