

A Magnesium-Rich Electrolyte Hydration Mix Reduces Exercise Associated Muscle Cramps in Half-Marathon Runners

Direct Original Research

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Open Access

Published: July 11, 2022



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Journal of Exercise and Nutrition: 2022, Volume 5 (Issue 3): 12

ISSN: 2640-2572

Abstract

Introduction: Magnesium is an uncommon electrolyte in a sports hydration drink despite the fact that many endurance athletes suffer from muscle cramps and soreness during marathon events. We tested if an optimal amount of elemental magnesium (100 mg/serving) in an electrolyte mix during a marathon can reduce the incidence and severity of muscle cramps.

Methods: The open survey was conducted using a questionnaire about muscle cramps that participating athletes completed after finishing the half-marathon race. The half-marathon course was identical in two separate events held at the same location. Participating athletes had magnesium-rich electrolyte mix, MAGNAK or water for hydration. The number of athletes who had mild-moderate and/or severe muscle cramps were recorded in this post-event survey.

Results: A total of 86 athletes participated in the survey during event 1 and 98 in event 2. Amongst the athletes who only had water for hydration, approximately 46% of athletes had muscle cramps as compared to 21% in those who hydrated with MAGNAK ($p=0.002$). Hydration with MAGNAK reduced the incidence of both, mild-moderate as well as severe muscle cramps in both events. Mild-moderate muscle cramps occurred in 12% of athletes who hydrated with MAGNAK as compared to 26% in those who used water for hydration ($p=0.02$). Incidence of severe muscle cramps was reduced from 20% to 9% by MAGNAK on average in the composite data ($p=0.04$).

Conclusions: Magnesium-rich electrolyte mix MAGNAK was highly effective in reducing mild to severe exercise associated muscle cramps in half-marathon runners.

Key Words: Magnesium, sports drink, muscle cramps.

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Introduction

Endurance athletes often suffer from painful muscle cramps on and off the course and in some cases, these can prevent them from completing their race. Although there are numerous proposed theories underlying exercise associated muscle cramps, dehydration, repetitive muscle contraction and electrolyte with fluid losses

are few of the key reasons why athletes cramp¹. Magnesium is often prescribed to reduce incidence of nocturnal muscle cramps in the elderly or those on diuretics². Despite some early data of beneficial effects of magnesium in athletes, most sports drink mixes do not have enough magnesium that can have a meaningful impact on muscle physiology of athletes³.

Magnesium deficiency can be subclinical as many individuals, even healthy athletes are unable to meet the recommended dietary intake of 400-450 mg of magnesium per day through diet alone⁴. The requirement of endurance athletes is likely more, about 500-600 mg/day although many athletes do not meet this requirement purely through diet⁵. Some studies have shown that serum magnesium levels can correlate with muscle performance in older individuals^{6,7}. In this regard, a clinical trial showed that supplementation of elderly women for 12 weeks with magnesium can improve muscle strength and performance⁸.

MAGNAK, a magnesium rich electrolyte mix contains about 100 mg of elemental magnesium per serving (650 mg of magnesium citrate) and was created to improve muscle endurance, reduce cramping and soreness associated with extreme exercise. The hypothesis of the study was to assess if such an optimal blend of electrolyte mix that included a higher content of magnesium can allow athletes to perform better and reduce incidence and severity of muscle cramping⁹.

Scientific Methods

Participants

The survey was conducted at two separate half-marathon events in Northern California. A total of 175 registered athletes participated in the first event and about 201 in the second event. Athletes were consented to participate in a post-marathon survey. No samples were collected during the study and no specific individual identification information other than email was obtained. Approximately half of the marathoners voluntarily participated in a 1-question survey about muscle cramps after the race. The study did not require an Institutional Review Board review as it qualified under the exempt study status of the Code of Federal Regulations based on the 45 CFR 46.104(d)(2) clause. Both events had MAGNAK and water for hydration and athletes were encouraged to choose either based on their preference.

Protocol

Participants were surveyed using a single question at the end of the race that asked if they had muscle cramps during the race. If they answered No, there were no additional questions. Those who answered YES, had to answer the next question about severity of the cramps: Mild-Moderate (defined as no additional intervention required except halting and a gentle massage, with cramp disappearing < 30 seconds) or Severe (severe pain lasting > 30 seconds, or inability of the athlete to continue the race or prolonged halt during the race). Data was collected as number of total responses received from participants, averaged over the two events and compared using appropriate statistical methods (described below).

Statistical Analysis

Total number of athletes with muscle cramps in each of the two groups based on their hydration choice were averaged from two separate events. Statistical analysis between the average percentages within these groups was performed using an independent t-test with $p < 0.05$ considered significant within the two groups compared.

Results

The survey data indicated that MAGNAK electrolyte mix significantly reduced the incidence and severity of muscle cramps in these half-marathon runners surveyed in two separate events.

On average, 46% of athletes running this half-marathon and using water for hydration had some degree of muscle cramps (Figure 1). However, this incidence was much lower in those athletes that used the magnesium-rich electrolyte mix MAGNAK for hydration (21%). In two separate events on the identical course in Northern California, the data was similar (presented in Figure 1 as composite average).

Addition of MAGNAK (Figure 2) to the hydration mix showed a significant reduction in the severity of muscle cramps. On average, mild-moderate symptomatic muscle cramps occurred in about 12% of athletes who had MAGNAK as opposed to 26% in those hydrating with water alone. Most of these cramps lasted less than 30 seconds and athletes were easily able to “shake these off” with a massage or minimal intervention and finish their race. Severe muscle cramps occurred in 20% of those who drank water alone as opposed to 9% of those who consumed MAGNAK. In this group, more athletes were able to finish their race after consuming MAGNAK due to a lesser amount of debilitating muscle cramps. Subjective (unreported) analysis also indicated that MAGNAK was well tolerated with most athletes feeling better rehydrated with less muscle soreness at the end of the race.

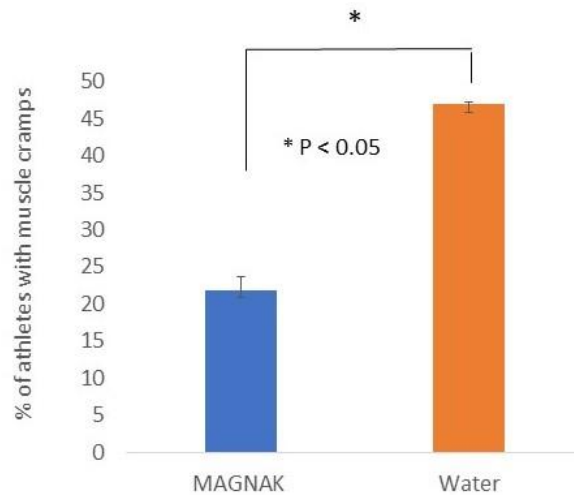


Figure 1. MAGNAK electrolyte mix reduced exercise induced muscle cramps in half-marathon runners. Data is represented as an average from two separate half-marathon races with error bars designating SD from mean. 46% of athletes who consumed water had muscle cramps as compared to only 21% of those who consumed MAGNAK. $P = 0.002$.

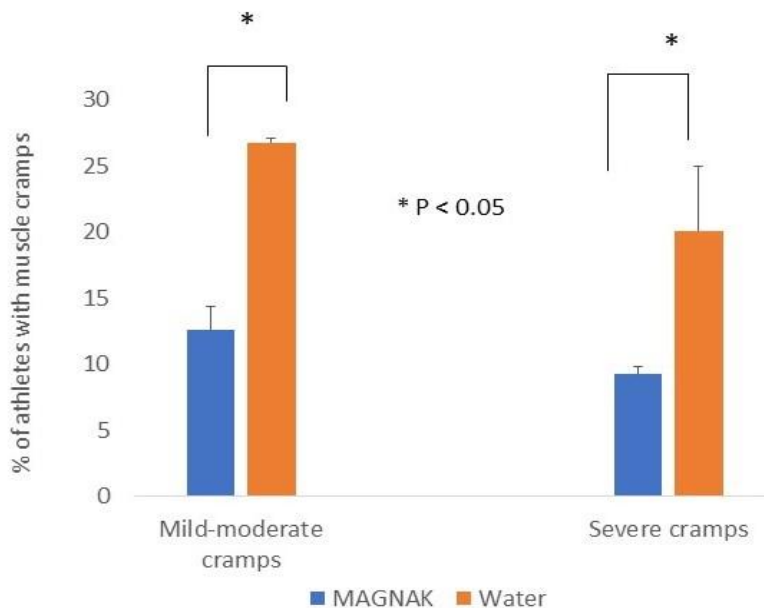


Figure 2. MAGNAK reduced the severity of muscle cramps as compared to water. Mild-moderate cramps occurred in 12% of athletes who had MAGNAK as compared to 26% in those who consumed water ($p=0.02$). Severe cramps occurred in 20% of those consumed water but in only 9% of athletes who had MAGNAK ($p=0.04$). Data represents an average of percentage of athletes with symptoms in each of the two half-marathon races with error bars representing SD.

A detailed description of the final composition of the electrolyte mix is listed in Table 1.

Table 1. Concentration of electrolytes in MAGNAK hydration mix per serving mixed in 16 fl.oz. of water (in addition to 8 g of organic sugar). Equivalent salts of magnesium citrate, sodium chloride and potassium citrate were used to derive the final concentration of electrolytes in the solution.

Electrolytes	Final concentration per serving
Magnesium	100 mg
Sodium	300 mg
Potassium	150 mg

Discussion

Endurance athletes are often limited in their ability to perform due to debilitating muscle cramps at the end of the marathons probably indicating a role of electrolyte depletion, dehydration and muscle fatigue due to a prolonged activity. Hence, any interventions that can help overcome even a few of the above deleterious effects (e.g. muscle cramps) can have a meaningful outcome in their performance. While magnesium can help with nocturnal leg cramps, data on whether endurance athletes can benefit from magnesium supplementation using a hydration beverage are lacking despite some evidence that magnesium supplementation in athletes can reduce inflammation and help with recovery^{10,11}. One of the challenges is to deliver an optimal amount of magnesium that can be quickly absorbed via the GI tract. Unfortunately, most magnesium salts such as commonly used magnesium oxide, are difficult to absorb from the gut, have an unpleasant taste and can cause diarrhea. This makes magnesium supplementation on the field rather difficult. Thus, delivering a higher amount of elemental magnesium (1.5 mg/kg for an average 70 Kg person or approximately 100-120 mg) via a flavored hydration mix may be the best way of supplementing magnesium during the actual endurance event.

The survey from two distinct half-marathon events indicates that MAGNAK electrolyte mix can reduce the incidence of exercise associated muscle cramps during endurance training. Athletes require much larger intake of magnesium in their daily regimen, and based on NHANES survey⁴, less than half of the individuals meet this requirement. A subclinical deficiency of magnesium can build up and lead to muscle cramps, soreness and palpitations when the body is severely stressed. Magnesium supplementation in some studies have shown to improve some aspects of muscle performance, however, a study of using a higher amount of magnesium in an electrolyte blend as a hydration mix has not been done in endurance athletes to assess if this could limit muscle cramping on the field.

The study lays a foundation for conducting a double-blinded randomized clinical trial (RCT) in athletes in a controlled training environment. The main limitation of our study was that this was not a randomized control trial but rather a post-marathon survey. Studies on athletes in the “field” have been challenging due to changing nature of the environment, topographic variation, and inadequate participation after an exhausting event, and changes in athletes’ patterns of hydration as well as their reporting during the race. Nutrition practices before the race and prior exercise training also play a major role in outcomes. In the current study approximately 50% of athletes who completed the race participated in the study, which limits findings in those who did not participate. Moreover, the amount of hydration per athlete during the course was not controllable. It is possible, that some hydrated less regardless of the solution (water or MAGNAK) and were more prone to cramping.

Lastly, it is possible that this effect is related to a composite of all electrolytes used in the hydration mix, and not just magnesium. It is well known that sodium and potassium, two other electrolytes have a role in muscle contraction and physiology, so better hydration¹² with this electrolyte mix as compared to water may account for these observations. Future studies will aim to study muscle specific physiology with specific electrolyte concentrations with an assessment of electrolyte changes (in serum), VO₂ max and other performance metrics through a randomized controlled trial.

Conclusions

This preliminary study indicates that the magnesium-rich electrolyte mix MAGNAK, reduced the incidence and severity of muscle cramps in athletes during a half-marathon race.

Acknowledgements

We thank Big Blue Adventures, LLC in North Lake Tahoe for their help in organizing the marathon events in 2021 and allowing MAGNAK (IGH Naturals) for sponsoring those events.

References

1. Schweltnus, MP. Cause of exercise associated muscle cramps (EAMC)--altered neuromuscular control, dehydration or electrolyte depletion? *Br J Sports Med.* 2009 ;43(6):401-8. Doi: 0.1136/bjsm.2008.050401.
2. Roffe C, Sills S, Peter Crome P, Jones P. Randomised, cross-over, placebo controlled trial of magnesium citrate in the treatment of chronic persistent leg cramps. *Med Sci Monit.* 2002 May;8(5):CR326-30.
3. Agus Z. Hypomagnesemia. *J Am Soc Nephrol* : 1999; 10: 1616-1622.
4. Ford E, Mokdad A. Dietary Magnesium Intake in a National sample of U.S. Adults. *J of Nutrition.* 2003; 133, (9); 10.1093/jn/133.9.2879.
5. Volpe SL. Magnesium and the Athlete. *Curr Sports Med Rep* 2015;14(4):279-83. doi: 10.1249/JSR.0000000000000178.
6. Nielsen FH, Lukaski HC. Update on the relationship between magnesium and exercise. *Magnes Res.* 2006;19(3):180-9.
7. Dominguez, LJ, Barbagallo M, Laurentani F, et al. Magnesium and muscle performance in older persons: the InCHIANTI study. *Am J Clin Nutr.* 2006; 84(2):419-26. Doi: 10.1093/ajcn/84.1.419.
8. Veronese N, Berton L, Carraro S, et.al. Effect of oral magnesium supplementation on physical performance in healthy elderly women involved in a weekly exercise program: a randomized controlled trial. *Am J Clin Nutr.* 2014; 100(3):974-81. doi: 10.3945/ajcn.113.080168.
9. Zhang Y, Xun P, Wang R, et al. Can Magnesium Enhance Exercise Performance? *Nutrients.* 2017; 28;9(9):946. doi: 10.3390/nu9090946.
10. Steward CJ, Zhou Y, Keane G, et al. One week of magnesium supplementation lowers IL-6, muscle soreness and increases post-exercise blood glucose in response to downhill running. *Eur J Appl Physiol.* 2019; 119(11-12):2617-2627. Doi: 10.1007/s00421-019-04238-y.
11. Kass LS, Poeira F. The effect of acute versus chronic magnesium supplementation on exercise and recovery on resistance exercise, blood pressure and total peripheral resistance on normotensive adults. *J Int Soc Sports Nutr.* 2015; 24;12:19. Doi: 10.1186/s12970-015-0081-z.
12. Lau WY, Kato H, Nosaka, K. Effect of oral rehydration solution versus spring water intake during exercise in the heat on muscle cramp susceptibility of young men. *J Int Soc Sports Nutr.* 2021;15;18(1):22. Doi: 10.1186/s12970-021-00414-8.