

## Effect of magnesium citrate on iron status parameters: an interventional study

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### Introduction

Magnesium is widespread in food and is essential for many metabolic activities (Schwalfenberg, 2017). Some studies indicate a trend toward the development of micronutrient deficiencies, including magnesium (Chen et al., 2022; De la Cruz-Góngora et al., 2011). The possible reason is that highly processed diets and refined cereals do not contain sufficient magnesium and that food intake does not reach the recommended daily intake (IMSCSEDRI, 1997). Although a balanced diet is recommended as the primary source of magnesium to meet recommended intakes, magnesium supplementation is becoming increasingly popular. The results of scientific research indicate an inverse association between serum magnesium levels and anemia in the general population and people with specific disorders (Shi et al., 2008; Xu et al., 2017). Various epidemiological studies indicate that one-third of the world's population suffers from anemia (Yenilmez et al., 2017). However, it is believed that anemia is not a disease but a sign of an underlying pathological process. Therefore, early detection supported by reliable laboratory diagnostics is important for detecting and treating the underlying pathology. Laboratory diagnosis of the degree and type of anemia is based on examining hematological and biochemical parameters of iron status. The aim of this study was to examine the effect of magnesium citrate supplementation on iron status parameters.

### Materials and methods

#### Participants

The study included 100 participants of both sexes, aged over 18 years, without disease, consuming magnesium-containing dietary supplements in the last three months. Before the start of the study, the respondents were informed, orally and in writing, about the study's objectives and they gave their written consent.

#### Study protocol

Participants took once a day for a period of ten days commercially available magnesium citrate in powder form for direct oral administration (Livsane Magnesium citrate direct, bags, Evropa Lek d.o.o., Belgrade) in a daily dose of 375 mg, which is 100% of the nutritional reference value (NRV) for magnesium. Serum biochemical parameters were analyzed before the start of the intervention, at the beginning (t0), on the fifth day (t1), and on the eleventh day (t2) of the intervention period.

#### Methods

Venipuncture was performed following the recommended standard operative procedure (Šimundić et al., 2019). Hemoglobin and hematocrit were determined directly on a gas analyzer in samples of lithium-heparin

whole blood (Nova Biomedical, USA). Total magnesium, unsaturated iron-binding capacity (UIBC), and iron were determined in serum by spectrophotometry using the commercial reagents from Beckman Coulter, Hamburg, Germany, on the Olympus AU400 biochemical analyzer. Transferrin and saturation were calculated using recommended formulas (Worwood et al., 2017). The SPSS version 24 (SPSS Inc., USA) statistical program was used for statistical analysis.

## Results and discussion

The results of our study have identified an effect of magnesium citrate on some iron status parameters. A decreasing trend of values from t0 to t1 was observed for all examined parameters, with a subsequent tendency to backup to t2, similar to baseline values. The most significant changes were observed in the values of TIBC and transferrin before and after supplementation (65.9  $\mu\text{mol/L}$  vs 62.4  $\mu\text{mol/L}$ ,  $P=0.019$  and 3.0 g/L vs 2.8 g/L,  $P=0.019$ , respectively). Although a significant decline in TIBC and transferrin values has been observed in t1 ( $P=0.028$ ), they return to baseline values in t2. Also, although not statistically significant, a decrease in hemoglobin (144 g/L vs 136 g/L vs 139 g/L,  $P=0.353$ ) and iron concentration (19.9  $\mu\text{mol/L}$  vs 12.7  $\mu\text{mol/L}$  vs 12.4  $\mu\text{mol/L}$ ,  $P=0.181$ ) was observed in the investigated period. The results indicated that the organism is trying to establish balance in the effect of magnesium on the parameters of iron status in a short period. The question is, what the interaction would be during long-term supplementation. The study of Sugimoto et al. (2019) has shown that iron deficiency anemia may be induced by magnesium overuse. This suggests that caution should also be exercised regarding the interactions between magnesium and iron prescribed by clinicians.

This study has limitations that warrant repeated trials on a larger number of subjects, with specific conditions and diagnosis of anemia, to examine the influence of gender and age, as well as the social status of subjects, and to evaluate additional parameters (e.g., ionized magnesium, ferritin). It is also important to examine the effect of other forms of magnesium supplements on iron status parameters and carry out the intervention over a longer period of time.

## Conclusion

Based on the results of this study, it can be concluded that caution should be exercised regarding magnesium supplementation and that laboratory monitoring of magnesium and iron status is necessary to avoid adverse consequences.

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