MAGNESIUM SUPPLEMENTATION IN PHYSICAL ACTIVITY & SPORTS: A CRITICAL EVIDENCE-BASED REVIEW

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Abstract

Magnesium is an essential macromineral involved in numerous biochemical processes relevant to physical activity, including energy metabolism, neuromuscular transmission, muscle contraction and relaxation, and nervous system regulation. In the context of sports and fitness, magnesium supplements are widely promoted as ergogenic aids, with claims that they enhance energy availability and endurance, reduce muscle cramps, improve neuromuscular coordination, accelerate post-exercise recovery, support sleep and psycho-emotional balance, and contribute to a healthy hormonal profile, including testosterone regulation. The validity of these claims, however, remains debated.

The aim of this review is to critically evaluate the scientific evidence supporting magnesium supplementation in physically active individuals and athletes, and to assess the extent to which promotional claims align with evidence-based research. A narrative critical review was conducted using peer-reviewed human studies, randomized controlled trials, and systematic reviews retrieved from authoritative scientific databases. Promotional and popular sources were examined separately to contextualize common marketing assertions, while critical evaluation was restricted to high-quality scientific literature.

The available evidence confirms the fundamental physiological role of magnesium in cellular metabolism and neuromuscular function. However, findings from controlled studies indicate that, in individuals with adequate magnesium status, supplementation does not consistently improve athletic performance, endurance, muscle cramp incidence, recovery, or hormonal outcomes. Benefits are most apparent in populations with documented magnesium deficiency or insufficient dietary intake.

In conclusion, while magnesium is indispensable for normal physiological function, current evidence does not support its routine use as an ergogenic supplement in magnesium-replete, healthy, physically active individuals. Magnesium supplementation appears justified primarily as a corrective strategy in cases of deficiency rather than as a universal performance-enhancing intervention.

Keywords:
Magnesium supplementation; Athletic performance; Energy metabolism; Neuromuscular function; Exercise recovery; Hormonal regulation; Evidence-based nutrition.

INTRODUCTION

Magnesium (Mg) is an essential macromineral involved in numerous biochemical processes that are relevant to human physiology, particularly in energy metabolism, neuromuscular function, and muscle contraction and relaxation [1]. In recent decades, magnesium supplements have become widely used in athletic and physically active populations. A substantial body of marketing and promotional material suggests that magnesium supplementation enhances energy production, improves endurance performance, reduces muscle cramping, supports neuromuscular coordination, facilitates post-exercise recovery, and contributes to general hormonal balance, including testosterone regulation [2–4]. These

claims are frequently disseminated through commercial websites, athletic blogs, and supplement industry advertising.

Despite this popularization, the scientific basis for such claims remains variably supported. Some studies demonstrate physiological correlations between magnesium status and exercise performance, while others indicate limited or no benefit from supplementation in healthy individuals with adequate dietary intake [5–7]. Therefore, there is a need for a systematic examination of the empirical evidence to determine whether these marketing claims reflect true physiological effects or are unverifiable assertions lacking rigorous support.

The objective of this review is to critically evaluate the evidence on magnesium supplementation in the context of physical activity and sport, examining whether the purported benefits align with findings from peer-reviewed, evidence-based research. Specifically, this research assesses magnesium's role in energy metabolism, muscle function, neuromuscular coordination, recovery processes, hormonal regulation, and exercise-induced magnesium loss.

METHODS

A narrative review methodology was employed to identify and synthesize relevant scientific literature on magnesium supplementation and physical activity. Literature searches were conducted in PubMed and Google Scholar using combinations of the following terms: *"magnesium supplementation AND exercise"*, *"magnesium AND athletic performance"*, *"magnesium AND muscle cramps"*, and *"magnesium AND testosterone"*. Articles published up to January 2026 were considered.

Inclusion criteria were: (1) original human research studies, (2) randomized controlled trials, (3) systematic reviews or meta-analyses, and (4) peer-reviewed clinical investigations that examined the effects of magnesium supplementation on performance-related outcomes. Exclusion criteria included in-vitro or animal studies not directly translatable to human outcomes, and observational studies without intervention.

This review distinguishes between two approaches to source material. **Approach 1** includes popular and non-scientific sources to illustrate the range of promotional claims about magnesium supplements. **Approach 2** restricts evidence to authoritative, evidence-based scientific research from recognized health organizations (e.g., National Institutes of Health), peer-reviewed journals, and systematic reviews.

RESULTS

Energy Metabolism and ATP Function

Magnesium plays a central role in cellular energy metabolism, serving as a cofactor for ATP synthesis and utilization [8]. ATP exists physiologically as a complex with magnesium (Mg-ATP), which is essential for enzymatic reactions in glycolysis and oxidative phosphorylation [8, 9]. Several studies suggest that adequate magnesium status is necessary for optimal energy metabolism, particularly in high-intensity and endurance activities [9].

However, clinical trials assessing magnesium supplementation in athletes with sufficient dietary intake have not shown consistent improvements in direct measures of energy metabolism, such as VO2 max or time trial performance [10, 11]. For instance, one randomized controlled trial found no significant

enhancement in aerobic performance following magnesium supplementation in trained runners without baseline deficiency [10].

Muscle Function, Cramps, and Spasms

Magnesium is theorized to influence muscle contraction and relaxation due to its role in ion channel function and neuromuscular transmission [12]. Epidemiological observations indicate that severe magnesium deficiency can lead to neuromuscular symptoms, including cramps and spasms [12]. Yet, clinical evidence regarding supplemental magnesium's ability to prevent exercise-associated muscle cramps in healthy athletes is limited.

A systematic review reported mixed results, with some trials showing modest reduction in cramp frequency, while others demonstrated no effect beyond placebo [13]. Many studies suffer methodological heterogeneity, small sample sizes, and varied supplementation regimens.

Neuromuscular Coordination and Psycho-Emotional Recovery

Some proponents assert that magnesium supports neuromuscular control and reduces nervous tension, thereby improving recovery and sleep quality [14]. Magnesium influences central nervous system excitability and is implicated in the regulation of sleep-related neurotransmitters [14, 15].

Clinical investigations show that magnesium supplementation may improve subjective sleep measures in older adults or individuals with insomnia [15, 16]. However, evidence specific to physically active young adults and athletes remains unclear, with several trials demonstrating no significant changes in sleep architecture or recovery markers.

Post-Exercise Recovery and Adaptation

Markers of recovery, such as muscle soreness and inflammation, have been examined in studies of magnesium supplementation. Some evidence suggests that magnesium may influence inflammatory cytokines, but findings are inconsistent [17]. Randomized trials have generally not shown clear performance recovery benefits attributable to magnesium supplementation in healthy athletic cohorts.

Hormonal Implications and Testosterone Levels

Claims that magnesium supports healthy hormonal balance, including testosterone levels, have biochemical plausibility due to magnesium's involvement in steroidogenesis pathways [18]. Some observational studies indicate correlations between magnesium status and circulating testosterone concentrations [19].

Yet, randomized controlled trials with supplementation protocols in healthy athletic male populations have not consistently demonstrated significant increases in testosterone beyond natural physiological fluctuations [20].

Magnesium Loss Through Sweat

Magnesium is lost in sweat, leading to concerns about depletion during prolonged or intense exercise. Sweat magnesium content varies widely across individuals and activity conditions [21]. Although athletes may experience a modest increase in magnesium loss compared to sedentary individuals, dietary magnesium replacement through food sources typically compensates for these losses in individuals without clinical deficiency.

DISCUSSION

The promotional claims for magnesium supplementation partially derive from the mineral's established roles in biochemical pathways relevant to physical activity. However, evidence from controlled human trials reveals that in the absence of clinical deficiency, supplementation does not uniformly translate into enhanced athletic performance or recovery. Many positive claims are extrapolated from mechanistic understanding or studies in specific clinical populations, rather than directly tested in large, well-controlled athletic cohorts.

Notably, supplementation may benefit athletes with documented magnesium deficiency or suboptimal dietary intake. In such cases, restoring magnesium status aligns with general nutritional recommendations and may indirectly support performance and health outcomes.

However, for athletes with adequate baseline magnesium levels, the evidence does not robustly support routine supplementation for performance enhancement, reduction of cramps, or hormonal modulation.

CONCLUSION

Based on the critical review of contemporary scientific literature:

1. Magnesium supplementation shows biological plausibility in metabolic regulation, but does not consistently enhance performance outcomes in magnesium-replete athletes.
2. Claims that magnesium universally improves endurance, muscle cramps, neuromuscular control, recovery, or testosterone levels are not substantiated by high-quality evidence.
3. Evidence supports supplementation primarily in cases of deficiency or increased physiological need, rather than as a universal ergogenic aid.

In summary, magnesium supplementation is not supported as a performance-enhancing intervention for generally healthy, physically active individuals without clinical deficiency.

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