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An evidence-based review of oral magnesium supplementation in the preventive treatment of migraine

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Abstract

Background: Migraine is an incompletely understood, debilitating disorder that lacks a universally effective treatment. Magnesium participates in a variety of biochemical processes related to migraine pathophysiology, and a deficiency could contribute to migraine development.

Methods: A review of the literature from 1990 to the present on magnesium and migraine was conducted.

Review: The authors identified 16 studies aimed at magnesium status assessment in migraine, and four intervention trials assessing the efficacy of oral magnesium supplementation, independent of other therapies, in the prevention of migraine.

Conclusion: The strength of evidence supporting oral magnesium supplementation is limited at this time. With such limited evidence, a more advantageous alternative to magnesium supplementation, in patients willing to make lifestyle changes, may be to focus on increasing dietary magnesium intake.

Keywords

Magnesium, migraine, migraine prophylaxis

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Introduction

Migraine is a common and potentially debilitating condition associated with a significant socioeconomic burden (1,2). The lack of a universally effective therapy and an incomplete understanding of migraine pathophysiology make treatment difficult. Data from the *American Migraine Prevalence and Prevention Study* demonstrate that two out of every five individuals who suffer from episodic migraine have unmet treatment needs, and 15% of episodic migraine sufferers are dissatisfied with their current treatment (3). The financial burden of migraine has been estimated to exceed $4 billion annually in health care services and surpasses $14.5 billion annually for employers (1).

The pharmacological treatment of episodic migraine is primarily focused on pain relief. Frequent use of acute medications, however, places patients at risk of developing medication-overuse headache (4,5). Preventive therapy is often the focus with patients who suffer from frequent migraines, or in patients in whom acute therapy is ineffective or contraindicated.

Identifying and treating underlying conditions that contribute to migraine development are important to successful migraine management. Suboptimal magnesium status has repeatedly been identified in migraine sufferers (6–21). Magnesium is intimately tied to a number of physiological processes connected to migraine, potentially implicating magnesium deficiency in increased susceptibility to migraine development (9,22). Intervention trials demonstrate a potential role for magnesium in the prophylaxis of migraine (23–26). The primary purpose of this review is to provide an evidence-based recommendation on the use of oral magnesium supplements in migraine prevention.

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The physiological role of magnesium

Magnesium is a critical and often overlooked nutrient that contributes to a wide variety of physiological body processes (27–29). A magnesium deficiency can present with a variety of symptoms, ranging from neuromuscular and psychiatric to metabolic and cardiovascular symptoms (30).

Magnesium is found in a wide variety of foods. Good sources are considered whole grains, nuts, green-leafy vegetables, and legumes (31,32). Processed foods and refined grains are generally lower in magnesium (29,33).

Dietary magnesium is typically absorbed passively (34). The intestinal bioavailability of magnesium is negatively affected by the presence of fiber and phosphate (35). High-fiber diets, however, are generally high in magnesium-rich foods—compensating for any impact of fiber on bioavailability.

Magnesium intake is inadequate in a large percentage of the population, likely owing to an increased intake of refined and processed foods. National Health and Nutrition Examination Survey (NHANES) III data demonstrate a dietary magnesium intake below the estimated average requirement (EAR) in nearly 50% of individuals in the United States (36). In addition, an increasing prevalence of phosphate additives in the food supply may potentiate the prevalence of inadequate magnesium intake in the general population (37).

Magnesium balance in the body is primarily controlled through renal reabsorption and gastrointestinal absorption (38). Altered gastrointestinal absorption due to medications such as proton-pump inhibitors, malabsorptive conditions, or vomiting, can contribute to a negative body magnesium balance (31,39). An increase in renal excretion of magnesium can occur with renal disease, poorly controlled diabetes mellitus, numerous medications (most notably loop diuretics and caffeine), alcohol use, and stress (31,38,40–42).

Serum magnesium is the most frequent measure of magnesium status (43). It is limited, however, by poor sensitivity (30,44). A value within normal limits does not rule out a whole-body deficiency, as skeletal magnesium has the ability to buffer extracellular magnesium (30,43,44). A magnesium loading test, assuming normal renal function, is considered to be one of the best assessments of whole-body magnesium status (30,43). The test is time and labor intensive, however, and not appropriate in a clinical setting. A simple, cheap, and effective magnesium measurement is currently unavailable (45).

The role of magnesium in migraine pathophysiology

Migraine is likely a disorder of brain excitability (46). Patients with migraine may have a genetically induced hyper-excitable brain. If a genetically primed neuron is triggered by a change in the external or internal environment, it may induce the brain pathways that normally conduct head pain to activate, resulting in the symptoms of migraine (47). Magnesium deficiency may influence all of the following, leading to an increased susceptibility to migraine: neuroinflammation, calcium channel and N-methyl-D-aspartate (NMDA) receptor blockade, glutamate and nitric oxide activity, serotonin receptor affinity, and endogenous hormone regulation (46). Magnesium depletion leads to neuronal injury by causing NMDA-coupled calcium channels to be biased toward opening (46). Magnesium blocks excitatory NMDA glutamate receptors, and inactivates them (48). With deficient magnesium, NMDA receptors allow an increased influx of calcium, causing cytotoxicity and leading to the generation of toxic amounts of nitric oxide radicals (46).

A leading theory related to the development of migraine aura is cortical spreading depression (49,50). Altered mitochondrial metabolism has been suggested to increase the susceptibility of the brain to this phenomenon (51). A magnesium deficiency could contribute to an altered mitochondrial metabolism by altering oxidative phosphorylation and neuronal polarization, resulting in cortical spreading depression (22).

Methods

A review of the literature from 1990 to the present on magnesium and migraine was conducted using the keywords magnesium, migraine, prophylaxis, and prevention. There is very little literature on magnesium and migraine prior to 1990 (52). A study published in 1989 by Ramadan et al. using magnetic resonance spectroscopy (MR SPECT) to measure brain magnesium levels in migraine and control individuals was one of the first to identify a potential relationship between magnesium and migraine development (53). The first published intervention trial the authors were able to identify was published in 1991 (23). The authors chose 1990 as a start date for this review because of the lack of literature prior to the 1990s and the desire to focus primarily on interventional studies.

The search was conducted using the following databases: MEDLINE, PubMed, EMBASE, Scopus and Cumulative Index to Nursing and Allied Health Literature (CINAHL) databases. Abstracts were reviewed by a single reviewer (corresponding author) to determine which articles met the inclusion criteria. Once appropriate articles were determined, a complete copy of each article was obtained.

Studies were eligible for inclusion if they were published in a peer-reviewed scientific journal, if the participants studied were greater than 18 years of age, and

if a full copy of the article was accessible. If it was a study aimed at assessing magnesium status in migraine patients, there were no additional inclusion criteria. If the study was an intervention trial, oral magnesium supplementation had to be provided independently of other therapies and the aim of the study had to focus on prevention of migraine versus acute treatment for inclusion. The following data were extracted from the reviewed studies using a data extraction sheet with the following categories: inclusion and exclusion criteria, study design, length of study, number of patients and controls, magnesium level monitoring, primary endpoints, secondary endpoints, and outcomes.

Results

The authors identified 16 studies aimed at magnesium status assessment in migraine. None of the magnesium assessment studies were population based, but most used healthy controls. Four intervention trials assessing the efficacy of oral magnesium supplementation, independent of other therapies, in the prevention of migraine were identified. A fifth intervention trial was identified, but not included in this review as the results were invalidated by the single-blind design and lack of a placebo-controlled group (54,55).

Magnesium assessment studies seem to support a relationship between magnesium status and migraine (Table 1) (6–21). The results of these studies are varied, but low magnesium levels and migraine generally remain associated regardless of the magnesium measurement techniques used. The measurement techniques include plasma magnesium, both serum total and ionized magnesium, brain cytosolic-free magnesium, intracellular magnesium, hair magnesium, and an oral magnesium load test.

One of the higher quality magnesium assessment studies was conducted by Trauninger et al. (20). Using the oral magnesium load test, which is considered one of the best measures of whole-body magnesium status, Trauninger et al. demonstrated significantly higher magnesium retention in migraine patients compared to controls.

Most of the published magnesium intervention trials in migraine assess the role of intravenous magnesium in the acute treatment of migraine (56–61). Intravenous magnesium has been demonstrated to be an effective therapy for migraine in an acute setting. A small number of studies, however, have assessed the role of an oral magnesium supplement in the prophylaxis of migraine in adults (Table 2) (23–26).

A study published in *Headache* by Facchinetti et al. in 1991, assessing the efficacy of oral magnesium supplementation for menstrual migraine prophylaxis, appears to be the first intervention trial of oral magnesium supplementation for migraine prevention (23). The primary endpoint of the study focused on changes in pain index scores. The study included 20 patients who suffered from menstrual migraines and 15 women with no history of migraine or premenstrual syndrome (PMS). No concurrent disease was present in participants at entry into the study. A daily headache diary was kept by all individuals for the duration of the study and duration and intensity of attacks were recorded. Intracellular and plasma magnesium were also measured as secondary endpoints.

The study consisted of a two-month run-in period (that was used to establish mean baseline values), a two-month double-blind, placebo-controlled trial, and an additional two months that were not blinded during which all participants received the magnesium supplement. The intervention group received 360 mg of magnesium pyrrolidone carboxylic acid daily. A statistically significant decrease in migraine frequency was seen in both the placebo and magnesium-supplemented groups.

Following the paper by Facchinetti et al., two intervention studies assessing the prophylactic role of oral magnesium were published in *Cephalalgia* in 1996 with conflicting results. Peikert et al. provided 600 mg of oral trimagnesium dicitrate, while a similar study by Pfaffenrath et al., provided 243 mg of oral magnesium-L-aspartate-hydrochloride-trihydrate (25,26).

The study conducted by Peikert et al. included adults who met International Headache Society criteria for migraine with and without aura, while the study conducted by Pfaffenrath et al. included only individuals who suffered from migraine without aura. Both trials followed the same timeline—an initial four-week period for baseline establishment with the final 12 weeks serving as the double-blind intervention phase.

Peikert et al. recruited 81 individuals with 68 completing the study. Primary endpoints were the number, intensity, and duration of headaches based on participant headache diaries. Serum magnesium was also obtained prior to and at study completion. The results of the study demonstrated a significant decrease in the duration and frequency of migraine when comparing the magnesium supplemented group to the placebo group ($p = 0.0303$). An inverse correlation was also demonstrated between initial serum magnesium values and attack frequency.

Pfaffenrath et al. had similar participant numbers with 69 individuals completing their study. The primary endpoint was to obtain at least a 50% reduction in duration of migraine in hours or intensity compared to baseline. A reduction of at least 50% of migraine duration was found in 20% of the magnesium-supplemented group and 23.5% of the placebo group.

Table 1. Characteristics of studies that assessed magnesium status in migraine.

Author, year	Study populations	Timing of screening (if known) and magnesium (Mg) measurement method(s)	Outcomes
Schoenen et al.,[16] 1991	44 migraine patients: - 38 migraine without aura - 6 migraine with aura 25 chronic tension-type headache patients 19 neurological, non-headache patients	Screened between attacks Measures: Serum Mg Erythrocyte Mg	Serum Mg levels were not significantly different between groups. Erythrocyte Mg levels were significantly lower in migraine without aura patients compared to the other three groups.
Thomas et al.,[19] 1992	79 migraine patients 55 non-migraine patients, who had other disorders not known to alter blood magnesium	Measures: Serum Mg Erythrocyte Mg	Serum Mg levels were not significantly different between groups. Erythrocyte Mg in migraine sufferers was significantly lower than controls.
Sarchielli et al.,[15] 1992	70 migraine patients: - 41 migraine without aura - 29 migraine with aura 30 tension-type headache patients 40 age-matched controls	Assessed both ictally and interictally Measures: Serum Mg Salivary Mg	Migraine patients showed significantly lower serum and salivary Mg levels compared to healthy controls and tension-type headache patients.
Gallai et al.,[7] 1993	90 migraine patients: - 60 migraine without aura - 30 migraine with aura 30 healthy age-matched controls	Screened during the interictal and ictal periods Measures: RBC Mg	RBC Mg concentration lower in migraine sufferers, both with and without aura, compared to controls. No significant change in RBC Mg levels when comparing ictal and interictal measurements.
Mauskop et al.,[11] 1993	33 intermittent migraine patients 13 continuous, daily headache patients 60 healthy controls	Measures: Serum Mg, ionized Mg, and ionized calcium	Ionized Mg was lower in both migraine and continuous headache groups compared to controls. Total Mg was significantly lower in intermittent migraine compared to the other two groups.
Gallai et al.,[8] 1994	100 migraine patients: - 60 migraine without aura - 40 migraine with aura. 30 healthy controls	Screened during the interictal and ictal periods Measures: Mononuclear blood cell Mg content	Mononuclear blood cell Mg content was significantly lower in migraine sufferers compared to controls during the interictal period. No significant difference noted when comparing interictal and ictal values
Smeets et al.,[17] 1994	38 familial hemiplegic migraine sufferers (from three families) 23 migraine without aura 9 migraine with aura 11 non-afflicted members 32 healthy controls	Screened between attacks Measures: Intracellular Mg Plasma Mg	No significant differences were found between intracellular or plasma Mg values between any of the study groups.
Mishima et al.,[12] 1997	36 migraine patients: - 28 migraine without aura - 8 migraine with aura 20 tension-type headache patients 24 healthy controls	Screened between attacks Measures: Platelet Mg concentration Platelet cAMP concentration Platelet cGMP concentration	No significant difference in platelet Mg concentration between migraine and control groups. Significantly lower in tension-type headache patients.

(continued)

Table 1. Continued.

Author, year	Study populations	Timing of screening (if known) and magnesium (Mg) measurement method(s)	Outcomes
Ilhan et al.,[21] 2000	40 migraine patients: - 28 without aura - 12 with aura 21 healthy controls All participants had been staying in Malatya for at least one year	Measures: Hair Mg, zinc, copper, and manganese Serum Mg	Hair Mg levels significantly lower in migraine patients than in controls. Serum Mg levels lower in migraine patients compared to controls, but not significantly.
Lodi et al.,[9] 2001	91 headache patients: - 7 migraine stroke - 13 migraine with prolonged aura - 37 migraine with typical aura or basilar migraine - 21 migraine without aura - 13 cluster headache 36 healthy controls	Screened between attacks Measures: Brain cytosolic-free Mg Cellular bioenergetics	Free Mg was found to be significantly lower in migraine and cluster headache patients compared to controls. Subsequently, free energy released by ATP was found to be reduced.
Boska et al.,[6] 2002	46 migraine patients: - 19 migraine without aura - 19 migraine with aura - 8 hemiplegic migraine 40 healthy controls	Screened between attacks Measures: P MRS imaging using a 3-T scanner	An inverse correlation was seen between Mg in the posterior brain and increasing severity of neurological symptoms, but only hemiplegic migraine patients showed significantly reduced Mg values.
Trauninger et al.,[20] 2002	20 migraine patients: - 16 migraine without aura - 4 migraine with aura 20 healthy controls All subjects had a normal BMI	Screened between attacks Measures: Mg load test Serum Mg	Mg excretion of the patients with migraine was found to be significantly lower than the controls. Baseline serum Mg was within reference range for both groups.
Mauskop et al.,[10] 2002	67 women with migraine without aura whose headaches were more common or worsened during menstruation 66 healthy controls	Screened between and during both attacks and menses Measures: Serum ionized Mg, ionized calcium, and total Mg	Only the ionized Mg levels measured during menstrual attacks ($n = 20$) were found to be significantly lower than controls. No additional ionized or total Mg measurements were significantly lower than controls.
Talebi et al.,[18] 2011	140 migraine patients: - 100 migraine without aura - 40 migraine with aura 140 healthy controls	Measures: Serum Mg	Mean serum Mg values were significantly lower in migraine patients compared to controls. A significant linear relationship was found between mean Mg level and frequency of headaches.
Samaie et al.,[14] 2012	50 acute migraine patients 50 healthy controls	Screened during the postictal phase Measures: Serum Mg	Serum Mg was found to be significantly lower in the migraine patients compared to controls.
Qujeq et al.,[13] 2012	21 migraine patients 24 healthy controls	Measures: Lymphocyte Mg and calcium	No significant lymphocyte Mg or calcium differences were found between migraine patients and healthy controls.

RBC: red blood cells; BMI: body mass index; 3-T: 3 Tesla; P MRS: proton magnetic resonance spectroscopy; cAMP: cyclic adenosine monophosphate; cGMP: cyclic guanosine monophosphate; ATP: adenosine triphosphate.

Table 2. Characteristics of studies that examined oral magnesium supplementation for migraine prevention.

Author, year, study design	Study purpose	Study populations	Intervention	Outcomes
Facchinetti et al.,[23] 1991 Study design: Double-blind, randomized, placebo-controlled	Assess the role of oral magnesium supplementation in the prophylaxis of menstrual migraine Primary measure: Migraine duration and intensity	20 subjects who suffered from menstrual migraine and 15 women without any history of migraine (control group) Size of placebo and treatment groups not reported Ages: 28 to 36 years	Intervention period: Patients received placebo or magnesium pyrrolidone carboxylic acid administered three times per day for a total of 360 mg of magnesium per day for the first two months. Second two months all participants received magnesium.	Pain total index scores decreased significantly in both placebo and treatment groups. Magnesium supplemented group, however, saw a greater decrease in the first two months.
Peikert et al.,[25] 1996 Study design: Prospective, multicenter, double-blind, randomized, placebo controlled	Assess the prophylactic effect of oral magnesium in migraine Primary measure: Reduction in attack frequency compared to baseline	81 patients who suffered from migraine with or without aura were recruited (68 completed the study per protocol) Treatment group: $N = 43$ Control group: $N = 38$ Ages: 18–65 years	Four-week baseline period followed by a three-month intervention period during which patients received either a 600 mg magnesium supplement (trimagnesium dicitrate) once per day or placebo	Results demonstrated an average decrease in frequency of attacks from baseline to weeks 9–12 of 41.6% in the magnesium intervention group Eight subjects in the intervention group reported diarrhea or soft stool
Pfaffenrath et al.,[26] 1996 Study design: Prospective, multicenter, double-blind, randomized, placebo-controlled	Assess the prophylactic effect of oral magnesium in migraine Primary measure: Reduction of at least 50% in duration of migraine hours or in the intensity of migraine	69 patients who suffered from migraine without aura Treatment group: $N = 35$ Control group: $N = 34$ Ages 18–60 years	Three-month intervention period. Magnesium-L-aspartate-hydrochloride-trihydrate was provided twice per day for a total of 243 mg/day.	A 50% reduction of migraine duration from baseline was demonstrated in 20% of the magnesium group and 23.5% of the placebo group 10 patients in the magnesium group (28.6%) reported adverse gastrointestinal events with treatment
Köseoglu et al.,[24] 2008 Study design: Double-blind, randomized, placebo-controlled	Assess the prophylactic effect of oral magnesium in migraine Primary measure: Reduction in attack frequency and intensity of migraine	40 patients with migraine without aura Treatment group: $N = 30$ Control group: $N = 10$ Ages 20–55	Three-month intervention period. Magnesium citrate was provided twice per day for a total of 600 mg per day.	Attack frequency in the magnesium treated group decreased from 3.0 to 2.0 migraine attacks per month. In the placebo groups attacks decreased from 3.5 to 3.0 attacks per month.

No statistically significant difference was seen in the absolute number of migraine days or attacks.

The most recent published intervention trial was a double-blind, placebo-controlled trial, conducted in adult patients with migraine without aura (24). The treatment duration was similar to that of previous studies with a four-week period for baseline establishment and a three-month intervention period. Forty migraine patients (30 treatment, 10 placebo) were compared in addition to 20 healthy controls. Primary endpoints were the number, intensity, and duration of headaches based on participant headache diaries. Secondary endpoints included visual evoked potential recordings and brain single photon emission computerized tomography imaging conducted on individuals before and after the three-month trial period. The intervention group received 600 mg of oral magnesium citrate supplementation per day.

Migraine frequency and severity were found to decrease significantly in the magnesium-supplemented group. Frequency also decreased significantly, however, in the placebo group. The average decrease in attack frequency was ~33% (a change from 3.0 attacks per month down to 2.0).

Discussion

The variability in results of the four intervention studies is likely due to methodological differences and underlying limitations secondary to confounding variables that were unaccounted for. The main limitations of these studies were the lack of control or assessment of participant dietary magnesium intake during the study, incomplete assessment of magnesium status of participants pre-treatment, and the absence of inclusion and exclusion criteria based on magnesium status of the participants.

The methodological quality of the studies assessed was varied. Although three of the studies had similar time lines with a four-week baseline (treatment free) and 12-week treatment period, one of the studies had a longer baseline period and shorter placebo-controlled treatment period (two months). Each study analyzed different sample sizes and assessed differing primary and secondary endpoints using predominately subjective data collection. The four studies also provided varying treatment doses and forms of magnesium. Magnesium dosing is poorly understood and different forms have varying levels of bioavailability (62). The varied methodological quality of the studies likely explains some of the variability in the trial results.

The lack of a simple and effective test to determine whole-body magnesium status increases the importance of using dietary intake data, in addition to laboratory measures, in the comprehensive assessment of a participant's magnesium status. It is important to thoroughly evaluate the magnesium status of the patients being treated with supplemental magnesium in order to more accurately appraise its effectiveness.

With a large body of correlative data demonstrating a relationship between magnesium deficiency and migraine, it would be prudent to control for the magnesium status of participants in interventional studies. Although it has not been established that magnesium supplementation offers only a prophylactic role in magnesium-deficient patients, non-magnesium-deficient migraine patients may respond differently to treatment. If non-magnesium-deficient patients are included in study groups with magnesium-deficient patients, increasing magnesium intake may not have the same effect on those individuals, possibly confounding the study findings regarding the efficacy of oral magnesium supplementation.

While previous correlative data suggest that low body stores of magnesium may increase migraine susceptibility, data from oral magnesium supplementation interventional studies do not demonstrate efficacy similar to other more established treatments, as demonstrated by recent evidence-based reviews (6–21,23–26,63). Several migraine treatment guidelines recommend oral magnesium for migraine prevention, but acknowledge a limited quality of evidence (52,64–66). The justification for this recommendation is that side effects are minimal and high-dose oral magnesium supplementation might offer some benefit. This line of reasoning, however, fails to account for potential underlying modifiable risk factors that may be contributing to both low magnesium measurements and migraine occurrence.

Although there is a strong body of correlational data demonstrating a relationship between magnesium and migraine, the studies fail to account for additional migraine risk factors such as obesity, metabolic syndrome, or caffeine overuse (6–21). Dietary magnesium intake has been shown to be inversely associated with metabolic syndrome and obesity, and caffeine has been demonstrated to increase magnesium excretion (40,41,67–70). The possibility that obesity, metabolic syndrome, or caffeine overuse are influencing the strength of the correlation between magnesium and migraine is worth considering.

With limited evidence on oral magnesium supplementation in migraine prophylaxis, and the relatively high prevalence of inadequate dietary magnesium intake in the general population, a more advantageous approach may be to focus on increasing dietary magnesium intake instead of supplementation.

Magnesium supplementation is intrinsically easier for patients than increasing dietary magnesium intake, but it only addresses magnesium status. In migraine patients with low dietary magnesium intake who are

Table 3. Magnesium content of selected foods.

Food	Serving size	Magnesium content[a]
Almonds	1 ounce (23 whole kernels)	77 mg
Mixed nuts (without peanuts)	1 ounce	71 mg
Pumpkin seeds (roasted)	1 ounce	156 mg
Black beans, cooked	0.5 cup	60 mg
Lentils	0.5 cup	36 mg
Whole-grain wheat flour	100 g	137 mg
Oats	100 g	177 mg
Brown rice	1 cup (cooked)	86 mg
Whole wheat spaghetti	1 cup (cooked)	42 mg
Spinach, raw	1 cup	24 mg
Baked potato (Russet)	1 large potato	90 mg
Butternut squash	1 cup (cubed, cooked)	59 mg
Dark chocolate	1 ounce	41 mg
Non-fat milk	8 ounce	37 mg

Information obtained from the United States Department of Agriculture (USDA) database: http://ndb.nal.usda.gov/ndb/search/list.
[a]Recommended dietary allowance for magnesium[b].
Males: 400 mg/day (19–30 years), 420 mg/day (31–70 years).
Females: 310 mg/day (19–30 years), 320 mg/day (31–70 years).
[b]US Department of Agriculture and US Department of Health and Human Services. Dietary Guidelines for Americans, 2010. 7th ed. Washington, DC: U.S. Government Printing Office, December 2010.

willing to make lifestyle changes, a focus on magnesium-rich foods could result in an increase in magnesium intake similar to that seen with supplementation (Table 3). The dietary changes needed to increase magnesium intake, such as increased whole-grain, nut, or vegetable intake, may also benefit patients with additional modifiable migraine risk factors such as obesity or metabolic syndrome (71–76). A focus on dietary magnesium would also eliminate any potential adverse gastrointestinal effects associated with supplementation (23–26).

Conclusions

There is a strong body of evidence demonstrating a relationship between magnesium status and migraine. Magnesium likely plays a role in migraine development at a biochemical level, but the role of oral magnesium supplementation in migraine prophylaxis and treatment remains to be fully elucidated. The strength of evidence supporting oral magnesium supplementation is limited at this time.

Given the limited evidence, the wide variety of magnesium dosing recommendations, and the various available forms of magnesium and differences in bioavailability, it is difficult to outline clear recommendations for magnesium supplementation for migraine prophylaxis at this time (62). The *Canadian Headache Society guideline for migraine prophylaxis* recommends 24 mmol (600 mg) of elemental magnesium daily as magnesium citrate to be used for migraine prophylaxis (66).

With such limited evidence supporting supplementation, it may be advantageous to consider dietary strategies to increase magnesium intake in individuals willing to make lifestyle changes. The lifestyle changes necessary to increase dietary magnesium intake have the potential to improve multiple modifiable risk factors associated with migraine, while improving body magnesium stores similarly to supplementation.

Clinical implications

- Magnesium deficiency has been suggested to increase susceptibility to migraine.
- Dietary intake data suggest that magnesium intake is inadequate in a large percentage of the population.
- Evidence supporting magnesium supplementation for the prevention of migraine is limited at this time.
- Magnesium deficiency is associated with multiple conditions that are also modifiable risk factors for migraine.
- With limited evidence available, increasing dietary magnesium intake may offer an alternative to magnesium supplementation for migraine prophylaxis in patients willing to make lifestyle changes. Increasing dietary magnesium intake also offers the opportunity to address additional modifiable migraine risk factors.

Conflict of interest

None declared.

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