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Review

Effect of magnesium supplementation on insulin resistance in humans: A systematic review

Jennifer Beatriz Silva Morais [a], Juliana Soares Severo [a], Geórgia Rosa Reis de Alencar [a], Ana Raquel Soares de Oliveira M.Sc. [a], Kyria Jayanne Clímaco Cruz M.Sc. [a], Dilina do Nascimento Marreiro Ph.D. [a], Betânia de Jesus e Silva de Almendra Freitas Ph.D. [a], Cecília Maria Resende de Carvalho Ph.D. [a], Maria do Carmo de Carvalho e Martins Ph.D. [b], Karoline de Macedo Gonçalves Frota Ph.D. [a]

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Highlights

- Magnesium participates directly in glucose metabolism disorders in humans.
- In the present review, we evaluated evidence for the effectiveness of supplementation of magnesium in the control of the insulin resistance.

- This systematic review provided evidence of the benefits of magnesium supplementation on insulin resistance in patients with hypomagnesemia.
- Magnesium plays a potentially significant role in improving insulin sensitivity. However, larger-scale studies over a longer duration of treatment are needed to confirm this conclusion.

Abstract

Objectives

Recent studies have demonstrated that minerals play a role in glucose metabolism disorders in humans. Magnesium, in particular, is an extensively studied mineral that has been shown to function in the management of hyperglycemia, hyperinsulinemia, and insulin resistance (IR) action. The aim of this study was to investigate the effect of magnesium supplementation on IR in humans via systematic review of the available clinical trials.

Methods

This review was conducted in accordance with Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) recommendations. A survey was conducted to select clinical trials related to the effects of this mineral in insulin sensitivity using the following databases: PubMed, SciVerse Scopus, ScienceDirect, and SciVerse Cochrane.

Results

After the selection process, 12 articles were identified as eligible, representing different clinical conditions and being free of restriction with regard to sex, age, ethnicity, and differential dosing/shape of magnesium. The results of eight clinical trials showed that supplementation with magnesium influences serum fasting glucose concentrations, and five trials determined an effect on fasting insulin levels. The results of seven studies demonstrated that mineral supplementation reduced homeostasis model assessment for IR values.

Conclusions

The data of this systematic review provide evidence as to the benefits of magnesium supplementation in reducing IR in patients with hypomagnesemia presenting IR. However, new intervention studies are needed to elucidate the role of the nutrient in protection against this metabolic disorder, as well as the standardization of the type, dose, and time of magnesium supplementation.

Introduction

Insulin resistance (IR) is a metabolic disorder characterized by impairment of insulin-mediated glucose transport to peripheral cells, which leads to increased concentrations of this hormone in the circulatory system as a compensatory mechanism. IR is associated with the development of various diseases, such as cardiovascular disease, metabolic syndrome, obesity, cancer, and type 2 diabetes mellitus (T2DM) [1], [2], [3], [4].

Recent studies have demonstrated the participation of minerals in glucose metabolism disorders in humans. Magnesium participates directly in this process by acting as a cofactor for many enzymes involved in energy metabolism, and modulating the insulin secretion and action in target tissues through interaction with receptors of this hormone. Mineral deficiency, in particular, appears to be associated with hyperglycemia, hyperinsulinemia, and IR action [1], [4], [5].

Reduction in magnesium food intake is associated with the increase in consumption of processed foods containing reduced amounts of the mineral. Consuming processed foods instead of whole grains causes deficiency of this nutrient [6], [7], [8].

Scientific evidence concerning the effects of magnesium supplementation on IR is still scarce and controversial. Recent research has shown that magnesium supplementation possibly helps to control IR and improve glucose metabolism [9], [10], whereas other related studies were inconclusive [3], [11].

Therefore, the aim of this study was to describe, in a systematic review, the outcomes of clinical trials on magnesium supplementation and IR.

Section snippets

Data sources and study selection

The search for articles was conducted in PubMed, Scopus, ScienceDirect, and Cochrane, by two authors (JBSM and JSS) independently. Research conducted by these authors was compared and verified in equivalence of search and selection of items.

The PICO strategy (patient, intervention, comparison, and outcomes) was used for the guiding question of this review setting. The following descriptors were used in the search for articles: “magnesium and (insulin resistance or insulin sensitivity) and …

Selected articles

We identified 1720 articles by searching the following databases: PubMed (n=562), SciVerse Scopus (n=690), SciVerse ScienceDirect (n=45), and Cochrane (n=423). After the screening process, removal of duplicate articles and analysis of the inclusion criteria, 12 articles were identified as eligible for this systematic review. Table1 shows the characteristics of the included articles.

From the evaluation of 12 studies included in this review, it was observed that the clinical trials were …

Discussion

This systematic review was conducted to investigate the effect of magnesium supplementation on IR in humans. Regarding the effect of the intervention on glycemic control, most of the included trials found an improved fasting glucose and IR index. Moreover, few studies investigated the influence of magnesium on fasting insulin or percentage of HbA1c.

It is worth mentioning the meta-analysis by Simmental-Mendía et al. [20], which also evaluated the effects of magnesium supplementation on glycemic …

Conclusion

The results of this systematic review provide evidence of the benefits of magnesium supplementation on IR in patients with hypomagnesemia compared with those with normomagnesemia. However, new intervention studies are needed to elucidate the role of the nutrient as a protective factor against this metabolic disorder, as well as the standardization of the type, dose, and time of magnesium supplementation. …

Recommended articles

References (24)

F. Guerrero-Romero *et al.*

Oral magnesium supplementation improves glycaemic status in subjects with prediabetes and hypomagnesaemia: a double-blind placebo-controlled randomized trial

Diabetes Metab (2015)

E. Cosaro *et al.*

Effects of magnesium supplements on blood pressure, endothelial function and metabolic parameters in healthy young men with a family history of metabolic syndrome

Nutr Metab Cardiovasc Dis (2014)

F. Guerrero-Romero *et al.*

Oral magnesium supplementation improves insulin sensitivity in non-diabetic subjects with insulin resistance. A double-blind placebo-controlled randomized trial

Diabetes Metab (2004)

S. Lee *et al.*

Effects of oral magnesium supplementation on insulin sensitivity and blood pressure in normomagnesemicnondiabetic overweight Korean adults

Nutr Metab Cardiovasc Dis (2009)

M. Rodriguez-Moran *et al.*

Oral magnesium supplementation improves the metabolic profile of metabolically obese, normal-weight individuals: a randomized double-blind placebo-controlled trial

Arch Med Res (2014)

Z. Asemi *et al.*

Magnesium supplementation affects metabolic status and pregnancy outcomes in gestational diabetes: a randomized, double-blind, placebo-controlled trial

Am J Clin Nutr (2015)

L.E. Simental-Mendía *et al.*

Systematic review and meta-analysis of randomized controlled trials on the effects of magnesium supplementation on insulin sensitivity and glucose control

Pharm Res (2016)

C.H. Sales *et al.*

Magnesium and diabetes mellitus: their relation

Clin Nutr (2006)

H. Chutia *et al.*

Association of serum magnesium deficiency with insulin resistance in type 2 diabetes mellitus

J Lab Physicians (2015)

L.S. Hadjistavri *et al.*

Beneficial effects of oral magnesium supplementation on insulin sensitivity and serum lipid profile

Med Sci Monit (2010)

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Cited by (60)

Modeling Steatohepatitis in Humans with Pluripotent Stem Cell-Derived

Organoids

2019, Cell Metabolism

> *Citation Excerpt :*
>
> ...Furthermore, survival of Wolman sHLOs, which was severely compromised after 12 days of culture, was significantly improved by FGF19 exposure (Figure 4G). In contrast, the highly controversial magnesium treatment did not improve survival, similar to clinical reports (Karandish et al., 2013; Morais et al., 2017; Navarrete-Cortes et al., 2014). Mechanistically, triglycerides, in particular, are predominantly hydrolyzed by LAL (Zechner et al., 2012), and cells with high lipid storage due to LAL deficiency have higher levels of reactive oxygen species (ROS) (Welte, 2015)....

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The crucial role and mechanism of insulin resistance in metabolic disease ↗

2023, Frontiers in Endocrinology

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Modelling metabolic diseases and drug response using stem cells and organoids ↗

2022, Nature Reviews Endocrinology

Association between dietary mineral nutrient intake, body mass index, and waist circumference in U.S. Adults using quantile regression analysis NHANES 2007–2014 ↗

2020, PeerJ

Magnesium: Are we consuming enough? ↗

2018, Nutrients

Magnesium and Human Health: Perspectives and Research Directions ↗

2018, International Journal of Endocrinology

View all citing articles on Scopus ↗

JBSM, JSS, GRRA, KJCC, ARSO participated to the redaction and the review of the manuscript; DNM, BJSAF, CMRC, MCCM, and KMGF supervised the paper, participated in the redaction, and reviewed of the paper.

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