Research Article



INTERNATIONAL RESEARCH JOURNAL OF PHARMACY

www.irjponline.com

ISSN 2230-8407 [LINKING]

MAGNESIUM INTAKE ON BLOOD PRESSURE CONTROL IN HYPERTENSIVE SUBJECTS- AN ANALYTICAL STUDY

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How to cite: Narayanam H. Magnesium intake on blood pressure control in hypertensive subjects- an analytical study. International Research Journal of Pharmacy. 2019;10(2):126-130.

Doi: 10.7897/2230-8407.100256

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ABSTRACT

Background: Even with the best salt restriction and medicine, a considerable percentage of hypertensive people are unable to reach good blood pressure. Numerous research has documented magnesium's ability to decrease blood pressure, however there is a dearth of information on Indian individuals in the literature.

Aim: Using 24-hour urine magnesium excretion as a surrogate marker for magnesium consumption and the impact of magnesium-rich flaxseed on blood pressure control, the current study sought to evaluate the significance of magnesium intake on blood pressure control in Indian patients.

Methods: Eighty participants with essential hypertension and inadequate blood pressure control were evaluated in this study using the JNC-8 BP objectives. As controls, the remaining 80 individuals had essential hypertension and adequate blood pressure control. Urinary Mg/Cr (magnesium-creatinine) ratios were measured from 24-hour urine samples collected from controls and patients. Two groups were compared using this Mg/Cr ratio. Three tablespoons of roasted whole flaxseeds were administered daily for four weeks to a subgroup of forty-six patients, and the significance of the mean blood pressure change before and after the intervention was evaluated.

Results: According to the study's findings, persons with good blood pressure management had a considerably greater Mg/Cr ratio than those with poor blood pressure control (p=0.02). The mean systolic and diastolic blood pressure considerably dropped in a different subset of participants who took three tablespoons of flax seeds per day (p=0.005 and 0.01, respectively).

Conclusion: According to the current study, individuals with hypertension who have effective blood pressure control excrete more magnesium in their urine during a 24-hour period than those who do not. As an adjunct to medication therapy, flaxseeds can help hypertensive patients better control their blood pressure.

Keywords: magnesium shortage, hypertension, and flaxseeds.

INTRODUCTION

Due to its asymptomatic appearance that causes myocardial infarction and stroke in those who have it, hypertension is a chronic and extremely common lifestyle disease that is also referred to as the silent killer. Hypertension is currently the most common chronic illness in India, with millions of Indians dying from it each year. It is typically challenging to properly manage blood pressure due to its complex etiology, which results in significant mortality and morbidity. Pharmacologic treatment is the primary approach to managing hypertension. However, it has been scientifically demonstrated that changing one's lifestyle can assist control blood pressure.[1]

The DASH (Dietary Approaches to Stop Hypertension) diet was evaluated by the National Heart, Lung, and Blood Institute (NHLBI) for the management of hypertension, which aided in the creation of WHO guidelines. The DASH diet highlights how important minerals like sodium and potassium are for blood pressure regulation. Magnesium, an essential intracellular element, is another mineral that is less frequently associated with hypertension. The amount of magnesium

consumed is determined by the amount of magnesium in food and water. The ileum and jejunum absorb about 30–40% of the magnesium in food.[2]

Magnesium absorption has been found to be primarily regulated by parathyroid hormone and 1-25 dihydroxy vitamin D. Magnesium homeostasis is maintained by the kidneys, and the amount of magnesium excreted in the urine is typically 100 mg per day and is connected with net interstitial absorption. Since the early 1900s, magnesium's effects on cardiovascular health have been the subject of several literary works.3

Magnesium shortage has been reported worldwide, despite the fact that magnesium is widely available in food sources such pumpkin seeds, flaxseeds, green leafy vegetables, legumes, nuts, cereals, and drinking water. A low dietary intake of magnesium over a period of time might result in an asymptomatic deficient state known as subclinical magnesium deficiency. Due to dietary changes and the usage of water softeners and purifiers, among other things, it is quite prevalent in the modern world. Such a magnesium deficit causes poor cardiovascular health and the emergence of numerous chronic inflammatory disorders, although it goes undiagnosed for years. Significant differences in magnesium levels between hypertension individuals and the general population have been observed in existing literature data.4

According to WHO data, the Mg/Cr ratio has a significant inverse relationship with TC (total cholesterol), DBP (diastolic blood pressure), SBP (systolic blood pressure), and BMI (body mass index). Additionally, a 24-hour urine Mg/Cr ratio is linked to a lower risk of cardiovascular diseases, such as obesity, hypertension, hypercholesterolemia, and BMI.5

Therefore, the current study sought to evaluate the relationship between magnesium consumption and blood pressure control in Indian hypertensives on antihypertensive medication. The study additionally evaluated the relationship between blood pressure control and 24-hour urine magnesium levels because the urinary Mg/Cr ratio is a trustworthy biomarker of magnesium intake. Additionally, because flaxseeds contain high quantities of magnesium, a sample of individuals received a daily supplement of 3 Tsp flaxseed. After 4 weeks, the subjects' blood pressure and 24-hour urine magnesium levels were reevaluated to determine changes in BP and magnesium excretion.

The goals of the current study were to measure and compare 24-hour urine magnesium excretion in hypertensive individuals with poor and good blood pressure control, as well as to evaluate the relationship between 24-hour urinary magnesium excretion and blood pressure following a 4-week intake of 3 Tsp flaxseeds.

MATERIALS AND METHODS

The goals of the current prospective assessment study were to measure and compare 24-hour urine magnesium excretion in hypertensive individuals with poor and good blood pressure control, as well as to evaluate the relationship between 24-hour urine magnesium excretion and blood pressure following a 4-week intake of 3 Tsp flaxseeds. The Institute's Outpatient Department provided the study participants. Prior to participation, each subject provided both written and verbal informed consent.

The study evaluated individuals with essential hypertension who visited the Institute's outpatient department throughout the specified study period and were between the ages of 30 and 80. The study's exclusion criteria included people taking diuretics, which lower magnesium urine excretion and make measuring urine magnesium excretion an unreliable indicator of magnesium intake; people who were critically ill or morbidly obese; people with chronic kidney disease; and people taking proton-pump inhibitors, which decreased gastrointestinal magnesium absorption.

Subjects were informed about the study's goals, length, and urine collection technique following final inclusion. All subjects had their demographic information collected, and they were given 5-liter airtight cans that were prefilled with 20% diluted HCl as a preservative. They were also instructed on the 24-hour urine collection method, which involved voiding the first urine in the morning and collecting all urine until the same time the following day. The Institute's biochemistry lab used a completely automatic chemistry analyzer to measure urine creatinine and magnesium using the Jaffe's Alkaline Picrate method and the Calmagite dye binding method, respectively.

SBP and DBP were measured using an auscultatory technique using a mercury sphygmomanometer. Two readings were taken on different occasions, resulting in a mean of four readings. The JNC-8 recommendations were followed when doing the BP assessment.[6] Following completion of the first section of the test, 46 subjects were selected from the original 160 based on their desire to participate further and get counseling regarding the advantages of a diet high in magnesium. For four weeks, the subjects were instructed to consume three teaspoons of flax seeds every day.

Supplemental flaxseed was administered as whole and roasted flaxseed sachets weighing 120 mg each and containing 3 tsp. Their blood pressure and a two-hour urine sample were taken again after four weeks. To assess changes in blood pressure following the intervention, the mean BO of 46 participants was compared before and after dietary flax seed intake.

Using SPSS, the collected data was statistically analyzed using the Student t-test, ANOVA (analysis of variance), Mann-Whitney U test, Chi-square test, and assessment of descriptive measures. The mean, standard deviation, frequency, and percentages were used to express the results. A p-value of less than 0.05 was taken into account.

RESULTS

The goals of the current prospective assessment study were to measure and compare 24-hour urine magnesium excretion in hypertensive individuals with poor and good blood pressure control, as well as to evaluate the relationship between 24-hour urine magnesium excretion and blood pressure following a 4-week intake of 3 Tsp flaxseeds. The goals of the current prospective assessment study were to measure and compare 24-hour urine magnesium excretion in hypertensive individuals with poor and good blood pressure control, as well as to evaluate the relationship between 24-hour urine magnesium excretion and blood pressure following a 4-week intake of 3 Tsp flaxseeds. The study participants, who ranged in age from 36 to 78, were split into two groups: 80 individuals with essential hypertension and controls, who did not have the condition.

According to the JNC-8 guidelines for controlling blood pressure in hypertensives, subjects between the ages of 18 and 59 who did not have a major comorbidity and those who did had a major comorbidity had a goal blood pressure of 140/90 mmHg. They were classified as having good control when their mean blood pressure was less than 140/90 mmHg and as having poor control when their mean blood pressure was greater than 140/90 mmHg. The third group of individuals included those who were at least 60 years old and had diabetes or CKD, as well as those who were at least 60 years old and did not have diabetes or CKD. Good and poor control were taken into account for mean blood pressure readings of less than 150/90 mmHg and more than 150/90 mmHg (Table 1).

Examining the study subjects' demographic information revealed that the control group's mean age was substantially higher than that of the case patients ($p=0.01$). In both control and case subjects, the male-to-female ratio was statistically similar ($p=0.226$). The controls and patients had mean SBPs of 131.3±8.82 and 151.9±9.35 mmHg, respectively, and DBPs of 81.43±6.04 and 93.20±8.12 mmHg. 52.5% of patients from cases and 42.5% of subjects from controls had diabetes; this difference was not statistically significant ($p=0.35$). The controls and patients had urine Mg/Cr (magnesium/creatinine) ratios of 77.03 and 56.47 mg/gm, respectively (Table 2).

The study's findings revealed that, when comparing the Mg/Cr ratio and mean blood pressure before and after four weeks of increased magnesium intake, the study subjects' mean SBP was 141.11±10.8 mmHg prior to the intervention, and it dramatically fell to 134.20±11.48 mmHg following the intervention ($p=0.005$). Prior to the intervention, the mean DBP was 87.63±9.17 mmHg; it dramatically dropped to 84.63±8.15 mmHg with $p=0.01$. Prior to the intervention, the mean Mg/Cr ratio was 45.96±15.03 mg/gm; this considerably rose to 112.71±53.15 mg/gm with $p<0.00001$ (Table 3).

DISCUSSION

The goals of the current prospective assessment study were to measure and compare 24-hour urine magnesium excretion in hypertensive individuals with poor and good blood pressure control, as well as to evaluate the relationship between 24-hour urine magnesium excretion and blood pressure following a 4-week intake of 3 Tsp flaxseeds. The study participants, who ranged in age from 36 to 78, were split into two groups: 80 individuals with essential hypertension and controls, who did not have the condition. These results were similar to those from earlier studies by Swaminathan M7 in 2003 and Houston M8 in 2011, where the authors evaluated a similar distribution of hypertensive patients and individuals from age groups equivalent to the current study.

The JNC-8 guidelines for blood pressure control in hypertensives were followed in this predetermined study. Subjects aged 18 to 59 with no major comorbidity and those aged 18 to 59 with major comorbidity had a goal blood pressure of 140/90 mmHg, and their mean blood pressure was classified as good control if it was less than 140/90 mmHg and as poor control if it was greater than 140/90 mmHg. The other group of participants had a mean blood pressure of less than 150/90 mmHg and more than 150/90 mmHg, and they were aged ≥60 years with diabetes/CKD and age ≥ years without diabetes/CKD. The present study's results were in line with those of Patni N et al. (2022) and Yamori Y et al. (2015), whose authors likewise used the JNC-8 recommendations for hypertension assessment.

Regarding the evaluation of the study participants' demographic information, it was observed that the control group's mean age was substantially higher than that of the case patients ($p=0.01$). In both control and case subjects, the male-to-female ratio was statistically similar ($p=0.226$). The controls and patients had mean SBPs of 131.3±8.82 and 151.9±9.35 mmHg, respectively, and DBPs of 81.43±6.04 and 93.20±8.12 mmHg. 52.5% of patients from cases and 42.5% of subjects from controls had diabetes; this difference was not statistically significant ($p=0.35$). The magnesium/creatinine (Mg/Cr) ratio in the urine was 56.47 mg/gm in the patients and 77.03 mg/gm in the controls. These results were consistent with

those of Chidambaram N et al. (2014) and Seo JW12 (2008), whose authors similarly evaluated participants with hypertension and demographic information comparable to the current study.

When the Mg/Cr ratio and mean blood pressure were compared before and after four weeks of increased magnesium consumption, the study subjects' mean SBP was 141.11±10.8 mmHg before the intervention, and it dramatically fell to 134.20±11.48 mmHg after the intervention (p=0.005). Prior to the intervention, the mean DBP was 87.63±9.17 mmHg; it dramatically dropped to 84.63±8.15 mmHg with p=0.01. Prior to the intervention, the mean Mg/Cr ratio was 45.96±15.03 mg/gm; this considerably rose to 112.71±53.15 mg/gm (p<0.00001). These findings were consistent with earlier research by Colussi NA et al. and Schwalfenberg GK14 (2017), where the authors also noted a comparison of the mean blood pressure and the Mg/Cr ratio before and after four weeks of flax seed consumption.

CONCLUSIONS

Within its limits, the current study finds that individuals with hypertension who have good blood pressure control excrete more magnesium in their urine during a 24-hour period than those who have poor blood pressure management. As an adjunct to medication therapy, flaxseeds can help hypertensive patients better control their blood pressure.

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S. No		Goal BP (SBP/DBP)	Good control	Poor control
1.	**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			
2.	**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[6]

S. No	Groups	Controls (Good BP control) (n=80)	Cases (Poor BP control) (n=80)	p-value
1.	**Mean age (years)**	58±8.7	54.1±10.6	**0.01**
2.	**Male: female ratio**	3:5	1:3	0.226
3.	**Mean SBP (mmHg)**	131.3±8.82	151.9±9.35	**-**
4.	**Mean DBP (mmHg)**	81.43±6.04	93.20±8.12	**-**
5.	**% having diabetes**	42.5	52.5	0.35
6.	**Urinary magnesium/creatinine ratio (mg/gm)**	77.03	56.47	**0.02**

Table 2: Demographic data of study subjects

S. No		Before intervention	After intervention	p-values
1.	**Mean SBP (mmHg)**	141.11±10.8	134.20±11.48	**0.005**
2.	**Mean DBP (mmHg)**	87.63±9.17	84.63±8.15	**0.01**
3.	**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