Influence of exercise on ionized and total magnesium concentrations in athletes

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Background

Magnesium (Mg) is an essential micronutrient for health and exercise. Exercise performance is highly dependent on the regulation of magnesium homeostasis. Monitoring magnesium status in athletes may therefore be important. Currently, total serum magnesium is the most commonly measured magnesium parameter. However, free ionized magnesium (iMg), the active from involved in all processes, is not routinely measured due to limited availability of well-validated assays. Recently, more devices that measure iMg have become available. Before routinely measuring iMg in athletes, it is important to know which factors affect iMg values in athletes.

Aim of the study

Determine the influence of an acute bout of exercise on the ionized magnesium concentration.

Methods

- Cross-over design, with 18 healthy well-trained athletes.
- Blood samples: 7 times at set time points (8:30 fasted, 11:00 fed, 12:30, 13:30, 15:0016:00 and 18:30) during an exercise day and control day.
- Exercise day data was corrected for the control day data in a Linear Mixed model.
- At exercise day, between 11:00 and 12:30, athletes performed a bicycle ergometer test at 70% of their VO2max.
- Blood samples were analysed directly on the Stat Profile pHOx Plus M analyzer (Nova Biomedical) for the ionized magnesium concentration and on the Vista 1500 (Siemens) for total magnesium concentration.

Results

- Ionized and total magnesium both decreased significantly (0.52 ± 0.04 to 0.45 ± 0.03 mmol/L and 0.81 ± 0.07 to 0.73 ± 0.06 mmol/L, respectively) after exercise.
- Both, ionized and total magnesium concentrations, recovered to base-level 2.5 hours after exercise.
- Ionized and total magnesium have a correlation at exercise day of $r = .728$ ($p = .000$).

Table 2. Mean and SD values for ionized and total magnesium at exercise day

Time point	Ionized magnesium (mmol/L)	Total magnesium (mmol/L)
08:30	0.51 ± 0.04	0.81 ± 0.06
11:00	0.52 ± 0.04	0.81 ± 0.07
12:30	0.45 ± 0.03*	0.73 ± 0.06*
13:30	0.47 ± 0.02*	0.75 ± 0.05*
15:00	0.51 ± 0.03	0.85 ± 0.06
16:00	0.52 ± 0.04	0.85 ± 0.09
18:30	0.54 ± 0.04#	0.90 ± 0.08#

Note, * significantly lower concentration compared with all other time points ($p < .00$). # significantly higher concentration compared with all other time points ($p < .05$).

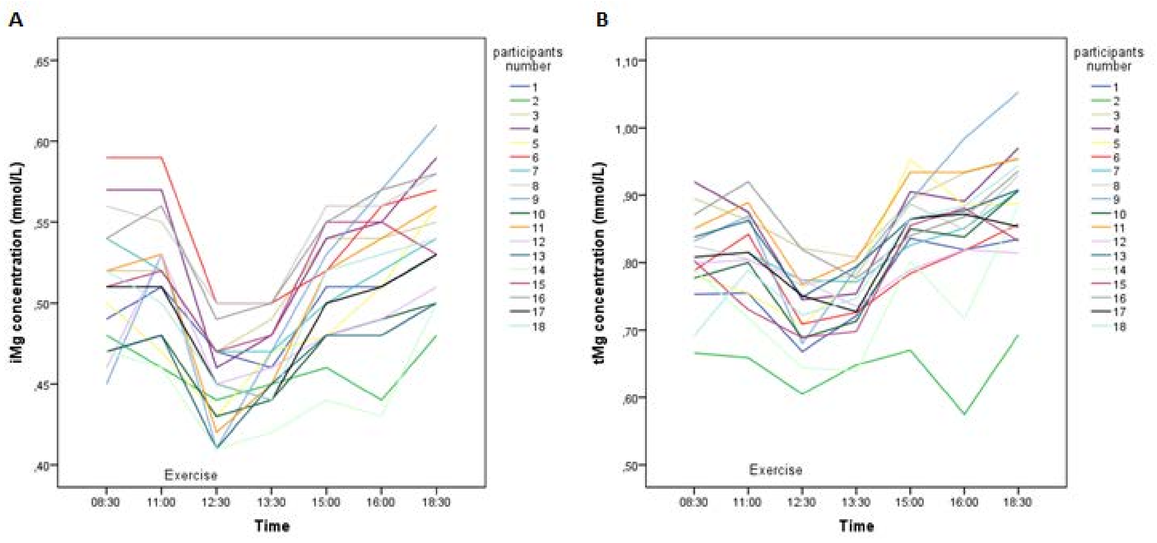

Figure 1: Ionized (A) and total magnesium (B) concentrations during exercise day. Lines represent the individual profiles of each athlete.

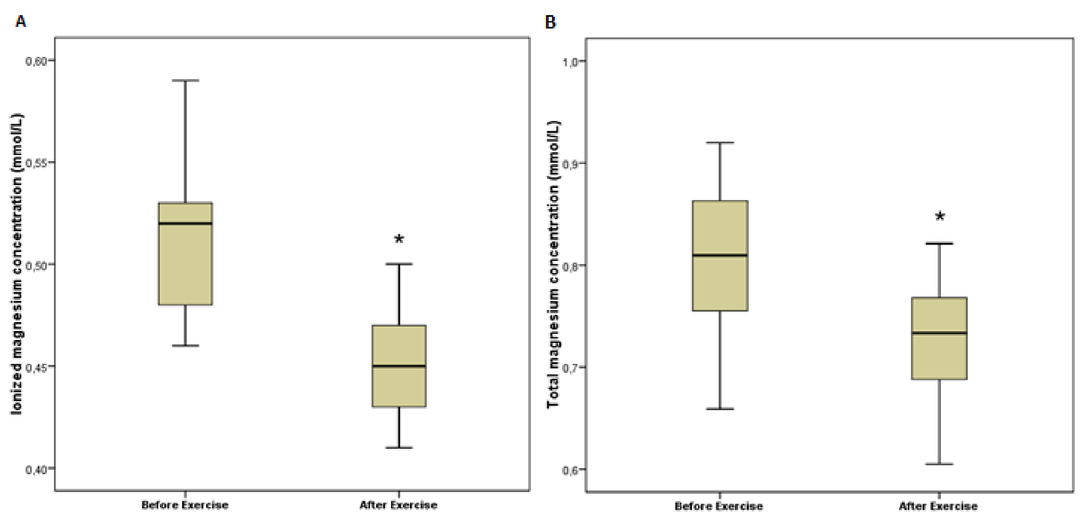

Figure 2: Difference in ionized (A) and total magnesium (B), directly before and after exercise; * significant difference between before and after exercise, ($p > 0.00$).

Conclusions

Both ionized and total magnesium concentration significantly decrease after exercise and recovery is observed 2.5 hours after finishing exercise. In case of blood sampling for diagnostics: as recovery happens within the same day, measuring one day after exercise offers sufficient recovery and reliable magnesium concentrations in athletes.